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In charge of the United States National Museum.

AUGUST 8, 1911.

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THE RECENT CRINOIDS OF THE COASTS OF AFRICA.

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HISTORY.

The history of the study of the recent crinoids inhabiting the coasts of Africa can be stated in a few words. With but three exceptions all the references to African crinoids are only incidental, incorporated in works sometimes restricted to the echinoderms alone, but more commonly very general in scope. Thus while the titles of books and papers number about seventy, from each one only a small amount of information is gained, and an adequate conception of African crinoids as a whole can be acquired only by an amount of labor totally incommensurate with the sum of the knowledge gained.

The first crinoid known from African waters was described from Mauritius in 1816 by Lamarek under the name of *Comatula carinata*. Lamarek adopted the name *carinata* from Leach, who in the previous year had diagnosed, in a very insufficient manner, his *Alecto carinata*, which Lamarek thought might turn out to be his species.

In 1817 the portion of Savigny's Description de l'Égypte dealing with the echinoderms was published, and in it were figured two comatulids from the Red Sea, one of which was designated by Audouin as "*Comatula* sp.," the other as "*Comatula multiradiata*." There is no further reference to the first of these figures, which represents *Tropiometra encrinus*; but in 1836 de Blainville copied the second in the atlas to his Manuel d'Actinologie. In doing this he made a curious mistake, for the plate is lettered "*Comatula adconæ*," though in the text the description of *Comatula adconæ* is taken from Lamarek, and the species is correctly said to have ten arms. In the following year the Penny Encyclopedia copied de Blainville's account of *Comatula adconæ*, multiradiate figure and all, and the same slip was made by Knight in his Natural History, published in 1867.

Rüppel, in the course of his travels, found in the Red Sea an interesting multiradiate comatulid upon which he bestowed the manu-

script name of *Comatula leucomelas*, but I have not been able to find that he mentioned it anywhere in his works. In 1833 Leuckart came across his specimens in the Senckenberg Museum at Frankfort on Main and published the name, together with the locality, though without any diagnosis.

Leuckart was the first to describe the curious parasitic worms belonging to the genus *Myzostoma* with which crinoids are usually infested, his attention having been first called to them by mistaking one for a madreporic plate. In discussing the genus *Myzostoma* he mentions a multiradiate comatulid from the Red Sea, which, following Audouin, he identifies as *Comatula multiradiata*, but which von Graff, acting on the advice of P. H. Carpenter, has suggested was probably an example of *Heterometra savignii*, the species to which Audouin's *Comatula multiradiata* has always been referred.

In the *Iconographie du Regne Animal*, published by Guérin-Ménéville from 1828-1837, there are two figures¹ supposed to represent the species described as *Comatula carinata* from Mauritius. Possibly the first does represent this species, though it looks more like some species of *Antedon*; but the second (2a) appears to be a species of *Amphimetra*, and agrees fairly well with *A. discoidea* from northern Australia and the East Indies. There is a specimen of *Amphimetra discoidea* (labeled by P. H. Carpenter *Antedon milberti*, var. *dibrachiata*) in the Paris Museum from which I suspect the figure was drawn.

In 1841 Johannes Müller described his *Alecto savignii*, which was based upon specimens which had been brought from the Red Sea by Hemprich and Ehrenberg, now in the Berlin Museum, and he also identified Savigny's figure, which had been called *Comatula multiradiata* by Audouin, as this species. Two years later he described *Alecto wahlbergii* from specimens brought by Wahlberg from Port Natal, which he examined at the Stockholm Museum.

Michelin in 1845 noted the occurrence of *Comatula carinata* at Mauritius. His specimens are now in the Paris Museum.

In 1849 the comprehensive monograph of Müller, completing his studies on the comatulids, gave a summary of the knowledge in regard to African species at that date. Practically the same account was given in 1862 by Dujardin and Hupé in their monograph on the so-called Zoophytes.

Böhlsche in 1866 described as new a curious little comatulid from the coast of Brazil which he had been unable to identify with any previously known species. He called it, in compliment to the justly famous Norwegian naturalist of that name, *Antedon dübenii*. This species has been the cause of considerable confusion. P. H.

¹ Zoophytes, pl. 1, figs. 2, 2a.

Carpenter identified with it a specimen which the *Challenger* dredged at Bahia, and figured both this specimen and the type in the *Challenger* report on the Comatulæ. The *Challenger* specimen is a young example of *Tropiometra picta*, but the type-specimen obviously belongs to the Antedonidæ and to the genus *Antedon*. Nothing like it has since been found on the American side of the Atlantic.

E. Von Martens in 1869 recorded from the Red Sea the *Alecto palmata* of Müller, which had originally been described from India, and at the same time recorded *Comatula solaris* from Zanzibar. The determination of the former was correct, but the latter appears to have been in reality *Tropiometra carinata*. Von Martens did not discover that the species recorded by Leuckart as *Comatula leucomelas* is the same as the one given by himself as *Comatula palmata*.

Sir C. Wyville Thomson, in his preliminary report upon the crinoids of the *Porcupine* expedition and in his semipopular work *The Depths of the Sea*, published in 1873, as well as in *The Atlantic*, published in 1877, touches upon the fauna of the Mediterranean, but the only crinoid he mentions from the vicinity of Africa is "*Rhizocrinus loffotensis*," which was dredged by the Swedish frigate *Josephine* on the Josephine Bank.

In 1878 Pourtalès and in 1879 Rathbun discussed at considerable length specimens of *Tropiometra carinata* from Zanzibar, comparing them with specimens of *T. picta* from the coast of Brazil.

In 1879 also Edgar A. Smith described in detail a new comatulid, *Comatula indica*, from the island of Rodriguez, which remains to-day the only crinoid known from that locality.

Greiff, while visiting the island of Rolas, in the Gulf of Guinea, found some crinoids there which he identified with the species inhabiting southern Europe. Carpenter was inclined to consider them as being in reality the *Antedon dübenii* of Böhlische, but it seems probable that they are identical with the *Antedon lupferi* of Hartlaub, which is closely related to that species.

De Loriol, discussing the echinoderms of Mauritius in 1883, includes, as did Michelin, *Tropiometra carinata*.

The work of the two French steamers, the *Travailleur* and the *Talisman*, had resulted in the discovery of many interesting crinoids off the coasts of southern Europe and northwestern Africa. Scattered references to these are found in the writings of E. Perrier, Captain Parfait, de Folin, and of the Marquis de Fillhol, but they are mostly very indefinite and very unsatisfactory. Interest in these crinoids appears to have soon died out, and no detailed report upon them was ever prepared.

Prof. F. Jeffrey Bell, in listing the echinoderms obtained by the *Alert* in the western Indian Ocean, records (1884) immature specimens of a species of "*Actinometra*" from the Amirante Islands.

In the same year P. H. Carpenter published an account of the crinoids occurring between the Faroe Islands and Gibraltar, mostly based upon the results of the work of the *Porcupine* expedition, and he also finished the monograph on the stalked crinoids which had been obtained by the *Challenger*. This latter is more comprehensive in scope than is indicated by its title, for it includes an account of the material obtained by all the other exploring ships, in so far as he had access to it, and cites nearly all of the published references, thus offering a reasonably complete summary of everything known in regard to the recent stalked crinoids previous to 1884. Four years later this monograph was followed by a similar work dealing with the comatulids; but this is less comprehensive in its scope, so that species not among the *Challenger* collections are neither described in detail nor figured. As the *Challenger* obtained but a single species while in African waters, at Simons Bay, Natal, and that a well-known form (*Comanthus wahlbergii*), it is evident that African species receive a comparatively small amount of attention.

Hartlaub's monograph on the comatulid fauna of the East Indian Archipelago, published in 1891 (after a preliminary paper in 1890), fills many of the gaps left by Carpenter in the *Challenger* monograph. Two new African species, one from the Red Sea (*Antedon klunzingeri*) and the other from the Ivory coast (*Antedon hufferi*), are described as new and figured, and two others, known from the Red Sea since 1817 and 1833, are for the first time adequately figured.

Bell in 1892 described a new species of "*Antedon*" from Mauritius under the name of *A. emendatrix*. Ever since then it has been a great puzzle to determine what the species really is, as the diagnosis is far from clear, and there is a possibility that it covers two distinct species belonging to two different genera, one of which is a species of *Cenometra*, though Bell did not recognize its affinity with *C. bella*, which Hartlaub had made known two years previously.

In 1899 Hubert Ludwig published an important paper upon the echinoderms of Zanzibar, based upon a collection made in that country by Doctor Voeltzkow. In this he recapitulates the previous records for the region about Zanzibar published by von Martens, Rathbun, Pourtalès, and Carpenter, and adds *Antedon flagellata*, a species previously known only from Singapore and the Pelew Islands.

The work of the steamer *Valdivia* while under charter to the German Government resulted in the discovery of two interesting crinoids off the coast of Somaliland, which are figured by Professor Chun, with tentative identifications furnished by Professor Döderlein, in his interesting account of the voyage (Aus den Tiefen des Weltmeeres). One of these was a species of *Rhizocrinus*, a genus known from many places in the Atlantic, but hitherto only known outside that area from the indefinite report of Korotneff, who found a large species

(? *R. weberi*) in the Straits of Sunda; the other was a new species of *Pentametrocrinus*.

The work of the Prince of Monaco has added a great deal to our knowledge of the crinoids of the deeper waters off northwest Africa. Much information is contained in short papers published by the Prince himself and by Professors Kœhler and Richard. All the data acquired has recently (1909) been presented in magnificent form under the authorship of Professor Kœhler.

It is very remarkable that the *Princesse-Alice* should have obtained only two new species, but the lack of quantity is more than compensated by the interest attaching to one of them, *Gephyrocrinus grimaldii*, representing a second genus of Hyocrinidæ, first described in a preliminary paper by Professor Kœhler and Dr. F. A. Bather, jointly, in 1902.

The investigations conducted by the Cape of Good Hope Government into the marine resources of that colony had resulted in the accumulation of most excellent collections of echinoderms. These were turned over to Prof. F. Jeffrey Bell for determination, and he found among them four species of crinoids, three of which he described as new, assigning them all to systematic positions very remote from those they in reality occupy; his fourth species was misidentified. These four species are:

Antedon capensis = *Tropiometra carinata*.

Antedon sclateri = *Pachylometra sclateri*.

Antedon magnicirra = *Crotalometra magnicirra*.

Actinometra parvicirra = *Comanthus wahlbergii*.

In his report upon the stalked crinoids of the *Siboga* expedition, which appeared toward the close of 1907, Professor Döderlein figured the species of *Rhizocrinus* dredged by the *Valdivia* off Somaliland, calling it, most appropriately, *Rhizocrinus chuni*.

Mr. Herbert C. Chadwick in 1908 communicated to the Linnæan Society of London a short paper upon the crinoids collected by Mr. Cyril Crossland on the coast of the Sudan during the course of the investigations of the marine biology of the Red Sea under the direction of Prof. W. A. Herdman. Six species are listed, four of which are new to the region; these are:

Antedon serripinna = *Colobometra chadwicki*.

Antedon parvicirra = *Iridometra ægyptica*.

Antedon marginata = ? *Stephanometra marginata*.

Antedon imparipinna = *Dichrometra protectus*.

Antedon palmata = *Dichrometra palmata*.

Antedon savignyi = *Heterometra savignii*.

Mr. Chadwick himself was not certain of the correctness of his determination of *Antedon marginata*, and in a review I took the liberty of stating that *Antedon serripinna* and *A. parvicirra* were

possibly not quite the same as the East Indian species called by those names by Carpenter. Thanks to the kindness of Mr. Chadwick and Professor Herdman, I have been able to examine one of the specimens identified as *A. serripinna*, and I find it to be a new species of *Colobometra*, and not an *Oligometra* at all. I also found in the British Museum a specimen of what is undoubtedly his *Antedon parvicirra*, which turned out to be a new species of *Iridometra*.

In October 1909, Professor Bell reported upon the echinoderms of the Percy Sladen Trust expedition, which included four crinoids. All were misidentified. The four species are:

| | |
|---------------------------------|------------------------------------|
| <i>Actinometra multiradiata</i> | = <i>Comatella maculata</i> . |
| <i>Antedon carinata</i> | = ? <i>Cosmiometra gardineri</i> . |
| <i>Antedon palmata</i> | = <i>Stephanometra indica</i> . |
| <i>Antedon spicata</i> | = <i>Cenometra emendatrix</i> . |

MATERIAL.

The specimens examined in connection with the present work include all the crinoids from Africa in the British Museum, the Bergen Museum, the Museum of Comparative Zoölogy, the Copenhagen Museum, the Hamburg Museum, the Museum für Naturkunde and the Museum für Meereskunde, Berlin, the Oceanographic Museum at Monaco, the Paris Museum, and the U. S. National Museum. Among them are the originals of all the published records of Leuckart, Guérin-Ménéville, J. Müller, Michelin, Dujardin and Hupé, von Martens, Wyville Thomson, Pourtalès, Rathbun, E. A. Smith, Bell, P. H. Carpenter, Hartlaub, and Ludwig, and most of those of Döderlein and Chadwick. At Lyons Prof. R. Kœhler and M. Vaney showed me the specimens collected by the *Travailleur*, the *Talisman*, and the *Princesse-Alice*, upon which they are soon to publish a report. Two of their new species I had already seen in the museums at London and Paris, and I had drawn up diagnoses of them; but it is only fair to those gentlemen to withhold my diagnoses until they are able to publish theirs, and to confine myself, in treating of the material collected by the French and Monacan ships, to the published records.

FAUNAL RELATIONSHIPS OF THE AFRICAN COASTS.

There are known to-day from the coasts of Africa and the outlying islands fifty-three species of recent crinoids; forty-five of these belong to the Comatulida, representing seven families, viz, the Comasteridæ (six); the Himerometridæ (twelve); the Colobometridæ (six); the Tropiometridæ (three); the Thalassometridæ (eight); the Antedonidæ (eight), and the Pentametrocrinidæ (two), while eight are stalked, representing the Pentacrinitidæ (one); the Hyocrinidæ (one), and the Rhizocrinidæ (six). These species are included in twenty-four genera, of which four are stalked.

The African shores are faunally divisible into five well-marked districts, each with its characteristic species and genera, as follows:

MEDITERRANEAN COAST.

Family ANTEDONIDÆ.

*Antedon mediterranea.**Leptometra phalangium.*

NORTHWEST COAST (STRAITS OF GIBRALTAR TO CAPE VERDE, INCLUDING THE AZORES, MADEIRA, CANARY, AND CAPE VERDE ISLANDS).

Family COMASTERIDÆ.

Neocomatella (new species).¹

Family THALASSOMETRIDÆ.

*Crotalometra flava.*¹*Thalassometra lusitanica.*¹*Thalassometra omissa.*¹

Family ANTEDONIDÆ.

*Antedon bifida.**Leptometra celtica.*

Family PENTAMETROCRINIDÆ.

Pentametrocrinus atlanticus.^{2 1}

Family PENTACRINITIDÆ.

*Endoxocrinus wyvillethomsoni.*¹

Family HYOCRINIDÆ.

*Gephyrocrinus grimaldii.*¹

Family BOURGUETICRINIDÆ.

*Bathycrinus gracilis.*¹*Bathycrinus recuperatus.*¹*Bathycrinus perrieri.*¹*Rhizocrinus parfaiti.*^{2 1}

WEST COAST (INCLUDING THE ISLANDS OF ST. HELENA AND ASCENSION).

Family TROPIOMETRIDÆ.

*Tropiometra picta.*²

Family ANTEDONIDÆ.

*Antedon hufferi.*¹ Deep-water species.² Occurs also in the West Indies.

Family THALASSOMETRIDÆ.

Crotalometra porrecta.¹*Thalassometra multispina*.¹

Family RHIZOCRINIDÆ.

Bathycrinus aldrichianus.¹

SOUTHEAST COAST (FROM MOMBASA TO CAPE TOWN, INCLUDING ALL THE OUTLYING ISLANDS).

Family COMASTERIDÆ.

Comatella maculata.*Capillaster multiradiata*.*Comissia ignota*.*Comanthus parvicirra*.*Comanthus wahlbergii*.

Family HIMEROMETRIDÆ.

Amphimetra africana.*Craspedometra madagascarensis*.*Heterometra joubini*.*Heterometra gravieri*.*Stephanometra indica*.*Dichrometra flagellata*.

Family COLOBOMETRIDÆ.

Cenometra emendatrix.*Decametra möbiusi*.*Decametra modica*.*Decametra alaudæ*.*Oligometra serripinna*.

Family TROPIOMETRIDÆ.

Tropiometra carinata.

Family THALASSOMETRIDÆ.

Crotalometra magnicirra.¹*Cosmiometra gardineri*.¹*Pachylometra sclateri*.¹

Family ANTEDONIDÆ.

Iridometra mauritiana.*Perometra afra*.

NORTHEAST COAST (FROM BRITISH EAST AFRICA TO SUEZ).

Family COMASTERIDÆ.

Comanthus (?*parvicirra*).¹ Deep-water species.

Family HIMEROMETRIDÆ.

| | |
|---------------------------------|---------------------------------|
| <i>Craspedometra ater.</i> | <i>Dichrometra protectus.</i> |
| <i>Heterometra savignii.</i> | <i>Dichrometra klunzingeri.</i> |
| <i>Stephanometra marginata.</i> | <i>Dichrometra palmata.</i> |

Family COLOBOMETRIDÆ.

Colobometra chadwicki.

Family TROPIOMETRIDÆ.

Tropiometra encrinus.

Family ANTEDONIDÆ.

Iridometra ægyptica.

Family PENTAMETROCRINIDÆ.

Pentametrocrinus (new species).¹

Family RHIZOCRINIDÆ.

*Rhizocrinus chuni.*¹

Mediterranean coast.—So far as we know, the Mediterranean coast of Africa is the same faunally as the Mediterranean coast of Europe. Only two genera, *Antedon* and *Leptometra*, are found here, both of which are primarily, as I have shown, of Indian Ocean or East Indian origin,² and both of which occur in the Atlantic northward nearly or quite to Norway. These two genera may be said to delimit the EUROPEAN faunal area—in reality an attenuated derivative from the great Indo-Pacific-Japanese region—and this EUROPEAN faunal area may logically be divided into (1) the *Mediterranean* area, inhabited by *Antedon mediterranea*, *A. adriatica*, and *Leptometra phalangium*; and (2) the *European-Atlantic* area, inhabited by *Antedon pctasus*, *A. bifida*, and *Leptometra celtica*, and extending from Norway south to Morocco and Madeira.

Northwest coast.—This is the meeting ground between the preceding and succeeding littoral faunal areas; here the *European-Atlantic* area reaches its southern and the *West African* its northern limit.

In the deeper water, however, inhabited by species of the *Intermediate* faunal zone,³ we find a strongly marked “West Indian” element, indicated by *Neocomatella*, *Pentametrocrinus atlanticus*, and *Rhizocrinus parfaii*.

¹ Deep-water species.

² Cf. Vid. Medd. fra den naturhist. Forening i Kjøbenhavn, 1909, p. 128 et seq.

³ Idem., p. 126.

Thanks to the work of the ships of the U. S. Coast Survey and the U. S. Fish Commission we have long had data upon which to base a concept of the Antillean crinoid fauna, and we are able to state with a reasonable degree of accuracy that this fauna is directly derived from, and forms the outer fringe of, the great *Intermediate* area, the maximum intensity of which lies within a triangle whose apices are, roughly, southern Japan, the Kermadec Islands, and Singapore. Just as the genera *Antedon* and *Leptometra* characterizing the European faunal area are distinct from, though very closely related to, the parent genera *Mastigometra* and *Psathyrometra* of the East Indies, so the genera found in the West Indies are very closely related to, but entirely distinct from, the corresponding East Indian genera. The correspondence is well brought out by the following list:

WEST INDIAN GENUS.

CORRESPONDING EAST INDIAN GENUS.

Family COMASTERIDÆ.

| | |
|-----------------------|---------------------|
| <i>Nemaster.</i> | <i>Capillaster.</i> |
| <i>Neocomatella.</i> | <i>Comatella.</i> |
| <i>Leptonemaster.</i> | <i>Comissia.</i> |
| <i>Comactinia.</i> | <i>Comatula.</i> |

Family HIMEROMETRIDÆ.

| | |
|-----------------------|-----------------------|
| <i>Analcidometra.</i> | <i>Stephanometra.</i> |
|-----------------------|-----------------------|

Family THALASSOMETRIDÆ.

| | |
|--------------------|------------------------|
| <i>Stylometra.</i> | <i>Cosmiometra.</i> |
| <i>Crinometra.</i> | { <i>Pachylometra.</i> |
| | { <i>Glyptometa.</i> |

Family ANTEDONIDÆ.

| | |
|---------------------|-----------------------|
| <i>Hypalometra.</i> | <i>Erythrometra.</i> |
| <i>Zenometra.</i> | <i>Psathyrometra.</i> |
| <i>Coccometra.</i> | <i>Thysanometra.</i> |

Certain other genera probably should be paired in the same way, but our data in regard to them is as yet insufficient for generalization; a number of genera are, of course, common to both regions, though the species are never the same.

Now the entire western coast of North and South America is, as I have shown,¹ purely *Antarctic*, or, more precisely, *Magellanic*, in its affinities; the Indo-Pacific-Japanese species disappear far to the westward among the South Sea islands. It is thus highly improbable that the West Indies could ever have become colonized from the westward; if such had been the case there would certainly be traces

¹Geographical Journal, vol. 32, No. 6, p. 602 et seq.

remaining of the zoögeographic progression on the tropical west American coast. Moreover, the geology of the country between North and South America shows that there has been a fairly permanent land barrier at all times between the Caribbean and the Pacific; such channels as have intercommunicated between them could never have been deep, as none of the characteristic animals occurring below the sublittoral zone on the Pacific side appear to have passed through to the Caribbean. No crinoids ever passed through in either direction, and there is not even a subfamily or a genus common to both coasts of Central America; but crinoids are almost entirely sessile—much more nearly so than any other marine organisms—and many barriers therefore operate against their dispersal which are ineffective against other animals, including the other echinoderms.¹

The crinoids, therefore, move very slowly into new territory for this reason and also because of their slight adaptability to changes of salinity and especially of temperature, and the fact that a few of the littoral echinoids, ophiuroids, and asteroids have, during the periods when communication was established between the Caribbean and the Pacific, made their way from the former into the latter, does not in any way disprove the hypothesis that there has at all times been an insuperable barrier to the dispersal of the crinoids.

Thus it seems necessary to assume that the West Indian crinoid fauna reached the Caribbean basin from the eastward, from the northwest coast of Africa, having previously reached that district from the southward or southeastward, not from the eastward or northeastward.

According to this, the northwest African intermediate fauna (including that of Europe south of the Bay of Biscay) is zoögeographically more important than the West Indian, though at present much less known; the two, so far as can be judged, are practically the same, so that together they may be considered as making up a *South European-Northwest African-Antillean* faunal division of the intermediate region, which falls naturally into two subdivisions, (1) an *Afro-European* and (2) an *Antillean*.

It is a very curious fact that almost without a single exception the genera and species of this faunal division inhabit deeper—often much deeper—water than the genera and species from which they have been derived in the East Indian seas, and their habitat in the east is deeper again than their habitat in the west. It would appear that this faunal division has taken from the great parent Indo-Pacific-Japanese region only such genera as are most plastic and can best adapt themselves to changing conditions; these genera have been able to survive, but have become differentiated from the parent stock, while all the other less plastic genera, which we must assume were

¹ Vid. Medd. fra den naturhist. Forening i Kjøbenhavn, 1909, pp. 117-133.

originally carried along with them, have died out. The difference in depth of habitat between the species on the opposite coasts of the Atlantic is probably due to a difference in the nature of the food supply, and the increased depth of the habitat of the West Indian genera over their East Indian relatives originated probably from the same cause.¹

There is, therefore, a close similarity in origin between the species of the *European* and the south *European-northwest African-Antillean* faunal divisions; the former have reached their present habitat by passing northwestward around or across the northern end of what is now Africa, the latter by passing more to the southward. At first similar extensions from the common parent region, the diverse conditions which in past geologic ages they encountered, one in the north and the other in the south, reduced them differently, so that now they present a totally different aspect, and one would never suspect a common origin were they not both equally closely related to the parent region.

It is very interesting that in the ages since the constituent elements of these two faunal divisions left the parent region only comparatively slight changes have occurred; no widely diverse generic types have been evolved, and none of the collateral parent genera have entirely died out behind them, though they have largely disappeared from the intervening seas of the present day, being preserved, however, in certain cases, as fossils in the later rocks.

West coast.—There are only two littoral comatulids known from the west African coast and the outlying islands; one of these (*Tropiometra picta*) is, so far as I can see, identical with the commonest species on the opposite coast of South America, while the other (*Antedon hupferi*) is very close to a corresponding species originally described from Rio de Janeiro and since reported from Abrolhos and Madeira (*Antedon diibenii*). The third littoral Brazilian comatulid (*Nemaster lineata*) has probably spread southward from the West Indies just as *Tropiometra picta* has worked its way northward to those islands.

The faunal division characterized by the presence of *Tropiometra picta* and the small short armed species of *Antedon* may be conveniently known as the *West African-South American* area.

In the deep waters of the Atlantic there occur certain genera of the Oceanic region which are found in all deep seas, except that they never intrude upon the territory occupied by the so-called *Polar-Pacific* species. Such genera are *Bathycrinus*, *Bathymetra*, *Crotalometra*, and *Thalassometra*; possibly *Gephyrocrinus* should also be placed here.

¹ Geographical Journal, vol. 32, No. 6, p. 602 et seq.

Southeast coast.—The southeastern coast of Africa is faunally the richest section of the continent, supporting twenty-two species distributed among eighteen genera, of which latter eleven do not occur farther north. All of the genera are widely spread throughout the Indo-Pacific-Japanese region, but sixteen of the twenty-two species are confined to southeastern Africa, only six occurring in Ceylon and eastward. The only four species of the deeper water yet known belong to characteristically East Indian genera.

The affinities of this district are obviously with Ceylon and the region to the eastward of that island rather than with the coasts of the Arabian Sea, and the modern crinoid fauna evidently worked southwestward along the line now indicated by the Maldivé, Chagos, and Cargados islands to what is now Mauritius, Madagascar, and southeast Africa.

The following genera are common to southeast Africa and Ceylon (or the Bay of Bengal), but do not occur on the shores of the Arabian Sea north of Ceylon or north of British East Africa:

| | |
|---|----------------------|
| <i>Comatella.</i> | <i>Decametra.</i> |
| <i>Capillaster.</i> | <i>Oligometra.</i> |
| <i>Comissia.</i> | <i>Crotalometra.</i> |
| <i>Bennettia</i> group of <i>Comanthus.</i> | <i>Cosmiometra.</i> |
| <i>Amphimetra.</i> | <i>Pachylometra.</i> |
| <i>Cenometra.</i> | <i>Perometra.</i> |

The same is, so far as we know, true of the following species:

| | |
|----------------------------------|--------------------------------|
| <i>Comatella maculata.</i> | <i>Stephanometra indica.</i> |
| <i>Capillaster multiradiata.</i> | <i>Dichrometra flagellata.</i> |
| <i>Oligometra serripinna.</i> | |

As the south *European-northwest African-Antillean* division offers some striking points of similarity to the attenuated western extremity of the Indo-Pacific-Japanese region, as seen in southeast Africa, we are justified in supposing that it was originally derived from it by passage across what is now central Africa; in other words, that the genera characterizing it have moved outward from the East Indian region, first southwestward to southeast Africa and then northeastward to their present habitat.

The area from Mombasa southward to Cape Colony, and including Madagascar, the Seychelles, Réunion, and Mauritius, and the other islands as far as the Chagos group may be conveniently known as the *Southeast African* faunal division of the Indo-Pacific-Japanese region.

Along the coasts of Cape Colony and Natal occurs a comasterid (*Comanthus wahlbergii*) found nowhere else, but closely related to *Comanthus trichoptera* of southern Australia. Although it is associated with tropical forms, and although there are no representatives there of the other south Australian species, we must recognize the fact that the *Cape* subdivision is not quite the same faunally as the

shores farther north; it is poorer in species, and is modified by the intrusion of a south Australian element, just as has been shown in the case of many other animals.

Northeast coast.—The northeast coast of Africa is singularly different in the aspect of its crinoid fauna from the coast to the southward. Of strictly comparable species there are only ten, distributed among eight genera, of which one is not known from farther south; this is:

Colobometra.

All of the genera are purely East Indian; of the species five extend to India or beyond; these are:

| | |
|---------------------------------|-------------------------------|
| <i>Heterometra savignii.</i> | <i>Dichrometra protectus.</i> |
| <i>Stephanometra marginata.</i> | <i>Dichrometra palmata.</i> |
| <i>Tropiometra encrinus.</i> | |

The fauna of northeast Africa therefore is purely a derivative from East Indian stock, just as that of southeast Africa is, but a curious segregation of the genera and species composing the *Indo-Pacific-Japanese* region has occurred, one set of forms following the coasts of the Arabian Sea, the other extending in a southeasterly direction toward the Cape. While the faunas of the northeast and of the southeast coasts differ considerably between themselves, they are both about equally related to the general East Indian fauna, and the component species of both are remarkable in being in general smaller than the corresponding species in the great parent area.

The shores from Somaliland northward to and including the Red Sea, and thence eastward to the Persian Gulf, may be considered as marking the *Northeast African* faunal division.

Whether or not the genera *Antedon* and *Leptometra* reached their present habitat by way of the Arabian Sea—that is, through the fauna now occupying the shores of that basin—it is not possible to say; *Mastigometra* and *Psathyrometra*, their eastern equivalents, occur at or near Ceylon, but are known no farther west. They may have gone “overland” from India; may have passed along the shores of the Arabian Sea (or its ancient homologue) and subsequently died out, or, which is much the most likely, they may yet remain to be discovered between Ceylon and Suez.

Summary.—The crinoid fauna of the coasts of Africa falls into five divisions, as follows:

1. The EUROPEAN division, including the Mediterranean coast, and the northwest coast north of Morocco and Madeira; this falls into two subdivisions:

(a) The *Mediterranean* subdivision, comprising the coast of the Mediterranean, and

(b) The *European-Atlantic* subdivision, extending on the Atlantic coast from Madeira and Morocco northward;

2. The SOUTH EUROPEAN-NORTHWEST AFRICAN-ANTILLEAN division, extending from Madeira and Morocco northward to the Bay of Biscay and westward to and including the Caribbean Sea:

3. The WEST AFRICAN SOUTH-AMERICAN division, including the coast south of Morocco and the opposite coast of Brazil, with the intervening islands;

4. The SOUTHEAST AFRICAN division, extending from Mombasa to Cape Town, and eastward to include Madagascar, the Seychelles, Réunion, and Mauritius, and the intervening islands eastward to the Chagos archipelago; the southern part of this division, comprising the coasts of Cape Colony and Natal, forms the *Cape* subdivision; and

5. The NORTHEAST AFRICAN division, extending from Somaliland northward throughout the Red Sea and eastward to the Persian Gulf.

The West African-South American division is an attenuated offshoot from the South European-Northwest African-Antillean division, which itself is derived from the Southeast African division, the last the somewhat modified southwestern extremity of the great Indo-Pacific-Japanese faunal area.

The European faunal division is probably an attenuated offshoot from the Northeast African division, which itself is the considerably modified northwestern extremity of the great Indo-Pacific-Japanese faunal area.

ANNOTATED LIST OF SPECIES.

I. COMATULIDS.

Suborder OLIGOPHREATA.

Family COMASTERIDÆ.

Subfamily CAPILLASTERINÆ.

Genus NEOCOMATELLA A. H. Clark.

NEOCOMATELLA (new species).

Actinometra pulchella (part) P. H. CARPENTER, Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 369; *Challenger Reports*, vol. 26, Zoology, 1888, p. 304—KÖHLER and VANEY, Bull. du mus. d'hist. nat., 1910, No. 1, p. 32.

Localities.—West of Gibraltar (lat. 35° 56' N.; long. 7° 06' W.); northeast of the Seine Bank (lat. 34° 57' N.; long. 11° 57' W.); off Cape Peñas; south of Cape St. Vincent (lat. 35° 26' N.; long. 9° 09' W.); south of the Canary Islands (lat. 25° 41' N.; long. 18° 16' W.).

Depth.—228–533 fathoms.

Bottom temperature.—50.5° Fahr. (one record).

Bottom.—Clay (one record).¹

¹*Comatula solaris* has been recorded from the east coast of Africa (Zanzibar) by Professor von Martens, but the record appears to have been based upon a specimen of *Tropiometra carinata*.

Genus COMATELLA A. H. Clark.

COMATELLA MACULATA (P. H. Carpenter).

Actinometra multiradiata BELL, Trans. Linn. Soc. (Zool.), (2), vol. 13, 1909, pt. 1, p. 20.

Localities.—Salomon, from the reef; Coin Peros.

Remarks.—The specimen from Salomon, which I examined at the British Museum, has twenty-six arms 85 mm. long; the cirri are XXI, 15–18. The IIBr series are all developed externally. Compared directly with the type of Carpenter's *maculata*, this specimen is found to differ only in having more numerous arms.

Genus CAPILLASTER A. H. Clark.

CAPILLASTER MULTIRADIATA (Linnæus).

Asterias pectinata (part) LINNÆUS, Syst. Nat., 10th ed., 1758, p. 663 (reference to Petiver).

Asterias multiradiata LINNÆUS, Syst. Nat., 10th ed., 1758, p. 663 (type-specimen at Lund, but not references cited).

Comatula fimbriata LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 535.

Comatula coccodistoma (Paris Museum MS.) DUJARDIN and HUPÉ, Hist. nat. des zoophytes; échinodermes, 1862, p. 208.

Actinometra coppingeri BELL, Proc. Zool. Soc. London, 1882, p. 535.—Rep. Zool. Coll. H. M. S. *Alert*, 1884, p. 168, pl. 16, fig. B.

Actinometra multiradiata P. H. CARPENTER, *Challenger Reports*, vol. 26, 1888, Zoology, p. 322, pl. 66, figs. 1–3.

Capillaster multiradiata A. H. CLARK, Vid. Medd. fra den naturhist. Forening i Kjøbenhavn, 1909, p. 134.

Localities.—Madagascar; Cape St. André, Madagascar.

Depth.—Littoral, and down to about 30 meters.

In the Paris Museum there are three specimens of this species from Madagascar; one has the cirri XV, 21–23, and nineteen arms, one IIBr series being lacking; two of the IIBr series are 2, the remaining seven being 4 (3 + 4); another (Cape St. André; about 30 meters) has the cirri XVIII, 21–22, and twelve arms, one ray bearing two IIBr 4 (3 + 4) series; the brachials are very short and overlap rather strongly; the third is like the first, and also has nineteen arms; no IIIIBr series are present.

Compared directly with a typical example from the Straits of Sunda, these three specimens are seen to be smaller and proportionately weaker, but otherwise I can find no differences whatever. IIIIBr series, very common among East Indian specimens, do not occur. Very possibly these specimens represent a local permanently small race confined to the southeast African region. If this should prove to be the case the name *coccodistoma* would be applicable to it.

Genus COMISSIA A. H. Clark.

COMISSIA IGNOTA, new species.

Actinometra BELL, Rep. Zool. Coll. H. M. S. *Alert*, 1884, p. 510.

Actinometra pectinata Brit. Mus. MS.

Description.—Centrodorsal discoidal, with a flat dorsal pole 1.5 mm.—2 mm. in diameter.

Cirri XII–XV, 9–11 (usually 10–11), 4 mm.—5 mm. long; first segment short, second not quite so long as broad, the following increasing in length to the fourth, which is about three times as long as the median diameter; the sixth and following are about as long as broad; the third and fourth are strongly “dice-box shaped;” the fifth and following each bear a minute sharp subterminal tubercle; the shorter distal segments are somewhat compressed laterally, and hence appear comparatively broad in lateral view; the opposing spine is slight and inconspicuous.

Radials concealed; IBr_1 well separated, the interrarial angle of separation being about 90° .

Ten arms 30 mm.—35 mm. long, resembling in general those of *Leptoncmaster venustus*, but proportionately slightly stouter; genital glands are developed on the pinnules.

Locality.—Marie Louise Island, and Isle des Neufs, Amirante group; collected by H. M. S. *Alert*.

Depth.—17 fathoms.

Bottom.—Coral.

Subfamily COMASTERINÆ.

Genus COMANTHUS A. H. Clark.

Subgenus COMANTHUS.

Specific group BENNETTIA.

COMANTHUS (BENNETTIA) WAHLBERGII (J. Müller).

Comatula coccodistoma (part) Paris Museum MS.

Alecto wahlbergii J. MÜLLER, Archiv für Naturgesch., 1843, Heft 1, p. 131.

Actinometra parvicirra (part) P. H. CARPENTER, *Challenger* Reports, vol. 26, Zoology, 1888, p. 338.—BELL, Marine Investigations in South Africa, vol. 4, pt. 4, p. 141.

Localities.—Port Natal; Simons Bay, Natal; False Bay; Cape of Good Hope; Algoa Bay, close to Riy Bank (lat. $33^\circ 58' S$; long. $25^\circ 51' 30'' E$.); Tugela River mouth bearing NW. by W., $3\frac{1}{2}$ miles distant.

Depth.—Littoral, and down to 25 fathoms.

Bottom.—Dark sand, black specks, and rocks; rocks.

Remarks.—Hitherto this species has always been confused with the common East Indian *Comanthus parvicirra*, from which, however, it is very sharply separated, not even belonging in the same specific group. Its closest affinity is with *Comanthus trichoptera* of southern

Australia, and its presence at the Cape indicates a connection between the crinoid faunas of these two localities similar to that shown in many other groups.

Comanthus wahlbergii is a small stout species with well-developed, permanent cirri; these are from XII-XXV, 13-17 (usually about XV, 16), about 10 mm. long; from the fifth to the seventh (usually the sixth) a transition segment is developed which is usually well marked.

The centrodorsal is thin discoidal, with a broad flat dorsal pole 4 mm. in diameter, resembling that of *C. trichoptera*.

The arms are from thirteen to twenty-one in number (usually from sixteen to twenty) and are commonly about 60 mm. long. IIIBr series are rare. All the division series are 4 (3+4). The arms are short and stout, tapering rapidly, much as in *Comatula brachiolata*. The brachials overlap conspicuously, and the ends of the elements of the division series are prominent. The division series are broad and are close together laterally.

One of the specimens which I examined in the British Museum (catalogued under the name of *Actinometra paucicirra*) has thirteen pentacrinoids attached to the cirri; these are similar to those of *Comactinia meridionalis* and possess seventeen columnars.

Specific group VALIDIA.

COMANTHUS (VALIDIA) PARVICIRRA (J. Müller).

- Alecto parvicirra* J. MÜLLER, Archiv für Naturgesch., 1841, Heft 1, p. 145.
Alecto timorensis J. MÜLLER, Archiv für Naturgesch., 1841, Heft 1, p. 145.
Comatula brevicirra DUJARDIN and HUPÉ, Hist. nat. des zoophytes; échinodermes, 1862, p. 208.
Comatula simplex DUJARDIN and HUPÉ, Hist. nat. des zoophytes; échinodermes, 1862, p. 208.
Actinometra trachygaster (part) LÜTKEN, Mus. Godeffr. Cat., vol. 4, 1869, p. 125.
Actinometra intricata (part) LÜTKEN, Mus. Godeffr. Cat., vol. 5, 1874, p. 190.
Comatula mertensi GRUBE, J. B. der schls. Gesellsch. für vaterl. Cultur, 1875, p. 74.
Actinometra armata W. B. CARPENTER, Proc. Roy. Soc. London, vol. 24, 1876, p. 451.
Actinometra polymorpha P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 440.
Actinometra meyeri P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 525.
Antedon mertensi BELL, Proc. Zool. Soc. London, 1882, p. 535.
Actinometra mutabilis VON GRAFF, Challenger Reports, vol. 10, Zoology, 1884, p. 13.
Actinometra annotea BELL, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, 1887, p. 645.
Actinometra elongata P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 311.
Actinometra simplex P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 312.
Actinometra quadrata P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 331.

- Actinometra parvicirra* (part) P. H. CARPENTER, *Challenger Reports*, vol. 26, Zoology, 1888, p. 338.
- Actinometra rotalaria* P. H. CARPENTER, *Challenger Reports*, vol. 26, Zoology, 1888, p. 313.
- Actinometra guttata* (LÜTKEN MS.) HARTLAUB, *Nova Acta Acad. German.*, vol. 58, No. 1, 1891, p. 96.
- Comatula orientalis* A. H. CLARK, *Proc. U. S. Nat. Mus.*, vol. 33, 1907, p. 155.
- Comatula helianthus* A. H. CLARK, *Proc. U. S. Nat. Mus.*, vol. 34, 1908, p. 440.
- Comanthus rotalaria* A. H. CLARK, *Smiths. Misc. Coll. (Quarterly Issue)*, vol. 52, pt. 2, 1908, p. 205.
- Comanthus (Comanthus) rotalaria* A. H. CLARK, *Vid. Medd. fra den naturhist. Forening i Kjøbenhavn*, 1909, p. 144.

Locality.—Seychelles; two specimens in the British Museum were collected by the *Sea Lark* expedition, under Prof. J. Stanley Gardiner.

Depth.—34 fathoms.

Remarks.—In the Berlin Museum there are some immature comasterids from the Seychelles and some others from the Red Sea, the latter collected by Dr. R. Hartmeyer, which may belong to this species.

According to the data given by Carpenter in the *Challenger* report, the first available name for this species is *Comatula rotalaria* of Lamarek, Carpenter's figure of *Actinometra rotalaria* clearly representing this species. Upon examining Lamarek's types at the Paris Museum, however, I found that his *rotalaria* is the species called *Actinometra jukesii* by Carpenter and *Actinometra paucicirra* by Bell, so that Müller's *parvicirra* becomes the earliest available name for the present form.

Müller's *Alecto wahlbergii* must be eliminated from the synonymy of *Comanthus parvicirra*, in which it was included by Carpenter, as it has proved to be quite a different thing, a species related to *C. trichoptera* of southern Australia and not to *C. parvicirra* at all.

COMANTHUS (1 species).

Locality.—Cape St. André, Madagascar.

Depth.—About 30 meters.

Remarks.—Dr. P. R. Joly dredged in 1901 a single small specimen, undergoing adolescent autotomy, of some species of *Comanthus*. The cirri are XIII, 13-14; there are twenty-three arms; one of the internal IIIBr series is 2, all the other division series being 4 (3+4). The rays bear 4 (3+1), 5 (1+4), 5 (4+1), 2, and 7 (4+3) arms respectively. The cirri are rather more developed than is usual in *C. parvicirra*, with which the specimen otherwise agrees fairly well, and are rather more compressed and curved distally. The interradiial perisome is strongly plated.

COMANTHUS (1 species).

Actinometra cumingii Brit. Mus. MS.

Locality.—Mauritius.

Remarks.—There are two small comasterids in the British Museum from Mauritius, one with thirteen, the other with fourteen arms, which are very close to, if not the same thing as, *Comanthus parvicirra*.

Family HIMEROMETRIDÆ.

Subfamily HIMEROMETRINÆ.

Genus AMPHIMETRA A. H. Clark.

AMPHIMETRA AFRICANA, new species.

Description.—Centrodorsal, thin-discoidal, broad, the flat polar area being 4 mm. in diameter; cirrus sockets in a single more or less irregular closely crowded marginal row.

Cirri XXIII, 29–32 (usually 30), 20 mm. to 23 mm. long; first segment short, the following gradually increasing in length to the seventh or eighth, which is about as long as broad; following similar, after the eleventh or twelfth very gradually decreasing in length so that the terminal segments are about one-third broader than long; tenth or eleventh (usually the latter) and following bearing long and prominent dorsal spines which begin abruptly; the cirri do not taper distally.

Radials entirely concealed; IBr_1 very short, bandlike, in apposition laterally; IBr_2 short, two and one-half times as broad as long, the lateral edges not so long as those of the IBr_1 , in apposition; $IIBr_4$ (3+4) (eight $IIBr$ series are present; the other arms are broken off before the first syzygy); IBr , $IIBr$, and first brachials in close lateral apposition and sharply flattened against each other; sides of IBr and $IIBr$ series slightly produced; synarthrial tubercles obsolete.

Nineteen (? twenty) arms (in the type) apparently about 125 mm. long; first brachial short, slightly wedge shaped, twice as broad as long exteriorly, interiorly united; second brachial slightly larger and more obliquely wedge shaped; third and fourth (syzygial pair) slightly longer interiorly than exteriorly, twice as broad as long interiorly; following four or five brachials oblong, three times as broad as long, then becoming obliquely wedge shaped, twice as broad as long, and gradually less obliquely wedge shaped, after the end of the proximal half of the arm being practically oblong and very short.

P_1 12.5 mm. long, slender, flagellate distally, with twenty-nine segments, at first twice as broad as long, becoming about as long as broad on the eighth and nearly twice as long as broad terminally; second and following segments with a sharp carinate ridge with the crest parallel to the axis of the pinnule, which gradually becomes less

marked, disappearing on the tenth segment; P_2 15 mm. long, considerably stouter than P_1 and not tapering so rapidly distally, with twenty-five segments, at first short, becoming about as long as broad on the eighth or tenth, and twice as long as broad terminally; from the fourth segment there runs outward on the outer side of the pinnule just distal to the medio-dorsal line a prominent narrow ridge which continues almost to the tip; there is a similar but less marked ridge on P_1 ; second and following segments rather sharply, but not highly, carinate; P_3 similar to P_2 , slightly longer, about the same size, or slightly shorter and smaller; P_4 7 mm. long, rather stout, though much smaller than P_3 , tapering evenly to the tip, with fifteen segments which become about as long as broad on the eighth; the second-eighth are rather strongly carinate; P_5 similar, but more slender, 6 mm. long, with only the second-sixth segments carinate; the following pinnules gradually lose the basal carination, become more slender, and increase in length, reaching 8 mm. distally.

The color is brownish purple.

Localities.—Bagamoyo, German East Africa; the type is No. 4616, Berlin Museum.

Zanzibar; a smaller specimen in the British Museum has the cirri XVI, 25–27, but is otherwise similar.

Waxin; I also found in the British Museum a specimen (labeled "*Actinometra* sp.") from Waxin, south of Mombasa. This specimen has twenty-three arms 120 mm. long, the IIBr series being 4 (3 + 4) and the IIIBr series being 2; the cirri are XX, 27; long, sharp dorsal spines are developed from the tenth segment onward. Compared directly with a specimen of *H. savignii* the cirri are seen to be more spiny, the spines commencing nearer the centrodorsal, and the proximal pinnules are seen to be larger.

Remarks.—This species comes nearest to *Amphimetra philiberti* from the East Indies, but it is a smaller and less rugged form with fewer arms and much more spiny cirri.

Genus CRASPEDOMETRA A. H. Clark.

CRASPEDOMETRA ATER, new species.

Antedon ludovici Berlin Mus. MS.

Description.—Centrodorsal thick discoidal, the bare polar area slightly convex, 4 mm. in diameter; cirrus sockets in one and a partial second crowded and irregular marginal row.

Cirri XXII, 32–36, 30 mm. to 33 mm. long, stout, not tapering distally; first segment short, the following gradually increasing in length to the fifth or sixth, which, with the remainder, is about half again as broad as long; on the fifteenth or sixteenth the middle of the distal dorsal edge becomes prominent, this after one or two more segments becoming a prominent rather high rounded carination of the entire

median dorsal line; distally this carination gradually narrows antero-posteriorly so that on the last four or five segments preceding the penultimate there is only a blunt median spine; opposing spine usually rather longer and sharper than the spines on the preceding segments, terminal or subterminal, directed obliquely forward, half as long as the lateral diameter of the penultimate segment; terminal claw somewhat longer than the penultimate segment, stout and strongly curved basally but becoming straighter and more slender in the distal two-thirds.

Radials almost entirely concealed in the median line, but visible as a very low broad triangle in the angles of the calyx; IBr_1 very short, bandlike, five or six times as broad as long, in close apposition laterally; IBr_2 very broadly pentagonal, twice as broad as long; $IIBr$ 4 (3+4), well rounded dorsally; ossicles of the IBr and $IIBr$ series as far as P_D in lateral apposition, though not especially flattened; synarthrial tubercles obsolete.

Fourteen arms (in the type) about 160 mm. long; first brachial very short, slightly wedge shaped, almost entirely united interiorly; second brachial larger, more obliquely wedge shaped; third and fourth (syzygial pair) oblong, two and one-half to three times as broad as long; following five or six brachials oblong, three to four times as broad as long, then becoming wedge shaped, moderately oblique, about three times as broad as long, soon gradually becoming less and less oblique, in the outer part of the arm being very short, three or three and a half times as broad as long, only slightly wedge shaped.

P_D 11 mm. long with thirty-three segments, moderately stout proximally but rapidly tapering and becoming very slender and flagellate in the distal half; segments at first nearly three times as broad as long, but gradually increasing in length and becoming nearly or quite as long as broad in the distal third; P_1 13 mm. long with twenty-six segments, considerably stouter than P_D and tapering much less rapidly; the second-eighth segments are strongly carinate; P_2 22 mm. long with thirty segments, similar in general to P_1 though much larger and stouter and tapering less rapidly; proximal segments broad, becoming about as long as broad on the tenth or twelfth and remaining so until near the tip; the second-fifth segments are strongly carinate; P_3 13 mm. long, much smaller and more slender than P_2 ; P_4 somewhat smaller than P_3 ; P_5 9 mm. long, somewhat smaller than P_4 ; the proximal carination occurs on the second-sixth segments; the following pinnules very slowly become more slender, at the same time gradually increasing in length; the distal pinnules are 10 mm. long; the distal carination of the proximal segments, which is very marked on the earlier pinnules, gradually becomes less and less marked, involving fewer and fewer segments; it is but slightly evident beyond P_{20} .

The color is a uniform purplish or violet black.

Locality.—Red Sea; the type, which is No. 1055, Berlin Museum, was collected by Hemprich and Ehrenberg.

Remarks.—The stout short-segmented cirri which do not taper distally, and the uniformly large size of P_2 , which is much larger than P_3 , at once distinguish this species from all others in the genus.

CRASPEDOMETRA MADAGASCARENSIS, new species.

Description.—Centrodorsal thick-discoidal, the bare polar area slightly convex, 4 mm. in diameter; cirri arranged in two closely crowded irregular marginal rows.

Cirri XVI, 34–36, 25 mm. to 30 mm. long, stout basally, tapering slightly in the proximal half; first segment short, the following slowly increasing in length to the eighth or tenth, which is slightly broader than long to one-third broader than long, the distal segments being slightly shorter again; from the eleventh-fifteenth (usually about the fourteenth) onward small but prominent dorsal spines are developed; opposing spine larger than the spine on the preceding segment, triangular, the apex subterminal, arising from the whole dorsal surface of the penultimate segment, and equal in height to about one-half of its lateral diameter; terminal claw somewhat longer than the penultimate segment, moderately slender, especially in the distal two-thirds, rather strongly curved proximally but becoming straighter distally.

Radials concealed; IBr_1 very short, bandlike, in apposition laterally; IBr_2 very broadly pentagonal, twice as broad as long, the lateral edges only half as long as those of the IBr_1 ; $IIBr$ 4(3+4); IBr and $IIBr$ series and first brachials in close lateral apposition and laterally flattened; these flattened lateral edges are moderately produced; synarthrial tubercles obsolete.

Sixteen arms (in the type) 130 mm. long; first brachial slightly wedge shaped, twice as broad as long exteriorly, entirely united interiorly; second brachial about the same size, but more obliquely wedge shaped; third and fourth (syzygial pair) slightly longer interiorly than exteriorly, twice as broad as the exterior length; next three or four brachials oblong, three times as broad as long, then becoming very obliquely wedge shaped, twice as broad as long, after the proximal fourth of the arm gradually becoming less obliquely wedge shaped, but never oblong; eighth and ninth and following with slightly produced distal edges, this character gradually dying away after the middle of the arm.

P_1 slender, becoming very delicate in the distal half, 10 mm. long with twenty-six to twenty-eight segments, the first short, the following gradually increasing in length so that the eighth and following are about as long as broad; the second-fourth are rather strongly carinate.

P_D 9.5 mm. long, more slender than P_1 , with thirty-two segments, tapering more rapidly from the base and therefore more slender in its outer portion; earlier segments short, becoming about as long as broad on the twelfth and following; second-fourth segments strongly carinate, the following narrowly carinate to about the middle of the pinnule; P_2 12 mm. long, very slightly stouter basally than P_1 but tapering much more gradually, so appearing considerably stouter, with twenty-seven segments, which become about as long as broad on the sixth and from one-third to one-half again as long as broad distally; P_3 similar to P_2 , but very slightly larger and longer; P_4 8 mm. long, resembling P_2 and P_3 , but tapering more rapidly and therefore more slender in the distal half; P_5 6 mm. long, small and weak, with sixteen segments, all but the outermost broader than long; following pinnules similar, gradually increasing in length and in the length of the component segments, the distal pinnules being exceedingly slender, 8 mm. long. On the large lower pinnules the second-fifth segments are rather strongly carinate; this decreases rather rapidly distally, being soon confined to the second-fourth and then to the second-third, disappearing at the end of the proximal fourth of the arm.

The color is brownish white, the cirri being lighter and tinged with purple.

Locality.—Madagascar; the type, which is No. 5348 Berlin Museum, was collected by Doctor Voeltzkow.

Genus HETEROMETRA A. H. Clark.

HETEROMETRA SAVIGNII (J. Müller).

Comatula multiradiata AUDOUIN, in SAVIGNY, Description de l'Égypte, 1817, p. 205, pl. 1, fig. I, 1-6.—LEUCKART, Isis, vol. 5, 1839, p. 612.—VON GRAFF, Das Genus Myzostoma, 1877, pp. 2, 22; *Challenger Reports*, vol. 10, Zoology, 1884, p. 32.

Comatula, sp. LEUCKART, Zeitschr. für organ. Physik, vol. 3, 1833, Heft 4, p. 387.
Comatula adonæ DE BLAINVILLE, Manuel d'Actinologie (1834), 1836, pl. 26, figs. 1-5 (but not p. 249).

Alecto savignii J. MÜLLER, Archiv für Naturgeschichte, 1841, Heft I, p. 144 (Red Sea).

Antedon savignyi LUDWIG, in KOSSMAN, Reise nach dem Rothen Meer, vol. 5, 1880, p. 4.—P. H. CARPENTER, *Challenger Reports*, vol. 26, Zoology, 1888, pp. 55, 252, 253, 255, 263, 366, 380.—HARTLAUB, Nova Acta Acad. German., vol. 58, 1891, No. 1, pl. 2, fig. 20.—CHADWICK, Journ. Linn. Soc. (Zool.), vol. 31, 1908, p. 47.

Heterometra savignii A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 11.

Localities.—"Red Sea;" Gulf of Suez; Suez Bay; Ul Shubuk; Khor Shinab; Tor; Salaka.

This species ranges eastward as far as Muscat and Kurrachi.

Depth.—Littoral, and down to 12 fathoms.

HETEROMETRA JOUBINI, new species.

Description.—Cirri XXII, 39–43, 30 mm. long; the segments are all subequal, about half again as broad as long; those in the outer half of the cirrus bear short dorsal spines. The cirri as a whole are comparatively long and moderately stout.

Twenty arms 80 mm. long; ten IIBr 4 (3+4) series are present. The arm divisions and the arm structure are as in *H. reynaudi* of Ceylon.

P_2 is the longest, half again as long as P_1 or P_3 , slender, with 21 segments, which become squarish on the fourth or fifth, then somewhat longer than broad, and elongate terminally; P_3 is about as long as P_1 ; P_4 and the following pinnules are shorter than P_3 . The lower segments of the proximal pinnules are moderately carinate.

Compared directly with the type of *H. reynaudi*, this species is seen to differ in its longer and somewhat more slender cirri, which have slightly longer segments.

Locality.—Zanzibar; the type, which is in the Paris Museum, was collected by M. Rousseau in 1841. Dr. P. H. Carpenter examined the specimen on his visit to Paris, and noted it as representing a new species, though he never mentioned it in print.

HETEROMETRA GRAVIERI, new species.

Description.—Cirri XXVIII, 36–39, 21 mm. long, more slender than those of the preceding species; first segment short, the following gradually increasing in length to the fifth or sixth, which is from one-third to one-half again as broad as long, and after the eighth or ninth beginning to decrease again, so that those in the outer half are about twice as broad as long; the segments in the outer half of the cirri bear short dorsal spines.

Nineteen arms 80 mm. long, nine IIBr 4 (3+4) series being present; the arm structure resembles that of the preceding species; the division series have produced lateral margins; the brachials are only very slightly overlapping.

P_1 small and weak; P_2 half again as long as P_1 , slender, and flagellate distally, with 24 segments, of which the second-fifth are carinate; P_3 slightly smaller than P_2 , but much larger than P_1 ; P_4 about as large as P_1 ; following pinnules slightly shorter than P_4 ; the proximal segments of all the lower pinnules are distinctly carinate.

As a whole this species is slightly more slender and delicate than the preceding, though of the same size.

Locality.—Zanzibar; the type, which is in the Paris Museum, was collected by M. Rousseau in 1841. Dr. P. H. Carpenter also noted this species as new and as different from the preceding.

Subfamily STEPHANOMETRINÆ.

Genus STEPHANOMETRA A. H. Clark.

STEPHANOMETRA MARGINATA (P. H. Carpenter).

Antedon marginata P. H. CARPENTER, *Challenger Reports*, vol. 26, Zoology, 1888, p. 230, pl. 40.—CHADWICK, *Journ. Linn. Soc. (Zool.)*, vol. 31, 1908, p. 45.

Stephanometra marginata A. H. CLARK, *Vid. Medd. fra den naturhist. Forening i Kjøbenhavn*, 1909, p. 169; *Amer. Naturalist*, vol. 43, p. 255.

Locality.—Suez Bay.

This species is otherwise known from Ceylon, Singapore, and the Philippine Islands.

Depth.—10 fathoms. Other records of depth range from littoral down to 30 fathoms.

Remarks.—Mr. Chadwick has expressed some doubt in regard to the correctness of his identification of his two small and imperfect specimens from Suez, and I must confess to sharing his doubts.

STEPHANOMETRA INDICA (Smith).

Comatula indica SMITH, *Ann. and Mag. Nat. Hist. (4)*, vol. 17, 1879, p. 406; *Philos. Trans. Roy. Soc.*, vol. 168, p. 564, pl. 51, figs. 3, 3b (but not 3a).

Stephanometra indica A. H. CLARK, *Proc. Biol. Soc. Washington*, vol. 22, 1909, p. 10.

Antedon palmata BELL, *Trans. Linn. Soc. (Zool.)*, (2), vol. 13, 1909, pt. 1, p. 20.

Localities.—Rodriguez; Madagascar; Seychelles; north reef, Farquhar Atoll.

This species has also been reported from Ceylon, the Maldive Islands (under the name of *Actinometra maculata*), and the Bay of Bengal.

Depth.—Littoral, and down to 34 fathoms.

Remarks.—A specimen from Madagascar collected by M. Grandidier in 1905 has the cirri XXX, 20-22, smooth, the sixth segment the longest, about half again as long as broad; the last ten segments are half again as broad as long; the longer segments are slightly constricted centrally; there are about twenty-five arms; the IIIBr series are developed in all cases internally instead of externally, as usual in the species; P_2 is long, stiff and spinelike, with about sixteen segments. *Stephanometra indica* might aptly be described as *S. monacantha* with P_2 much elongated and more delicate and flagellate distally.

Subfamily MARIAMETRINÆ.

Genus DICHROMETRA A. H. Clark.

DICHROMETRA PROTECTUS (Lütken).

Antedon protectus LÜTKEN, *Mus. Godeffroy Cat.*, vol. 5, 1874, p. 190 (*nomen nudum*).—LÜTKEN, in P. H. CARPENTER, *Trans. Linn. Soc. (Zool.)*, (2) vol. 2, 1879, p. 19.

Antedon imparipinna P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 502.—CHADWICK, Journ. Linn. Soc. (Zool.), vol. 31, 1908, p. 46.

Dichrometra protectus A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 13; Vid. Medd. fra den naturhist. Forening i København, 1909, p. 172.

Localities.—Suez Bay; Suakim Harbor.

This species ranges eastward to Hongkong, the Philippines, Fiji, and Tonga.

DICHROMETRA PALMATA (J. Müller).

?*Caput-Medusæ cinereum* LINCK, De stellis marinis, 1733, p. 57, pl. 21, No. 33.

Comatula leucomelas (Rüppel MS.) LEUCKART, Zeitschr. für organ. Physik, vol. 3, 1833, Heft 4, pp. 387, 390 (*nomen nudum*).

Alecto palmata J. MÜLLER, Archiv für Naturgesch., 1841, Heft 1, p. 144.

Comatula scita Paris Museum MS.—DUJARDIN and HUPÉ, Hist. nat. des zoophytes; échinodermes, 1862, p. 208.

Comatula palmata VON MARTENS, in von der Decken's Reise in Ost-Africa, vol. 3, 1869, p. 129.

Antedon palmata BELL, Proc. Zool. Soc. London, 1882, pp. 533, 534.—HARTLAUB, Nova Acta Acad. German., vol. 58, 1891, No. 1, p. 49.—CHADWICK, Journ. Linn. Soc. (Zool.), vol. 31, 1908, p. 47.

Antedon leucomelas (Rüppel MS.) HARTLAUB, Nova Acta Acad. German., vol. 58, 1891, No. 1, p. 51.

Dichrometra palmata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 13.

Localities.—"Red Sea;" coral reef of Misharif Island, Khor Don-gola; between tide marks at Suez.

This species ranges eastward to the Tonga Islands.

Depth.—Littoral.

DICHROMETRA (? species).

Locality.—Cape St. André, Madagascar; Zanzibar.

Depth.—About 30 meters.

Remarks.—In the Paris Museum there are two young examples of some species of *Dichrometra* from Madagascar. One specimen has exactly twenty arms, one III Br series being present and one II Br series absent; the other also has about twenty arms. The species represented is related to *D. palmata*, though apparently different. There is a similar specimen in the British Museum from Zanzibar.

DICHROMETRA (? species).

Locality.—Zanzibar.

Remarks.—The British Museum contains a young specimen of some species of *Dichrometra*, near *D. flagellata*, from Zanzibar.

DICHROMETRA KLUNZINGERI (Hartlaub).

Antedon klunzingeri HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 175; Nova Acta Acad. German., vol. 58, 1891, No. 1, p. 46, pl. 2, figs. 22, 25.

Dichrometra klunzingeri A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 13.

Locality.—Koseir; Ras-el-Millan, Red Sea.

Depth.—Littoral.

DICHROMETRA FLAGELLATA (J. Müller).

Alecto flagellata J. MÜLLER, Archiv für Naturgesch., 1841, Heft 1, p. 145.

Antedon flagellata LUDWIG, Senck. naturforsch. Ges., vol. 21, 1899, Heft 4, p. 538.

Dichrometra flagellata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 13.

Localities.—Reef opposite the harbor of Lamu; Zanzibar.

Depth.—Littoral.

This species ranges eastward to Singapore, New Guinea, and Amboina.

Family COLOBOMETRIDÆ.

Genus CENOMETRA A. H. Clark.

CENOMETRA EMENDATRIX (Bell).

Antedon emendatrix BELL, Ann. and Mag. Nat. Hist., (6) vol. 9, 1892, p. 428, pl. 18.

Antedon spicata BELL, Trans. Linn. Soc. (Zool.), (2), vol. 13, 1909, pt. 1, p. 20.

Description.—Centrodorsal low hemispherical or thick discoidal, the sides strongly inclined, about 4 mm. in diameter; dorsal pole very slightly concave, small; cirrus sockets arranged in two crowded and irregular rows.

Cirri XVIII, 28-33 (usually nearer the latter), comparatively slender, 15 mm. to 20 mm. long; first cirrus segment short, the following gradually increasing in length to the fourth which, with the following, is about half again as broad as long; the penultimate and antepenultimate segments are about as long as broad; after the eighth the distal dorsal edge begins to project slightly, this projection after the sixteenth becoming a pair of small, though prominent, dorsal spines situated close together, one on either side of the median line; on the antepenultimate segment only a single median small spine is found; in the terminal third of the cirrus the paired dorsal spines, which at first were near the distal dorsal edge of the segments, have moved to a median position; opposing spine long and prominent, reaching somewhat over half the diameter of the penultimate segment in height, arising from nearly or quite the entire dorsal surface of that segment, the apex subterminal or median; terminal claw about as long as the penultimate segment, rather stout basally, but abruptly decurved and comparatively slender in its distal half.

Radials four or five times as broad as long, their interior angles slightly separated; IBr_1 oblong, twice as broad as long; IBr_2 (axillary) nearly or quite as long as broad, pentagonal, with a slight transverse median constriction; $IIBr_2$, resembling the IBr ; the division series and first brachials bear comparatively short, though thick, ventrolateral processes; the division series are well separated.

Seventeen arms 90 mm. long, comparatively slender and delicate, increasing slightly in width to the twelfth or fourteenth brachials, then gradually tapering distally; first two brachials subequal, wedge-shaped, about twice as broad as long exteriorly, the first interiorly

united for about the proximal two-thirds; third and fourth brachials (syzygial pair) slightly longer than broad to slightly broader than long; following three to five or six brachials oblong, about twice as broad as long, then becoming very obliquely wedge-shaped, almost triangular, half again as broad as long, and in the distal part of the arm nearly or quite as broad as long; there is a slight development of small spines along the distal edges of the brachials. Syzygies occur between the third and fourth brachials, again between the twenty-first and twenty-second to thirtieth and thirty-first, and distally at intervals of from nine to twenty-five (usually about fourteen) oblique muscular articulations.

P_1 small, slender, and weak, 5 mm. or 6 mm. long, with 18 or 20 segments, of which the second, third, and fourth bear broad carinate processes; first four segments broader than long, the fifth about as long as broad, the following slightly longer than broad, becoming about half again as long as broad distally; P_2 stout and stiff, 9 mm. long, with fifteen to eighteen segments, and much the largest pinnule on the arm, though not nearly so stout as in most of the allied species; the first two or three segments are broader than long, the following about as long as broad, distally slightly longer than broad; the distal ends of the segments are slightly produced and finely spinous, especially in the outer part; following pinnules small and weak, 4 mm. long, with eleven segments, the first two broader than long, the third about as long as broad, the following slowly increasing in length, becoming half again as long as broad distally; distal pinnules very slender, 9 mm. long, with twenty segments, which become twice as long as broad or somewhat longer distally.

The color is purple, the cirri and P_2 yellow, the remaining pinnules white.

Localities.—Mauritius; Seychelles.

Depth.—Littoral, and down to 39 fathoms.

Remarks.—This redescription is based upon a fine specimen in the Berlin Museum. The whole animal is very slender, which, with the strong carination of the lower pinnules, makes this species an easy one to recognize.

A fine series of eight specimens, four from Mauritius (the types) and four from the Seychelles (*Sea Lark* expedition) show that the arms vary from twelve to twenty-two in number, though the former is only found in young examples; the usual number appears to be between fifteen and twenty. The arm division is always external as in the other species of *Cenometra*. The arms are from 90 mm. to 100 mm. long. The cirri are XIV–XX, 32–41 (usually about 35); P_2 is, for the genus, comparatively slender, and possesses from nineteen to twenty-one segments. The strong carination of the earlier segments of the proximal pinnules make this species an easy one to recognize.

Genus COLOBOMETRA A. H. Clark.

COLOBOMETRA CHADWICKI, new species.

Antedon serripinna CHADWICK, Journ. Linn. Soc. (Zool.), vol. 31, 1908, p. 44 (Suez Bay).

? *Oligometra serripinna* A. H. CLARK, Amer. Naturalist, vol. 43, 1909, p. 255.

Description.—Centrodorsal thin discoidal, the polar area broad and flat, 2 mm. in diameter; cirrus sockets arranged in a single closely crowded marginal row.

Cirri XVI, 22–24, 12 mm. to 14 mm. long; first segment short, the following gradually increasing in length to the third or fourth which, with the remainder, is about as long as broad; second and following segments with the distal dorsal edge produced into a finely spinous transverse ridge which gradually becomes crescentic, in dorsal view, then V-shaped, on the tenth segment parting in the middle and on the last four or five before the antepenultimate becoming a pair of small erect median spines; antepenultimate segment with a single median spine; the dorsal processes are rather high, reaching about one-quarter of the lateral diameter of the segments; opposing spine large and prominent, triangular, terminal, arising from the whole dorsal surface of the penultimate segment, and one-half as high as that segment; terminal claw slightly longer than the penultimate segment, stout, strongly curved basally, but becoming straighter distally; the distal ventral edge of the cirrus segments is slightly produced and very finely spinous.

Radials even with the edge of the centrodorsal; IBr_1 oblong, slightly over twice as broad as long, not in contact basally; IBr_2 long, pentagonal, about as long as broad, the lateral edges nearly or quite as long as those of the IBr_1 .

Ten arms about 90 mm. long; first two brachials subequal, slightly wedge-shaped, the first about twice as broad as the median length, interiorly united for its proximal half or two-thirds, the distal halves of the inner edge diverging at a right angle; the second is somewhat longer; third and fourth (syzygial pair) about as long as broad; following five or six approximately oblong, about twice as broad as long, then becoming triangular, as long as broad, and distally wedge-shaped, about as long as broad, longer than broad terminally; IBr series and brachials in the proximal fourth of the arm with a faint narrow median keel; proximal triangular brachials with slightly produced distal ends.

P_a absent; P_1 7.5 mm. to 8 mm. long, very slender, evenly tapering from the base to the tip with sixteen segments, the first broader than long, the second about as long as broad, the following gradually increasing in length, after the seventh being three times as long as broad; the outer segments have slightly spinous distal ends; P_2

13 mm. long, slender (though stouter than P_1), especially distally, with twenty or twenty-one segments, the first not quite so long as broad, the second slightly longer than broad, the following increasing in length, so that the fourth and following are between two and five times as long as broad; fourth or fifth and following segments with the distal edge and the distal ventro-lateral border prominently everted and spinous as in the other species of the genus, though the production is not quite so much as usual; the dorsal (outer) portion of the outer edge of the segments is not produced; P_3 7.5 mm. long, as slender as P_1 but stiffened, with fifteen segments resembling those of P_2 ; P_4 6.5 mm. long, with sixteen segments, resembling P_3 , though slightly more slender; P_5 6 mm. long, slightly more slender and less stiffened than P_4 , but with the same number of segments; following pinnules resembling P_5 , soon slowly increasing in length, slenderness, and length of the component segments.

The color is deep violet, with the cirri a purplish flesh color.

Locality.—Suez Bay; the type is Cat. No. 27509, U.S.N.M.

Depth.—10 fathoms.

Genus DECAMETRA A. H. Clark.

DECAMETRA MÖBIUSI, new species.

Description.—Centrodorsal small, thin-discoidal; cirrus sockets arranged in a single, somewhat irregular, marginal row.

Cirri XIV, 14-16, 7 mm. long; first segment short, the following gradually increasing in length to the sixth, which, with the following, is about as long as broad; on the fourth a slight projection of the distal dorsal edge begins to appear; this moves progressively anteriorly, on the ninth and following becoming a low, short transverse median ridge, appearing as a small spine in lateral view, and on the last two or three segments a small median spine; opposing spine median in position, slender and sharp, much longer than the processes on the preceding segments, in height equal to about half the diameter of the penultimate segment; opposing spine longer than the penultimate segment, stout and comparatively slightly curved basally, but becoming more slender and more strongly curved in the distal half.

Radials projecting slightly beyond the centro-dorsal, the distal interradial angles widely separated; IBr_1 oblong, about two and one-half times as broad as long; IBr_2 (axillary) broadly pentagonal, about twice as broad as long.

Ten arms 50 mm. long, resembling those of *C. studeri*.

P_1 4.5 mm. long, slender, evenly tapering, and becoming flagellate distally with about thirteen segments, the first short, the second and third about as long as broad, the following gradually increasing in length, becoming about twice as long as broad distally, but shorter

again terminally; P_2 5 mm. long, stouter and stiffer than P_1 (the largest pinnule on the arm), with eleven or twelve segments; first segment about twice as broad as long, second almost or quite as long as broad, the following gradually increasing in length, being twice as long as broad in the distal half of the pinnule; the distal edges of the second and following pinnule segments are slightly everted and finely spinous, and the dorsal distal angles of the segments are produced in the form of a short blunt process tipped with a tuft of fine spines; P_3 3 mm. long, with about twelve segments proportioned as in P_2 ; the pinnule is slightly less stout basally than P_1 , and is shorter, weaker, and more slender than that pinnule; following pinnules similar, soon gradually increasing in length and becoming more slender, the distal pinnules being about 6 mm. long with about eighteen much elongated segments, and exceedingly slender.

The color is light yellowish, the primibrachs, a narrow band at the level of the second syzygy, and a few ill-defined bands in the distal portion of the arms, purple; perisome brown; cirri and P_2 straw yellow.

Locality.—Mauritius; the type, which is in the Berlin Museum, was collected by Prof. K. Möbius.

DECAMETRA MODICA, new species.

Description.—Centrodorsal small, discoidal, with a very small dorsal pole; cirrus sockets arranged in two closely crowded irregular rows.

Cirri XIV–XVI, 16–20, 8 mm. long; first segment short, the following slowly increasing in length and becoming terminally about as long as broad; third and following with slightly produced distal dorsal edges which gradually become narrower and move to a more central position, on the last five or six segments preceding the penultimate becoming a very small sharp median spine; opposing spine prominent, sharp, slender, subterminal, directed obliquely forward, much larger than the spines on the preceding segments, in height equal to one-half the lateral diameter of the penultimate segment.

Radials short, about two and one-half times as broad as long; IBr_1 oblong, rather more than twice as broad as long; IBr_2 pentagonal, broader than long, the distal edges slightly thickened.

Ten arms 35 mm. to 40 mm. long, resembling those of *D. informis*, but the brachials are slightly longer.

P_1 3.5 mm. long, with eleven or twelve segments, the first short, the second about as long as broad, the following slowly increasing in length and becoming three times as long as broad terminally; the pinnule is comparatively stout and resembles P_2 , though, in direct proportion to its lesser length, smaller; P_2 4.5 mm. long with thirteen segments, the first short, the second about as long as broad, the following gradually increasing in length and becoming twice as long as broad distally; third and following segments with slightly projecting

and finely spinous distal edges, especially along the thin ventral distal border; P_3 3 mm. long, much smaller and weaker and much less stiff than P_1 , with ten segments; following pinnules similar, slowly becoming longer and more slender, the component segments slowly increasing in length; distal pinnules very slender, 5 mm. long.

The color is light pinkish narrowly and sparsely banded with deep purple, or entirely deep purple.

Locality.—Bagamoyo, German East Africa.

DECAMETRA ALAUDÆ, new species.

Description.—Cirri XV, 26, small and slender, all the segments subequal, about twice as broad as long.

Ten arms, 90 mm. long resembling those of *D. taprobanes*, to which this species appears to be most closely related.

P_a absent; P_1 slender and flagellate, 8 mm. long with 21 squarish segments; P_2 much larger, stouter, and stiffer, 11 mm. long, tapering very gradually, with 16 segments, the fifth-seventh half again as long as broad, the remainder squarish or broader than long; from the fourth outward the segments have projecting distal edges and distal angles so that the pinnule as a whole reminds one strongly of P_2 in the genus *Cenometra*; P_3 is similar to P_2 but smaller and much more slender and flagellate distally, 10 mm. long, with 19 segments; P_4 and the following pinnules are 6 mm. long, small, weak, and slender; the distal pinnules are very slender, 10 mm. long.

Locality.—Cargados Carajos; the type, which is in the British Museum, was collected by Prof. J. Stanley Gardiner on the *Sea Lark* expedition. Another specimen from the same locality is probably referable to this species, though P_2 is more slender.

Depth.—30 fathoms.

Genus OLIGOMETRA A. H. Clark.

OLIGOMETRA SERRIPINNA, var. OCCIDENTALIS, new variety.

Antedon serripinna P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, 1881, p. 182.—HARTLAUB, Nova Acta Acad. German., vol. 58, 1891, No. 1, p. 82, pl. 5, fig. 48.

Oligometra serripinna A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126.

Locality.—Mauritius; Cargados Carajos.

Depth.—Littoral, and down to 30 fathoms.

Remarks.—The single specimen before me from Mauritius has the arms about 55 mm. long and the cirri XVI, 17, 9 mm. long. P_2 is 7 mm. long, with about fifteen segments.

The lower pinnules of this specimen exhibit almost none of the peculiar expansion of the distal ends of the segments from which this species gets its name, there being merely a small process ending in a

tuft of very fine spines at the three distal angles. This character, however, is very variable, and I find that I can match this specimen fairly well with some from Singapore in the collection of the Copenhagen Museum and with those from India in the collection of the Indian Museum. The cirri are proportionately slightly longer than usual, but here again it agrees with other specimens from India and Singapore. In these two features it represents rather an extreme type, and it may be that additional material will show the existence on Mauritius of a peculiar species, a localized offshoot from the *O. serripinna* stock.

Nine specimens in Prof. J. Stanley Gardiner's collection from Cargados Carajos which I recently examined at the British Museum are similar to the preceding. The cirri are XIV–XVII, 18–22 (usually 19–20), the distal segments being about as long as broad. P_2 is much larger than P_1 or P_3 and has nineteen segments, most of which are about as long as broad, or slightly longer than broad. The lateral processes at the distal ends of the outer pinnule segments are only slightly evident; the segments of the pinnules succeeding P_2 have rather strongly projecting distal edges and angles. The arms are from 70 mm. to 80 mm. long.

For the present it would be convenient to distinguish this form as var. *occidentalis*.

Family TROPIOMETRIDÆ.

Genus TROPIOMETRA A. H. Clark.

TROPIOMETRA CARINATA (Lamarck).

?*Alecto carinata* LEACH, Zool. Misc., vol. 2, 1815, p. 63.

Comatula carinata LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 535.—MICHELIN, Revue et mag. de zool., 1845, p. 27.—VON MARTENS, in von der Decken's Reise in Ost-Africa, vol. 3, 1869, p. 129.—POURTALÈS, Bull. Mus. Comp. Zool., vol. 5, 1878, No. 9, p. 214.

Comatula bicolor DUJARDIN and HUPÉ, Hist. nat. des zoophytes; échinodermes, 1862, p. 208.

Actinometra solaris VON MARTENS, von der Decken's Reise in Ost-Africa, vol. 3, 1869, p. 129.

Antedon carinata (part) P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 199 (but not pl. 34).

Antedon capensis BELL, Marine Investigations in South Africa, vol. 4, 1905, p. 139, pl. 2.

Tropiometra carinata A. H. CLARK, Smiths. Misc. Coll. (Quarterly Issue), vol. 50, 1907, pt. 3, p. 349.

Localities.—Seychelles; Mascarine Islands; Zanzibar; Mauritius; Madagascar; Saya de Malha;¹ Cargados Carajos; north reef, Farquhar Atoll; the following localities in South Africa: off Algoa Bay, close

¹ This locality is given by Bell as "Sd M. 300-500;" the solution of this missing word puzzle as given in the key is "Saya de Malha, 55 fathoms." What is the significance of the "300-500?"

to Riy Bank (lat. $33^{\circ} 58' S.$; long. $25^{\circ} 51' 30'' E.$); Tugela River mouth bearing NW. by W., $3\frac{1}{2}$ miles distant; Rocky Bank, False Bay; Dumford Point bearing NE by E., 9 miles distant.

Depth.—Littoral, and down to 30 fathoms.

Bottom.—Reefs; rocks; rocks and coral; sand and shell; dark sand, black specks, and rocks.

TROPIOMETRA PICTA (Gay).

?*Alecto carinata* LEACH, Zool. Misc., vol. 2, 1815, p. 63.

Comatula picta GAY, Historia física y política de Chile, vol. 8, 1854, p. 429.—DUJARDIN and HUPÉ, Hist. nat. des zoophytes; échinodermes, 1862, p. 208.

Antedon braziliensis (LÜTKEN MS.) VERRILL, Trans. Conn. Acad. Sci., vol. 1, 1867, p. 341 (*nomen nudum*).—RATHBUN, Trans. Conn. Acad. Sci., vol. 5, 1879, p. 156.

Antedon carinata (part) P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 199, pl. 34, figs. 1-7.

Antedon dübeni (part) P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 181, pl. 37, fig. 1 (but not figs. 2, 3).

Tropiometra braziliensis A. H. CLARK, Smiths. Misc. Coll. (Quarterly Issue), vol. 50, pt. 3, 1907, p. 349.

Locality.—St. Helena.

Remarks.—The specimen obtained by the *Challenger* at Bahia in 20 fathoms and referred by Carpenter to Böhlische's *Antedon dübeni* is also of this species.

Gay has described, under the name of *Comatula picta*, a new species of *Tropiometra* from Chile. I have examined his specimens in Paris and find that they are of the common Brazilian species. He says:

C. radii incassatis, pinnatis decem, dorso obsolete carinatis et tuberculatis; cirrhis dorsilibus 24; brachiis in pinnulis rubro et fusco articulatis.

Especie de radios espesos, articulados, en número de diez, cargados de pínulas bastante delgadas; estos radios llevan en el medio de su faz dorsal una carena poco marcada, sobre la cual existe una sene de tuberculillos salientes y puntuados. Los brazos ó las cirras dorsales son delgados, articulados, desiguales y en número de veinte y cuatro. Toda la extension del brazo y de las cirras dorsales está como articulada por manchas anulares, alternativamente encarnadinas y pardas.

Esta linda especie de Comátula es hasta cierto punto vecina del *C. carinata* Lamk. Sus brazos ó radios son espesos y carnosos como en esta especie, pero difiere de ella por su coloracion sumamente elegante, que consiste en manchas anulares de un bruno encarnadino el cual cubre toda la estension de los radios y de las pínulas. Se halla en Chile.

Gay's original specimens are in the Paris Museum, and were in 1862 listed by Dujardin and Hupé in their monograph under the name of *Comatula picta*. This name was originally proposed by Valenciennes, and subsequently adopted by Gay. Gay did not find the species in Chile himself, but merely recorded in his work some specimens he found in the Paris Museum labeled as from Chile while he was engaged in writing his history. The coast of Chile has been carefully searched by zoölogists over and over again, and no one who has been in that country ever mentioned the occurrence of crinoids

(other than *Helioметра*) there from personal observation. Dr. Carlos Porter, of Santiago, assures me that they are never found there. We must conclude, therefore, either that Valenciennes' specimens were wrongly labeled, or that some other Chile is meant.

The *Antedon braziliensis* proposed, but not described, by Lütken, which is the same thing as Gay's *Comatula picta*, and subsequently compared in considerable detail, with Lamarck's *Comatula carinata* by Rathbun has never been recognized; it is a perfectly good species, however, as I have recently been able to assure myself, most obviously differing from *carinata* in the greater length of the outer cirrus segments.

TROPIOMETRA ENCRINUS, new species.

Comatula, sp. AUDOUIN, in SAVIGNY, Description de l'Égypte, 1817, p. 205, pl. 1.

Alecto encrinus LÜTKEN MS.

? *Antedon*, sp. MOSELEY, Quart. Journ. Micr. Sci., vol. 17, 1877, p. 8.—MAC MUNN, Quart. Journ. Micr. Sci., vol. 30, 1890, p. 55.

Antedon marmorata P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 202 (*nomen nudum*).

Antedon carinata (part) (not of Lamarck) P. H. CARPENTER, Challenger Reports, vol. 26, Zoology, 1888, p. 199.

Localities.—"Red Sea;" Aden; ? Suez.

This species ranges eastward to the South Sea Islands and the east coast of Asia; it appears to be generally rare, though common about Ceylon.

Remarks.—I am not absolutely certain that the Red Sea specimens of *Tropiometra* should be referred to this species, as I have never been able to examine any of large size, but they seem to be nearer *encrinus* of corresponding size than to any other form.

Tropiometra encrinus, while having the same number of cirrus segments as *T. carinata* and *T. picta*, has proportionately longer and stouter cirri, the stoutness being especially noticeable distally. Owing to the increased size of the cirri as a whole, the proportions of the segments are the same as in *T. picta*.

Family THALASSOMETRIDÆ.

Subfamily THALASSOMETINÆ.

Genus CROTALOMETRA A. H. Clark.

CROTALOMETRA MAGNICIRRA (Bell).

Antedon magnicirra BELL, Marine Investigations in South Africa, vol. 4, 1905 p. 141, pl. 4.

Crotalometra magnicirra A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 80.

Localities.—Buffalo River, East London, bearing NW. $\frac{1}{2}$ W., 19 miles distant; the same landmark bearing N. 15 miles distant; East London bearing NW. $\frac{1}{2}$ N., approximately 20 miles distant (Bell).

Depth.—300–450 fathoms.

CROTALOMETRA PORRECTA (P. H. Carpenter).

Antedon porrecta P. H. CARPENTER, *Challenger Reports*, vol. 26, Zoology, 1888, p. 250, pl. 52, figs. 3-5.

Antedon (Crotalometra) porrecta KÆHLER and VANEY, *Bull. du mus. d'hist. nat.*, 1910, No. 1, p. 32.

Locality.—Near Ascension Island (lat. $7^{\circ} 54' 20''$ S.; long. $14^{\circ} 28' 20''$ W.).

Depth.—420 fathoms.

Bottom.—Volcanic sand.

Remarks.—MM. Kœhler and Vaney record this species from the Bay of Biscay (lat. $45^{\circ} 19' N.$; long. $6^{\circ} 29' W.$) in 1,480 meters; it thus probably occurs on the coast of Morocco.

CROTALOMETRA FLAVA (Kœhler).

Antedon flava KÆHLER, *Rev. biol. du nord de la France*, vol. 7, 1895, p. 475.

Antedon (Crotalometra) flava KÆHLER and VANEY, *Bull. du mus. d'hist. nat.*, 1910, No. 1, p. 31.

Locality.—South of the Canary Islands (lat. $25^{\circ} 39' N.$; long. $18^{\circ} 22' W.$).

Depth.—882 meters.

This species was, previous to 1910, only known from the Bay of Biscay, where the type was dredged by the *Caudan* in 1,480 meters.

Genus THALASSOMETRA A. H. Clark.

THALASSOMETRA LUSITANICA (P. H. Carpenter).

Antedon lusitanica P. H. CARPENTER, *Proc. Roy. Soc. Edinburgh*, vol. 12, 1884, p. 368; *Challenger Reports*, vol. 26, Zoology, 1888, p. 109, pl. 39, figs. 1-3; *Journ. Linn. Soc. (Zool.)*, vol. 24, 1892, p. 65.—KÆHLER, *Échinodermes provenant des campagnes du yacht Princesse-Alice*, 1909, p. 267, pl. 1, figs. 7, 8; pl. 32, figs. 12-14.

Thalassometra lusitanica A. H. CLARK, *Smiths. Misc. Coll. (Quarterly Issue)*, Issue, vol. 50, 1907, pt. 3, p. 360.

Antedon (Crotalometra) lusitanica KÆHLER and VANEY, *Bull. du mus. d'hist. nat.*, 1910, No. 1, p. 31.

Localities.—Madeira; from the Brazilian cable, near Funchal; south of Funchal (lat. $32^{\circ} 39' 20'' N.$; long. $16^{\circ} 40' 55'' W.$; lat. $32^{\circ} 32' 30'' N.$; long. $17^{\circ} 02' W.$; and lat. $32^{\circ} 34' N.$; long. $17^{\circ} 02' 45'' W.$); off the southeast coast of Teneriffe, Canary Islands (lat. $28^{\circ} 04' N.$; long. $16^{\circ} 49' 30'' W.$); near Mogador, Morocco (lat. $31^{\circ} 43' 30'' N.$; long. $10^{\circ} 46' 45'' W.$); between Madeira and Morocco (lat. $33^{\circ} 17' N.$; long. $11^{\circ} 23' W.$).

Depth.—900-2,165 meters.

THALASSOMETRA OMISSA (Kœhler).

Antedon omissa KÆHLER, *Échinodermes provenant des campagnes du yacht Princesse-Alice*, 1909, p. 268, pl. 33, fig. 10.

Locality.—Off the southeastern coast of Teneriffe, Canary Islands.

Depth.—1,330-1,349 meters.

THALASSOMETRA MULTISPINA (P. H. Carpenter).

Antedon multispina P. H. CARPENTER, *Challenger Reports*, vol. 26, Zoology, 1888, pp. 117, 241, 248, pl. 13, figs. 1-3; pl. 14, figs. 5-7; pl. 69, figs. 1-4.

Thalassometra multispina A. H. CLARK, *Smiths. Misc. Coll.* (Quarterly Issue), vol. 50, 1907, p. 360.

Locality.—Near Ascension Island (lat. $7^{\circ} 54' 20''$ S.; long. $14^{\circ} 28' 20''$ W.).

Depth.—420 fathoms.

Bottom.—Volcanic sand.

COSMIOMETRA GARDINERI, new species.

Description.—This species is most closely related to *C. woodmasoni*, with the type of which I was able to compare it directly. The cirri are longer and more slender than in that form, 30 mm. long with 29-31 segments which are proportionately longer.

Twenty arms; the carination of the division series is broader than in *woodmasoni*; the lower brachials have a broad median keel quite different from the faintly indicated crest of *woodmasoni*; the outer brachials are very strongly overlapping and broadly carinate, the raised portion, when viewed dorsally, having a triangular shape, the apex of the triangle being proximal. The same type of carination is found in *woodmasoni*, but the triangles are narrower.

Locality.—Saya de Malha; the type, which is in the British Museum, was collected by the *Sea Lark* expedition under Prof. J. Stanley Gardiner.

Depth.—135 fathoms.

Subfamily CHARITOMETRINÆ.

Genus PACHYLOMETRA A. H. Clark.

PACHYLOMETRA SCLATERI (Bell).

Antedon sclateri BELL, *Marine Investigations in South Africa*, vol. 4, 1905, p. 140, pl. 3.

Pachylometra sclateri A. H. CLARK, *Proc. Biol. Soc. Washington*, vol. 22, 1909, p. 20.

Locality.—East London bearing NW. $\frac{1}{2}$ N., 18 miles distant.

Depth.—250-300 fathoms.

Suborder MACROPHREATA.

Family ANTEDONIDÆ.

Subfamily ANTEDONINÆ.

Genus ANTEDON de Fréminville.

ANTEDON BIFIDA (Pennant).

Δεκάκνυμος rosacea LINCK, *De stellis marinis*, 1733, p. 55, pl. 37, fig. 66 (based upon the *Decempeda cornubiensium* of Lhuyd, 1699).

Asterias bifida PENNANT, British Zoology, vol. 4, 1777, No. 70.

Antedon rosacea P. H. CARPENTER, Zool. Anzeiger, Jahrg. 4, 1881, p. 521; *Challenger* Reports, vol. 26, Zoology, 1888, pp. 355, 377.—J. BARROIS, Rev. biol. du nord de la France, vol. 1, 1889, pp. 32, 33.

Antedon bifida BELL, Ann. and Mag. Nat. Hist., (6) vol. 4, 1889, p. 432.

Locality.—Azores (common); Bay of San Pedro (abundant); Algiers; Tangier; Morocco; Madeira.

Remarks.—There are three specimens of this species in the Copenhagen Museum collection which were collected at Tangier; one of them has the arms about 60 mm. long, rather stout, and cirri XXXV, 13–15 (usually 15) about 12 mm. long; P_1 is 12 mm. long with twenty-five segments, and P_2 5 mm. long with sixteen segments; the production of the distal ends of the segments of the proximal pinnules is marked; another is similar, with arms 60 mm. long and cirri XXX, 14–16; it has eleven arms, one of the IBr axillaries (the right posterior) bearing on the right (i. e., anterior) side a single axillary; the third specimen is similar to these, but smaller, with arms only 40 mm. long.

In general structure and in the details of the arms, especially the arm bases and the IBr series, these animals appear to be identical with a series at hand from southern England and the Channel Islands; moreover, there are the same small clusters of perisomic interradials in each interradial angle. A specimen from Plymouth, England, so far as I can see, matches them exactly in all respects.

It was somewhat of a surprise to me to find this species at Tangier, south of the Straits of Gibraltar, instead of the quite different *A. mediterranea*. It is more surprising still to find an example with eleven arms showing a physiological similarity as well as a similarity in form between specimens from England and from Africa; for of the four species of *Antedon*, *A. bifida* is the only one which, so far as known, ever exhibits any tendency toward an increase in the number of the arms over the primitive ten.

But the most curious fact of all is that it is this species and not *A. mediterranea* which occurs at Algiers. I have recently examined five specimens and several pentacrinoids from that locality which are in the Paris Museum. They resemble closely those from Tangier just described, but the cirri are XXIV–XXX, 12–14 (usually 13–14).

Carpenter has recorded "*Antedon rosacea*" from Madeira. While his specimens probably are of the present species, there is a possibility that they are in reality *Antedon hupferi*.

ANTEDON MEDITERRANEA (Lamarck).

Δεκάκνυμος crocea LINCK, De stellis marinis, 1733, p. 53 (based upon the *δεκαδασυακτινοειδής* of Columna, 1592).

Δεκάκνυμος barbata LINCK, De stellis marinis, 1733, p. 55, pl. 37, fig. 64 (based upon the *Δεκάκνυμος fimbriata* of Barrelier, 1714).

Comatula mediterranea LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 535.

Antedon rosacea (part) P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 441; Zool. Anzeiger, Jahrg. 4, 1881, p. 521; *Challenger* Reports, vol. 26, Zoology, 1888, pp. 355, 377.

Antedon mediterranea A. H. CLARK, Vid. Medd. fra den naturhist. Forening i København, 1909, pp. 120, 128.

Locality.—Bay of Benzert (Bizerta), Tunis.

Depth.—50–100 fathoms.

Remarks.—It is not absolutely certain that this is the species represented by the specimens dredged by the *Porcupine* off the coast of Tunis, though it seems most probable that this determination is correct. There is a possibility that *A. adriatica*, *A. bifida*, or even an undescribed form may occur in these waters. *A. mediterranea* is found on the European side of the Mediterranean as far east as the Cyclades, from which islands I have seen a specimen in the Bergen Museum.

ANTEDON HUPFERI (Hartlaub).

Antedon rosacea GREEFF, Zool. Anzeiger, Jahrg. 5, 1882, pp. 116, 159.

Antedon hupferi HARTLAUB, Nachr. Ges. Göttingen, Mai, 1890, p. 171; Nova Acta Acad. German., vol. 58, 1891, No. 1, p. 88, pl. 5, figs. 53, 59.

Locality.—Isla das Rolas (near São Thomé); Wapoo, Ivory Coast; Gorée, Sénégal; Canary Islands; Madeira.

Depth.—13–21 fathoms.

Remarks.—The *Challenger* specimen of "*Antedon dübenii*" described and figured by Carpenter is an example of *Tropiometra picta*. He unhesitatingly identified with "*Antedon dübenii*" as he understood it the specimens secured at Rolas by Professor Greeff, and some others from Madeira which he obtained from Professor Lovén and from Mr. J. Y. Johnson of Funchal; at the same time he expresses the belief that this species is only a synonym of *Antedon bifida*.

In view of all this it is rather uncertain just what the Canary and Madeira specimens can be; they are "unquestionably identical with those from Brazil," but the latter represent two species. Taking everything together, however, it would seem that the species with which he intended to compare these specimens was the one described by Böhlische, or else he certainly could not have remarked on their similarity to *Antedon bifida*.

Genus IRIDOMETRA A. H. Clark.

IRIDOMETRA MAURITIANA, new species.

Description.—Centrodorsal low-hemispherical, the slightly concave dorsal pole 1 mm. in diameter; cirrus sockets arranged in approximately four closely crowded alternating rows, the most proximal with about four cirrus sockets to each radial area.

Cirri XXX–XLV, 10–13 (usually 11–12) 9 mm. to 11 mm. long; first segment short, second not quite so long as broad, third twice as long as broad, fourth about two and one-half times as long as the proximal diameter; following segments gradually decreasing in length so that the penultimate is less than one-third again as long as broad; the elongated lower segments are slightly constricted centrally, and the distal half of the cirrus is rather strongly flattened laterally; opposing spine prominent, though small, sharp, sub-terminal, more or less erect; terminal claw slightly longer than the penultimate segment, rather stout and rather strongly curved.

Radials even with the edge of the centrodorsal; IBr_1 exceedingly short and bandlike; IBr_2 triangular, twice as broad as long, the anterior angle sharp, the middle of the posterior margin somewhat produced proximally, the lateral angles extending considerably beyond the anterolateral angles of the IBr_1 .

Ten arms 30 mm. to 45 mm. long; first brachial very short, somewhat shorter interiorly than exteriorly, interiorly united basally; second brachial much larger, irregularly quadrate; third and fourth brachials (syzygial pair) somewhat longer interiorly than exteriorly, about twice as broad as the interior length; following four brachials approximately oblong, about three times as broad as long, then soon becoming triangular, about as long as broad, and in the outer part of the arm wedge shaped and longer than broad.

Syzygies occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of three oblique muscular articulations.

P_1 small and slender, but somewhat stiffened, tapering evenly and rather rapidly, 3.5 mm. long with twelve segments, most of which are considerably elongated; P_2 similar, but somewhat smaller and more slender, 2.7 mm. long with eleven segments; P_3 6 mm. to 7 mm. long with eighteen to twenty segments, slender and flagellate; P_4 4 mm. long with thirteen segments, shorter than those of P_3 ; following pinnules slowly increasing in length, the distal pinnules being 6 mm. to 7 mm. long and exceedingly slender.

Locality.—Mauritius; the type, which is No. 5349 (part) Berlin Museum, was collected by Professor Möbius.

Madagascar; a specimen in the Paris Museum was collected here by M. Grandidier in 1905.

Remarks.—This species is most nearly related to *I. nana* of the East Indies, but may at once be distinguished by its much stouter cirri, the component segments of which are much less constricted centrally, and by the larger P_1 , which is considerably stiffened.

I had been aware of the occurrence of some species of this genus on Mauritius for some time before I was able to examine any speci-

mens, and in reviewing Mr. Chadwick's paper upon the Red Sea crinoids I mentioned that the *I. nana* group of species occurred there, for three years ago, while at Cambridge, I had been permitted to look over the letters sent by Capt. Nicholas Pike to Prof. Louis Agassiz while the former was United States consul at Mauritius. In one of these letters Captain Pike, in his usual charming style, describes a little crinoid which he found on the reef near Port Louis (about 1867), but which broke all up so that he could not preserve it. However he made a color sketch of it, and this I was able to recognize as being of a species near *I. nana*.

IRIDOMETRA ÆGYPTICA, new species.

Antedon parvicirra CHADWICK, Journ. Linn. Soc. (Zool.), vol. 31, 1908, p. 45.

?*Iridometra parvicirra* A. H. CLARK, Amer. Naturalist, vol. 43, 1909, p. 255.

Description.—Cirri XXV, 14–16 (usually 15–16), 13 mm. long, comparatively stout; first segment short, second about as long as broad, fourth or fifth the longest, about two and one-half times the median diameter; following segments slowly decreasing in length so that the antepenultimate is about one third longer than broad. The longer proximal segments are constricted centrally, with enlarged distal ends; there are no dorsal spines or projections. The cirri are rather strongly constricted laterally. The opposing spine is prominent, terminal, and directed obliquely forward.

Ten arms, apparently about 40 mm. long, resembling those of *I. nana*.

P_1 short, evenly tapering, about 5 mm. long, with eight segments which become twice as long as broad distally; P_2 considerably larger and much longer, but evenly tapering and very slender distally, 9.5 mm. long, with twelve segments which become much elongated outwardly; P_3 larger than P_2 , much the largest pinnule on the arm, 13 mm. long, becoming very slender distally, with eighteen to twenty segments, the distal much elongated, three times as long as broad; the ends of the segments are slightly swollen, but there are no spinous projecting borders; P_4 small and weak, 4.5 mm. to 5 mm. long, the outer segments much elongated and with somewhat swollen ends; P_5 slightly longer; following pinnules similar, becoming more slender and increasing in length distally.

Localities.—Suez Bay; Gulf of Suez.

Depth.—10 fathoms (one record).

Remarks.—This new species is very readily distinguishable from *Iridometra parvicirra* by its very much larger cirri, though the pinnulation is not very different.

Subfamily PEROMETRINÆ.

Genus PEROMETRA A. H. Clark.

PEROMETRA AFRA, new species.

Description.—Centrodorsal rounded-conical, the dorsal pole papillose, resembling closely the centrodorsal of *P. diomedæ* of Japan.

Articular radial faces almost exactly as in *P. diomedæ*; relation of radials to centrodorsal as in *P. diomedæ*.

Cirri long and slender, resembling those of *P. diomedæ*, 25 mm. to 30 mm. long, decreasing somewhat in length toward the dorsal pole, with 44–52 segments.

Eleven to fourteen arms 50 mm. long; the proximal arm structure, the flattening of the rays, and the synarthrial tubercles are exactly as in *P. diomedæ*, except that the synarthrial tubercles are not so long, being more like those of *P. pusilla*; the IIBr series are 2.

The lower pinnules are exceedingly slender, with greatly elongated segments; P₃ is the longest, followed by P₂, P₁, and P₄; P₅ and the following pinnules are short.

The color is purple, the cirri lighter.

Locality.—Providence Island, northeast of Madagascar; the type, which is in the British Museum, was collected by the *Sea Lark* expedition under Prof. J. Stanley Gardiner.

Depth.—125 fathoms.

Subfamily ZENOMETRINÆ.

Genus LEPTOMETRA A. H. Clark.

LEPTOMETRA CELTICA (Barrett and McAndrew).

Comatula woodwardii BARRETT, Ann. and Mag. Nat. Hist., (2) vol. 19, 1857, p. 33, pl. 7, fig. 1 (not of Forbes, 1852).

Comatula celtica BARRETT and McANDREW, Ann. and Mag. Nat. Hist. (2), vol. 20, 1858, p. 44.

Antedon mediterraneus (part) WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, 1872, p. 765.

Antedon phalangium (not of Müller) P. H. CARPENTER, Zool. Anzeiger, Jahrg. 4, 1881, p. 521 (part); Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 361 (part); *Challenger Reports*, vol. 26, Zoology, 1888, p. 159 (part); Journ. Linn. Soc. (Zool.), vol. 24, 1892, p. 67.

Leptometra celtica A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 129.

Antedon (Leptometra) phalangium KÖHLER and VANEY, Bull. du mus. d'hist. nat., 1910, No. 1, p. 32.

Localities.—Seine Bank (between Madeira and Morocco); near the Seine Bank (lat. 33° 47' N., long., 14° 21' W.); near the Gorringe Bank (west of the Straits of Gibraltar) (lat. 36° 30' 30'' N.; long. 11° 36' 15'' W.; and lat. 36° 31' N.; long. 11° 32' W.); off Madeira; Funchal Bay, Madeira; south of Cape St. Vincent (lat. 36° 20' N.;

long. $9^{\circ} 01' W.$); south of the Canary Islands (lat. $26^{\circ} 17' N.$; long. $17^{\circ} 12' W.$).

This species occurs northward to the Faroe Islands.

Depth.—50–500 (?700) fathoms.

Remarks.—As Carpenter, in discussing the specimen from Funchal Bay, speaks of “the extreme shortness of the later cirrus joints,” which is the character by which *Leptometra celtica* is most readily separated from *L. phalangiium*, it has seemed best to refer the records for the Atlantic coast of Africa and the outlying islands to the former species. The specimens from off Cadiz and from off the Portuguese coast, which I have recently examined, are undoubtedly this form.

Professor Kœhler remarks that this species ranges westward across the Atlantic, as Carpenter received specimens from Brazil, from a cable picked up in between 915 and 1,280 meters; the specimens upon which this statement was based were found on the Brazilian cable, but at its Madeira end, near Funchal.

LEPTOMETRA PHALANGIUM (J. Müller).

Alecto phalangiium J. MÜLLER, Archiv für Naturgeschichte, 1841, Heft 1, p. 142.

Antedon mediterraneus (part) WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, 1872, p. 765.

Antedon phalangiium MARION, Ann. de sci. nat., sér. 6, vol. 8, 1879, p. 40, pl. 18.—P. H. CARPENTER, Zool. Anzeiger, Jahrg. 4, 1881, p. 521 (part); Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 361 (part); *Challenger Reports*, vol. 26, Zoology, 1888, p. 159 (part).

Leptometra phalangiium A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 129.

Localities.—Tunis; Bay of Benzert (Bizerta), Tunis; Skerki Bank, off Tunis.

This species occurs also along the French and Italian coasts of the Mediterranean.

Depth.—30–120 fathoms.

Family PENTAMETROCRINIDÆ.

Genus PENTAMETROCRINUS A. H. Clark.

PENTAMETROCRINUS ATLANTICUS (Perrier).

Eudiocrinus atlanticus PERRIER, Comptes rendus, vol. 96, 1883, p. 725.—KœHLER, Échinodermes provenant des campagnes du yacht *Princesse-Alice*, 1909, p. 271, pl. 32, figs. 15–18.

Pentametrocrinus atlanticus A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135.

Eudiocrinus (Pentametrocrinus) atlanticus KœHLER and VANEY, Bull. du mus. d'hist. nat., 1910, No. 1, p. 31.

Localities.—Azores; southeast of Terceira (lat. $38^{\circ} 26' N.$; long. $26^{\circ} 30' 45'' W.$); Canary Islands; southeast of Arreceife (lat. $29^{\circ} 06' 30'' N.$; long. $13^{\circ} 02' 45'' W.$); between Madeira and Mogador (lat. $32^{\circ} 27' N.$; long. $12^{\circ} 15' W.$).

This species ranges northward to the Gulf of Gascony, and I have examined a specimen, apparently of this form, from Martinique, French West Indies.

Depth.—578–1,165 meters.

Specimens are recorded from as deep as 1,674 meters.

II. STALKED CRINOIDS.

Family PENTACRINITIDÆ.

Genus ENDOXOCRINUS A. H. Clark.

ENDOXOCRINUS WYVILLETHOMSONI (Wyville Thomson).

Pentacrinus wyville-thomsoni JEFFRIES, Proc. Roy. Soc., vol. 19, 1870, p. 157 (*nomen nudum*); Report Brit. Ass. for 1870, 1871, p. 119 (*nomen nudum*).—WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, 1872, p. 767.—P. H. CARPENTER, *Challenger Reports*, vol. 11, Zoology, 1884, p. 313, pl. 17, figs. 2–6; pl. 18; pl. 24; pl. 57, fig. 1.—FILHOL, *La vie au fond des mers*, 1885, pl. 2, opposite p. 10; pl. 5 (colored), opposite p. 160; p. 210; p. 212; fig. 66, I, p. 211.—PERRIER, *Nouv. arch. du mus. d'hist. nat.* (2), vol. 9, 1886, p. 145; *Explorations sous-marines*, 1886, p. 272.—P. H. CARPENTER, *Journ. Linn. Soc. (Zool.)*, vol. 24, 1892, p. 64.—ALBERT, PRINCE DE MONACO, *Comptes rendus*, vol. 126, 1899, p. 313.—RICHARD, *Les campagnes scientifiques de S. A. S. le Prince de Monaco*, 1900, p. 78.—RICHARD, *Bull. soc. zool. France*, vol. 27, 1902, p. 84.—ALBERT, PRINCE DE MONACO, *Comptes rendus*, vol. 134, 1902, p. 963; vol. 140⁸ 1905, p. 1373; *Bull. mus. Monaco*, 1905, No. 39, p. 1.—RICHARD, *Bull. mus. Monaco*, No. 41, 1905, p. 3.—KÆHLER, *Échinodermes provenant des campagnes du yacht, Princesse-Alice*, 1909, p. 254, pl. 5, fig. 1 (colored).

Pentacrinus PARFAIT, *Rapport sur la campagne scientifique du Talisman en 1883*, 1884, p. 41.

Pentacrinus PARFAIT, *Rapport sur la campagne scientifique du Talisman en 1883*, 1884, pp. 41, 47.—DE FOLIN, *Sous les mers*, 1887, pp. 275, 276, 288.

Endoxocrinus wyvillethomsoni A. H. CLARK, *Proc. Biol. Soc. Washington*, vol. 21, 1908, p. 152.

Pentacrinus (Endoxocrinus) wyville-thomsoni KÆHLER and VANEY, *Bull. du mus. d'hist. nat.*, 1910, No. 1, p. 31.

Localities.—Off the west coast of Morocco; off the coast of Morocco (lat. 32° 40' N.; long. 12° 10' E.; lat. 32° 31' N.; long. 12° 08' E.); off Cape Cantin, Morocco; Azores; Madeira, near Funchal and off Porto Santo Bay (lat. 32° 39' 20'' N.; long. 16° 40' 55'' W.); east of Hierro, Canaries (lat. 27° 41' N.; long. 17° 53' 45'' W.); off the southeast coast of Teneriffe, Canaries (lat. 28° 04' N.; long. 16° 49' 30'' W.); Canary Islands; between the Canary and Cape Verde islands; south of the Canary Islands (lat. 25° 39' N.; long. 18° 26' W.); between Madeira and Mogador (lat. 32° 31' N.; long. 12° 09' W.).

This species is found as far north as Rochefort (lat. 45° 59' 30'' N.).¹

Depth.—1,330–1,917 meters.

¹Bell has recorded it from Ferne Islands, off the coast of Northumberland. Probably he meant to say "Fayal," as it certainly does not occur anywhere in the British Channel. A similar error in his citation of the habitat of *Antedon dübenii* is "Bengal" instead of Brazil.

The extreme depth known for the species is 1,095 fathoms, at which depth it was originally dredged by the *Porcupine*.

Family HYOCRINIDÆ.

Genus GEPHYROCRINUS Kœhler and Bather.

GEPHYROCRINUS GRIMALDII Kœhler and Bather.

Hyocrinus ALBERT, PRINCE DE MONACO, Comptes rendus, vol. 134, 1902, p. 963.—RICHARD, Bull. soc. zool. France, vol. 27, p. 84.

Gephyrocrinus grimaldii, KÆHLER and BATHER, Mém. soc. zool. France, vol. 15, 1902, p. 68.—ALBERT, PRINCE DE MONACO, Comptes rendus, vol. 142, 1906, p. 621.—KÆHLER, Échinodermes provenant des campagnes du yacht *Princesse-Alice*, 1909, p. 256, pl. 1, fig. 12; pl. 32, figs. 1-9.

Localities.—East of Hierro, Canaries (lat. 27° 41' N.; long. 17° 53' 45'' W.); south of Funchal, Madeira (lat. 32° 32' 30'' N.; long. 17° 02' W.).

Depth.—1,786-1,968 meters.

Family BOURGUETICRINIDÆ.

Genus BATHYCRINUS Wyville Thomson.

BATHYCRINUS ALDRICHIANUS Wyville Thomson.

Bathycrinus aldrichianus WYVILLE THOMSON, The Atlantic, vol. 2, 1877, pp. 92-95 (86-87), fig. 23; Journ. Linn. Soc. (Zool.), vol. 13 (1876), 1878, pp. 47-51, fig. 1.—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 32, 1907, pp. 553, 554.

Bathycrinus campbellianus P. H. CARPENTER, Challenger Reports, vol. 11, Zoology, 1884, p. 238, pl. 7a, figs. 22, 23; pl. 8; fig. 15, p. 239.

Locality.—Lat. 1° 47' N.; long. 24° 26' W.

Depth.—1,850 fathoms.

BATHYCRINUS GRACILIS Wyville Thomson.

Bathycrinus gracilis WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, 1872, p. 772.—KÆHLER, Échinodermes provenant des campagnes du yacht *Princesse-Alice*, 1909, p. 254.

Locality.—Between the Azores and Gibraltar (lat. 38° 54' 55'' N.; long. 21° 06' 45''—18' 45'' W.).

This species is otherwise only known from the Bay of Biscay.

Depth.—5,005 meters.

The previous record of depth is 2,435 fathoms.

BATHYCRINUS PERRIERI Kœhler and Vaney.

Bathycrinus perrieri KÆHLER and VANEY, Bull. du mus. d'hist. nat., 1910, No. 1, p. 26, figs. 1, 2, p. 27.

Locality.—Off Cape Ghir, Morocco (lat. 30° 03' N.; long. 14° 02' E.).

Depth.—2,212 meters.

BATHYCRINUS RECUPERATUS (E. Perrier).

Ilyocrinus recuperatus E. PERRIER, Rev. scient., vol. 35, 30 mai 1885, p. 691.—
P. H. CARPENTER, Ann. and Mag. Nat. Hist. (5), vol. 16, p. 108.

Ilyocrinus recuperatus E. PERRIER, Rev. scient., vol. 35, 30 mai, 1885, p. 691.—
P. H. CARPENTER, Ann. and Mag. Nat. Hist. (5), vol. 16, p. 108.

Ilyocrinus recuperatus E. PERRIER, Explorations sous-marines, 1886, p. 273, fig. 193; p. 341, fig. 242, No. 4.

Bathycrinus recuperatus HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, 1907, p. 1574.—KÖHLER and VANEY, Bull. du mus. d'hist. nat., 1910, No. 1, p. 28, fig. 3, p. 29.

Locality.—Northeast of the Azores (lat. 44° 20' N.; long. 19° 31' W.)

Depth.—4,255 meters.

Genus RHIZOCRINUS M. Sars.

RHIZOCRINUS PARFAITI (Perrier).

Democrinus parfaiti PERRIER, Comptes rendus, vol. 96, 1883, No. 7, p. 450.

Rhizocrinus parfaiti A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 676.

Locality.—Off the coast of Morocco "par le travers du cap Blanc."

Depth.—1,900 meters.

Remarks.—This is a perfectly good species, but Carpenter subjected it to such severe criticism in the *Challenger* report that it has been allowed to drop into oblivion.

RHIZOCRINUS CHUNI Döderlein.

Rhizocrinus sp. nov. DÖDERLEIN, in CHUN, Aus den Tiefen des Weltmeeres, 1900, p. 487, fig., p. 488.

Rhizocrinus chuni DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, 1907, p. 14, pl. 1, fig. 5; pl. 6, fig. 6; fig. 6, p. 14.

Locality.—Off Somaliland, East Africa.

Depth.—1,644–1,668 meters.

UNIDENTIFIABLE SPECIES.

ANTEDON IMPINNATA (P. H. Carpenter).

Antedon impinnata VON GRAFF, *Challenger* Reports, vol. 10, Zoology, 1884, pp. 15, 16, 18 (*nomen nudum*).—P. H. CARPENTER, *Challenger* Reports, vol. 26, Zoology, 1888, p. 206.

Remarks.—The very short description of this species reads: "The third, fourth, and fifth brachials have no pinnules; eight or ten cirri of twelve joints," which would be now expressed: P_a , P_2 , and P_b absent; cirri VIII–X, 12. Carpenter further says that this "is a little species, which was obtained at Mauritius by Professor Möbius, who was kind enough to show it to me when I visited Kiel."

The type is recorded as having been taken in North Bay, Mauritius, at a depth of 15 fathoms.

COMATULES.

Comatules FERUSSAC, Bull. des sci. nat. (2), vol. 26, 1831, p. 183.

Ferussac records that M. Lamare-Picquot brought home numerous comatulids from his voyage to the East Indies and South Africa.

COMATULA.

Comatula VON GRAFF, *Challenger* Reports, vol. 10, Zoology, 1884, p. 48; repeated in BRAUN, Centralbl. für Bakteriöl. und Parasitenkunde, vol. 3, 1888, p. 186.

Professor von Graff records myzostomes from an undetermined comatulid taken at Fouquet Island, southeast of Mauritius, in 18 fathoms.

COMATULES.

Comatules PARFAIT, Rapport sur la campagne scientifique du *Talisman* en 1883, 1884, pp. 39, 41, 43, 45, 47, 49, 55, and 57.

Captain Parfait records comatulids from the *Talisman* dredgings as follows: south of the Bay of Cadiz (lat. $36^{\circ} 02' N.$; long. $9^{\circ} 01' E.$), 126 meters ("une pleine baille de comatules"); off Cape Spartel (lat. $35^{\circ} 26' N.$; long. $9^{\circ} 09' E.$), 717 meters; lat. $33^{\circ} 47' N.$; long. $11^{\circ} 23' E.$, 1,635 meters ("comatules jaune soufre;" probably *Thalassometridæ*); lat. $32^{\circ} 27' N.$; long. $12^{\circ} 15' E.$, 1,123 meters; lat. $30^{\circ} 08' N.$; long. $14^{\circ} 02' E.$, 2,200 meters; lat. $30^{\circ} 03' N.$; long. $14^{\circ} 02' E.$, 2,212 meters; lat. $29^{\circ} 01' N.$; long. $14^{\circ} 51' E.$, 1,180 meters; lat. $28^{\circ} 37' N.$; long. $15^{\circ} 22' E.$, 865 meters; lat. $28^{\circ} 35' N.$; long. $15^{\circ} 30' E.$, 975 meters; lat. $28^{\circ} 35' N.$; long. $15^{\circ} 36' E.$, 1,238 meters; lat. $26^{\circ} 17' N.$; long. $17^{\circ} 11' E.$, 355 meters ("multitude de comatules"); lat. $26^{\circ} 16' N.$; long. $17^{\circ} 11' E.$, 250 meters; lat. $26^{\circ} 13' N.$; long. $17^{\circ} 10' E.$, 175 meters; lat. $26^{\circ} 07' N.$; long. $17^{\circ} 08' E.$, 130 meters; lat. $25^{\circ} 41' N.$; long. $18^{\circ} 16' E.$, 410 meters; lat. $21^{\circ} 51' N.$; long. $19^{\circ} 18' E.$, 235 meters; lat. $19^{\circ} 19' N.$; long. $20^{\circ} 22' E.$, 2,333 meters; lat. $19^{\circ} 16' N.$; long. $20^{\circ} 20' E.$, 2,320 meters; lat. $38^{\circ} 38' N.$; long. $30^{\circ} 41' E.$, 1,257 meters; lat. $45^{\circ} 59' N.$; long. $6^{\circ} 29' E.$, 1,480 meters.

COMATULES.

Comatules DE FOLIN, *Sous les mers*, 1887, pp. 266, 277, 280, 281, 282, 283, 288, 297, 328, and 335.

Marquis de Folin records unidentified comatulids from the west coast of Morocco, off Cape Spartel, 717 meters; west coast of Morocco, 1,123 meters; west coast of Morocco, 2,200 meters; west coast of Morocco, 2,212 meters; Canary Islands, 1,180 meters, 865 meters, 1,238 meters, 345 meters, 130 meters, and 410 meters; off the coast of Senegal, 2,333–2,320 meters; among the Azores, 1,257–1,255 meters (and in the Gulf of Gascony, 1,480 meters).

Probably these specimens are in the Paris Museum.

COMATULES.

Comatules RICHARD, Les campagnes scientifiques de S. A. S. le Prince Albert I^{er} de Monaco, 1900, p. 78.

Professor Richard says: "Enfin il est interessant de signaler la capture, dans une masse, d'une centaine de comatules, par 175 meters sur le banc de Gorringe."

PENTAMETROCRINUS (? species).

Endiocrinus sp. nov. CHUN, Aus den Tiefen des Weltmeeres, 1900, p. 488.

Professor Chun records the discovery by the *Valdivia* of a sulphur yellow "*Eudiocrinus*" representing a new species (as determined by Professor Döderlein) in 1,289 meters off the coast of Somaliland.

BATHYCRINUS.

Bathycrinus MILNE-EDWARDS, Comptes rendus, vol. 97, 1883, p. 1392.

One or more species of this genus are stated to have been dredged "par le travers du cap Ghir et du cap Noun, à 120 milles environ de la côte," at depths between 2,000 and 2,300 meters.

One of these is undoubtedly the *Bathycrinus perrieri* recently described by MM. Kœhler and Vaney.

BATHYCRINUS.

Bathycrinus FILHOL, La nature, No. 572, 17 mai 1884, p. 391.

This refers to the same specimens as does the preceding.

CRINOÏDE.

Crinoïde PARFAIT, Rapport sur la campagne scientifique du *Talisman* en 1883, 1884, p. 43.

Captain Parfait here records a small crinoid from lat. 30° 03' N.; long. 14° 02' E., in 2,212 meters, on gray mud and broken shell; it is undoubtedly the same as the preceding.

BATHYCRINUS.

Bathycrinus PARFAIT, Rapport sur la campagne scientifique du *Talisman* en 1883, 1884, pp. 43, 57.

The remains of *Bathycrinus* are here recorded from lat. 29° 52' N.; long. 14° 04' E., in 2,075 meters, on gray mud and broken shell; and from lat. 44° 20' N.; long. 19° 31' E., in 4,255 meters, on soft white mud.

BATHYCRINUS.

Bathycrinus E. PERRIER, Rev. scient., vol. 35, 30 mai 1885, p. 691.

MM. Kœhler and Vaney believe that the individual here referred to is the specimen described by them as *Bathycrinus perrieri*.

CRINOÏDE.

Crinoïde DE FOLIN, Sous les mers, 1887, p. 281.

De Folin here records a small stalked crinoid from 2,212 meters off the west coast of Morocco.

BATHYCRINUS.

Bathycrinus DE FOLIN, Sous les mers, 1887, p. 282.

De Folin records a specimen dredged from 2,083 meters off the west coast of Morocco.

UN PETIT CRINOÏDE.

Un petit crinoïde RICHARD, Bull. soc. zool. France, vol. 27, 1902, p. 85.

Professor Richard records a small crinoid, probably a *Bathycrinus*, from 3,890 meters in the Cape Verde Islands.

RHIZOCRINUS LOFFOTENSIS Wyville Thomson.

Rhizocrinus loffotensis WYVILLE THOMSON, The Depths of the Sea, 1873, p. 450.

Sir Wyville Thomson records that the Swedish frigate *Josephine* obtained this species on the Josephine Bank. Undoubtedly the identification is incorrect.

RHIZOCRINUS (? species).

Rhizocrinus rawsoni (not of Pourtalès) P. H. CARPENTER, *Challenger Reports*, vol. 11, Zoology, 1884, p. 262 (part), pl. 10, figs. 8-14.—KÖHLER, *Échinodermes provenant des campagnes du yacht Princesse-Alice*, p. 255.—KÖHLER and VANEY, Bull. du mus. d'hist. nat., 1910, No. 1, p. 31.

Localities.—South of Terceira, Azores (lat. 38° 11' N.; long. 27° 09' W.); off the eastern end of Pico, Azores (lat. 38° 20' N.; long. 28° 04' 25'' W.); "par le travers du cap Ghir [Ras Aferni] et du cap Noun [Morocco], à 120 milles environ de la côte;" "par le travers du cap Blanc" (Morocco); near Cape Blanco (lat. 33° 09' N.; long. 11° 58' W.); northwest of Mogador (lat. 32° 38' N.; long. 12° 09' W.).

This group of species extends northward to west of the Scilly Islands and slightly west of south of the southwestern corner of Ireland (lat. 50° 01' N.; long. 12° 26' W.).

Depth.—1,435-2,300 meters.

The extreme recorded depth is 1,207 fathoms.

Remarks.—A number of distinct species are included by Carpenter and by Köhler under the name *Rhizocrinus rawsoni*, none of which are the same as the West Indian form originally described under that name by Pourtalès.

DEMOCRINUS.

Democrinus PARFAIT, Rapport sur la campagne scientifique du *Talisman* en 1883, 1884, pp. 41, 43, 47.

Captain Parfait records undetermined *Rhizocrinus* from the coast of Morocco as follows: lat. $32^{\circ} 40'$ N.; long. $12^{\circ} 10'$ E., 1,435 meters; lat. $29^{\circ} 52'$ N.; long. $14^{\circ} 04'$ E., 2,075 meters; lat. $25^{\circ} 01'$ N.; long. $19^{\circ} 15'$ E., 2,638 meters.

Probably the specimens mentioned are in the Paris Museum.

DEMOCRINUS.

Democrinus DE FOLIN, Sous les mers, 1887, pp. 282, 288.

M. de Folin records *Rhizocrinus* from African waters as follows: off the west coast of Morocco, 2,083 meters; off the Canary Islands, 2,636 meters.

Probably the specimens are in the Paris Museum.

APPENDIX.

While at the British Museum recently I was, thanks to the kindness of Prof. F. Jeffrey Bell, able to examine some very interesting comatulids which had been collected by the cable repair ship *Electra* in the Red Sea, and to the northwest of Sokotra. These I find to be as follows:

Locality.—Red Sea, southeast of Messawa (lat. $15^{\circ} 02' 30''$ N.; long. $41^{\circ} 13' 30''$ E.); depth, 20 fathoms.

Oligometra serripinna var. *electræ* A. H. Clark.

Locality.—Northwest of Sokotra (lat. $14^{\circ} 20'$ N.; long. $52^{\circ} 30'$ E.); depth, 1,200 fathoms.

Thalassometra (new species). *Thaumatometra* (new species).

Pachylometra (new species). *Cyclometra flavescens* A. H. Clark.

MAMMALS COLLECTED BY DR. W. L. ABBOTT ON BORNEO AND SOME OF THE SMALL ADJACENT ISLANDS.

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INTRODUCTION.

Before collecting on the mainland of Borneo, Dr. W. L. Abbott made two expeditions to adjacent islands, the mammalian fauna of which is closely allied to that of Borneo. One of these expeditions was to the Natuna Islands, north of Borneo, and was made during the spring and summer of 1900; the other was to the Karimata Islands, off the west coast, during August and September, 1904. Lists of the mammals obtained on these expeditions were published by Mr. Gerrit S. Miller, jr., in 1901 and in 1906.¹ More recently Doctor Abbott has visited the mainland of Borneo five times, on each occasion stopping at some of the adjacent islands. An account of the mammals collected on the first trip to the mainland, covering the Kapuas River region, was published by me in 1907.² The present paper aims to give an account of the mammals obtained on the remaining four expeditions—two to southwestern Borneo and two to southeastern Borneo—as well as those collected in the near-by islands. For the sake of completeness, I have included in the present paper the species collected in the Kapuas River region, as well as those from Karimata Islands, the latter having been visited a second time. Four short papers³ have appeared recently which

¹ Proc. Wash. Acad. Sci., vol. 3, pp. 111-138, March 26, 1901. Proc. U. S. Nat. Mus., vol. 31, pp. 55-66, July 23, 1906.

² Proc. U. S. Nat. Mus., vol. 33, pp. 547-572, December 24, 1907.

³ Lyon, Description of a new squirrel of the *Sciurus prevostii* group from Pulo Temaju, west coast of Borneo. Smiths. Misc. Coll., vol. 48, pp. 275-276, February 4, 1907.

Lyon, Remarks on the Insectivores of the genus *Gymnura*. Proc. U. S. Nat. Mus., vol. 36, p. 449, May 27, 1909. Doctor Abbott's Bornean specimens listed.

Elliot, On the genus *Presbytis* Esch., and *Le Tarsier Buffon*, with descriptions of two new species of *Tarsius*. Bull. Amer. Mus. Nat. Hist., No. 28, pp. 151-154, May 27, 1910. Describes the tarsier from the Kapuas River region.

Elliot, Descriptions of some new species of monkeys of the genera *Pithecus* and *Pygathrix* collected by Dr. W. L. Abbot and presented to the United States National Museum. Proc. U. S. Nat. Mus., vol. 38, pp. 343-352, August 6, 1910. Describes the common macaques from Karimata, the Kapuas River region, Bawean Island, and Pulo Mata Siri.

deal in part with the mammals included in the present paper, but the collections as a whole are here published for the first time.

A list of the localities visited by Doctor Abbott is given below, together with his geographical and natural history field-notes. Many of these localities are not to be found on the ordinary maps, and reference should be made to the maps on pages 55 and 57.

LIST OF LOCALITIES, WITH GEOGRAPHICAL AND NATURAL HISTORY FIELD-NOTES BY DR. W. L. ABBOTT.

WEST BORNEAN MAINLAND, June 6-September 16, 1907.

Sukadana (or Sukudana).—At Sukudana a mass of hills 1,000 to 2,000 feet high rise right from the seashore. They are well forested, but there are many plantations of durians and other fruit upon their slopes and many clearings in the neighborhood. The sea is very shallow near the coast; otherwise it would have been a good collecting ground for me,¹ as animal life is abundant in the neighborhood. The inhabitants are all Malays except a few Chinese traders and small planters.

Sempang River.—The country along the Sempang River is low and swampy, very little above high water, as is also nearly all west Borneo near the coast. The lower part of the principal affluent, the Semandang, is also low and flat. The headwaters of both rivers are among the hills. The low country is for the most part heavy forest, with a strip of clearing along the river banks. The hilly country is inhabited by Dyaks and here there is comparatively little virgin forest remaining. The greater part of the surface is covered with secondary jungle. A few rhinoceroses are said to inhabit the upper Sempang about Batu Dayeu (or Dajeuh). A much larger cat than *Felis nebulosa* occurs, called by Malays and Dyaks "rimow." It must be very rare, as very few people whom I met had ever seen it. The big red pig (*Sus gargantua?*) I heard of from both Dyaks and Malays, especially about the upper Sempang River, but not reported at all common.

Matan (or Matai) River.—The Sungei Matan enters the Sempang at the rajah's kampong (village) called Sempang. I camped about 12 miles up (4½ hours) at a place called Matan. Formerly there was a large kampong there but it was abandoned twenty to thirty years since. Most of the neighborhood is large secondary jungle. The hill called Matan was close by. Animal life was very abundant, and orang-utans plentiful. There are no permanent villages now upon the Sungei Matan, except on the slopes of the hill called Sepunchok, about 2½ hours above Sempang, where there are eight families.

Mount Palung.—Palung is 1,110 meters in height. I ascended Panti and remained one night; saw no mammals high up. Panti [not shown on map] is one of the hills of Palung. It is somewhere about 3,500 feet. Rhinoceroses are said to inhabit the lowlands about the base of Palung. No tapir or banting (*Bos*) in this part of Borneo.

SOUTHWEST BORNEAN MAINLAND, June 17-September 29, 1908.

Kendawangan River.—The country along the lower Kendawangan River, as elsewhere in west Borneo, is mostly swamp, just above high-water mark. Occasional higher patches and tracts occur which always remain dry and are called "pëmátong," about what we call "islands" in swamps or "hummocks" in Florida. There are no hills close to the lower river except at Mankol. At Lanchut, 30 miles from the mouth, there is quite a large tract of dry land extending back to Mount Kedio, 4 miles from the river. About Kalang Anyer, a Malay kampong of three houses, 70 miles from the mouth, the banks become higher, with but little swamp. A few miles higher up the hilly and rolling country is reached, the Dyak country, where most of the original jungle has been destroyed and now covered with secondary jungle, scrub, and "alang

¹ Doctor Abbott travels about in a schooner, and the anchorage probably was poor.

with them. On the upper Kendawangan among the Dyaks there are about 200 Malays, mostly about Maro. Nearly every man, both Dyak and Malay, has a gun; so game is remarkably scarce. Luckily, powder is difficult to obtain. The Dutch have not interfered with the natives much as yet, and have not taken away their firearms, as they are gradually doing all over their colonies, much to the advantage of the animal life, for Dyaks devour everything they can kill. I myself saw very much less life than on the Sempang, and far less than in southeast Borneo, where the natives were all disarmed several years ago. The Dyaks kill far more with their "bētantik," or spear traps, than by shooting, except in the case of orang-utan. The Dyaks are extremely fond of the meat of these, and it is useless to look for orangs anywhere in the neighborhood of a Dyak settlement. I could hear nothing of *Sus gargantua*, and probably it does not occur in that part of Borneo, nor could I hear anything of the "rimau," or tiger, which was said to inhabit the Sempang district. A few rhinoceroses are said to inhabit the neighborhood of Mount Kedio and a few sapi utan (*Bos sondaicus*) on its west slopes on the headwaters of the little river Tingar. This is the only place on or near the west coast of Borneo where wild cattle occur. The Malays told me they also existed in some places on the upper Pasaguan River—that is the next large river north of the Kendawangan. The country about Mount Kedio is uninhabited, and there is said to be much animal life there. Fifty or sixty years ago the district was inhabited by Dyaks, but these, becoming involved in war with the Malay rajah, left their homes and fled into the interior. All over this corner of Borneo occur slightly elevated sandy tracts covered with small trees (or smaller trees than the surrounding forest); these are locally called "padang," which is Malay for meadow. Much of this land and a good deal of the drier forest was burned over six or seven years ago, during a period of excessive drought. No rain fell for four or five months, a most unusual occurrence in any part of Borneo, where ordinarily rain falls every month in the year, and there is no proper dry season. The following animals, in addition to some already mentioned, were well known to the natives, but none was obtained during this trip: *Mydaus*, called bōbot by Malay and kalinsida by Dyaks; *Reithrosciurus*; *Felis nebulosa*, rimau dahan; *Felis marmorata*?, a wild cat with a large tail, was caught by a Malay in a snare, but for some reason was not brought to me; *Paradoxurus philippinensis*; *Gymnura*, local name āngkis.

Batu Jurong.—Batu Jurong is the southerly point of a range of hills which stretch north-northeast to Mankol on the Kendawangan River. I anchored in a small strait between Pulo Iras and the mainland. Two or three Malay families lived here and had their clearings. Pigs were plentiful; kijang (muntjacs) and rusa were also common, but the Malays were continually after them with their dogs. South of this there are no inhabitants in the southwest corner of Borneo, and until recently none on the south coast west of the Sungei Jelai. Lately, however, about a dozen families of Malays have made clearings on the lower course of the Sungei Ayer Hitam Besar. Animals were said to be plentiful, especially rusa, about Tanjung Kepala, where there is said to be large tracts of short grass. I saw two orangs and the sarongs (nests) of many more about 2 miles east of Batu Jurong, where I shot one female.

Mankol.—Mankol lies along the Kendawangan River for about 2 miles. There are about 25 or more houses altogether. At this point the north end of the range of hills (400 to 800 feet high) approaches the river. Animals were scarce, as most of the people had guns, and the jungle in the hills and along the base was full of old jerats and pagars (traps and snares). A few orangs were said to occur, but I saw no traces.

Lanchut.—Lanchut is now without inhabitants. It was formerly the most important village on the river and the residence of the rajah. The ground along the river is quite high and dry and covered with secondary jungle and long grass for some distance back from the river. Four or five miles due east rises Mount Kedio, in an uninhabited district covered with heavy forest.

KLUMPANG BAY, SOUTHEASTERN BORNEO, January 8–March 13, 1908, and April 18–19, 1909.

Tanjong Batu lies at the north entrance of Klumpang Bay. The hill is 3 or 4 miles long and 1,200 feet at its highest point. It is covered with heavy forest,

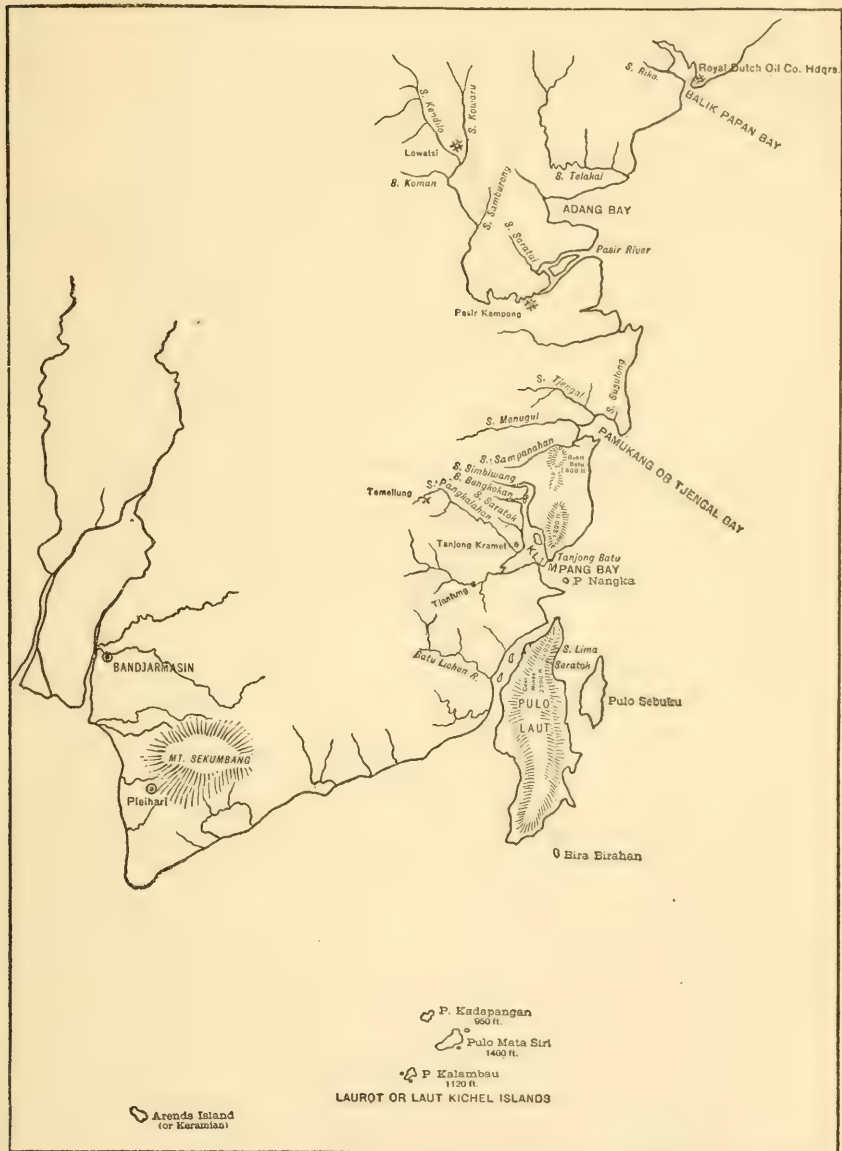


FIG. 2.—MAP OF SOUTHEASTERN BORNEO.

except at the south end, where there are some pepper gardens and a good many old clearings covered with scrub and coarse grass. The timber is very good, containing much bilian (iron wood). A range of lower hills extends north of this to Bukit Batu near the Sampanahan River and Pamukang Bay. This range of hills is evidently an

ancient island, joined to the mainland by the elevation of the land and also by silting up a wide tract of mangrove swamp lying in the intervening space. As one ascends the river, a few miles from the bay, evidences of elevation become everywhere visible in the masses of limestone coral projecting from the swampy surface. In many cases the flat surface of the ancient reef is but a few inches below the mud or actually on the surface. A little farther an irregular line of limestone hills, mostly with precipitous and waterworn sides, runs in a general direction parallel with the coast. The uncleared land is all heavy forest. Many old clearings and some new exist in the neighborhood of the rivers. The population of the coast is made up of Bugis, Banjar, and other Mohammedan Malay tribes. Inland is a large Dyak (pagan) population. The Dutch annexed this district in 1905.

Pangkallahan (or Bangkallaan) River.—Kampong Pangkallahan is about 7 miles up the river of the same name and is the residence of the mankoh, or head of the Dyaks of the district. The country is covered with splendid forest, with only a few clearings. There are ranges and scattered hills of precipitous limestone rock. Animals seemed scarce, as usual in Dyak districts, everything hunted off or driven away by the Dyaks and their dogs. They have very few guns and no powder. About a half mile above the village is the lower entrance to the Temmelung or tunnel of the Pangkallahan. This tunnel cave, through which the river flows, swarms with bats as well as with edible birds'-nest swifts, hundreds of thousands of their nests being collected annually. I could not devise any way of catching the bats, as I had no net and had not brought a gun for fear of a capsizing, there being a dangerous rapid near the lower end of the tunnel. The Temmelung must be about 2 miles long, judging by the time we took passing through it. It is through limestone rock. I do not think the roof was anywhere very thick, at some places only 2 or 3 yards. That part of the country is full of limestone hills and rocks all honeycombed with caves and passages. But bats did not seem to be present in the hundreds of holes I visited, except an occasional individual which I could not secure. Judging from the noise, for the light from the torches did little but accentuate the gloom, there must be hundreds of thousands in the Temmelung. Another tunnel occurs farther up the same river, but I did not visit it, as it was said to be very difficult of passage except by a very small canoe.

Saratok River.—The Saratok is a small river flowing into Klumpang Bay. Two Dyak houses stood in a small new clearing. Back of this and extending eastward for nearly 2 miles was a large tract of alang alang (tall, coarse grass) covering several hundred acres. There appeared to be a good many rusa here, but the grass, 4 to 5 feet high, made it very difficult to shoot anything. When the grass is burned off in the dry season the place is said to be frequented by a herd of sapi utan (*Bos sondaicus*). There were no tracks of these at the time of my visit. Most of my collecting was done near some limestone hills and rocks about a mile westward in the midst of splendid forest. Only the red *Presbytis* was seen here; near the coast only the black one existed.

Besides the animals shot in Klumpang Bay I saw the long-tailed and the pig-tailed macaques and *Presbytis cristata*.

PAMUKANG OR TJENGAL BAY, March 17–April 7, 1908, and March 23–April 13, 1909.

Musangs were generally scarce except the tangalunga, which was common. I let most of those go which I caught in traps. The *Mydaus* was well known, but no specimens were obtained. *Gymnura* must be very common, as one often smelt them in the jungle, although none were obtained. The pig-tailed macaque was twice met with in droves, but none were secured. I met with *Reithrosciurus* twice on Bukit Batu. It was running on the ground in heavy forest. Its movements were so quick I could not shoot it. Its big bushy tail, carried high over its back, made the animal very conspicuous. I was much surprised to find that it is a ground squirrel. The headman of the Bajaus at Sungei Manungul, Pamukang Bay, said there used to be some rhinos in that locality, but he had seen no traces for years.

PASIR RIVER, December 31, 1908–January 22, 1909.

BALIK PAPAN BAY, February 1–February 24, 1909. Balik Papan Bay extends nearly 18 miles in a northerly direction. Several rivers empty into it. The eastern shore is high and hilly for the most part, the western low and covered with mangroves. There were very few inhabitants when the Royal Dutch Oil Company first established its headquarters here about fifteen years ago. Now there is a large settlement, wharves, oil refineries, paraffin works, etc., and about 6,000 inhabitants, situated on the eastern entrance to the bay. It is an excellent harbor. The shores of the bay are still mostly heavy forest. The line of the bay probably coincides with that of a fault. The hills are mostly red laterite, but a line of limestone stretches southwestward not far from the head of the bay. Animal life is fairly plentiful. Banting (*Bos sondaicus*) were said to occur especially around the head of the bay.

PULO LAMUKOTAN, May 7–10, 1907. Pulo Lamukotan is the largest of the Burong Islands, and lies about 10 miles off the mainland of Borneo. It is about 4 miles long by 1 mile wide. It consists of a long ridge with a low rock near the middle of the island. The highest point is near the southern end and is nearly 1,000 feet in height. Most of the surface is now cleared and the lower parts entirely planted with coconuts, which are very fine and healthy. The only heavy forest remaining covers the highest summit and the crest of the ridge on the southern part of the island, and a smaller piece on the summit of the northern ridge. The soil seems fertile and the surface is not very rocky, except upon the shore. The forest trees are very large in the remaining jungle. The other islands in the group, four in number, are smaller and have been entirely cleared and planted with coconuts. The inhabitants are Malays from Sambas. A *Sciurus vittatus*, a *Macacus cynomolgus*, a large pig, and three or more rats constitute the mammalian fauna. Pigs are not now very numerous, having been largely hunted off by Chinese from the mainland, who employ dogs. Pigs were formerly very abundant upon the other islands of the group (Penata and Kebun), but have been entirely exterminated upon these since the clearing of the jungle. Rats seemed pretty common. My traps were set in the jungle on the ridge near the highest peak. Fruit pigeons and Nicobar pigeons were fairly common.

PULO TEMAJU, May 5–6, 1907. (First visited by Doctor Abbott in 1905.) Pulo Temaju is now mostly cleared and planted with coconut. The only heavy forest remaining covers the summit and upper slopes of the highest peak. There are no mammals except *Sciurus proserpinæ* and rats. The coconut trees are not very productive and seem much diseased.

PULO DATU, May 2–4, 1907. Pulo Datu lies 21 miles from the coast of Borneo. It is about 1½ miles long by three-fourths mile wide. It is very hilly (mountainous) and rocky, and rises to about 1,000 feet. It is covered with heavy forest, except at some places on the east side, where some clearings have been made and a few coconuts planted. The clearings are now overgrown with large secondary jungle, as the rats swarm to such an extent it is impossible to grow anything. Squirrels (*Sciurus vittatus* group) were plentiful. No monkeys. I put out about forty rat traps one night. Nearly every one was sprung in the morning, but many of the rats had been devoured by land or hermit crabs. White fruit pigeons and Nicobar pigeons were common. There are no sand beaches, but plenty of fresh water flows out beneath the rocks, on the east side at any rate, between high and low water marks. *Mus "rattus"* appeared to be more abundant than *M. "lingensis,"* but the hermit crabs showed marked preference for the latter and spoiled most of those caught.

PULO PANEBANGAN, May 16–26, June 2–3, and September 20–21, 1907. Pulo Panebangan lies 8 miles from Pulo Maja, which is practically the mainland of Borneo. It is about 4 miles long by 2 to 3 wide, containing about 6,000 to 7,000 acres. It is very hilly, scarcely any level ground. The highest point is said to be 1,700 feet. It is uninhabited and covered with dense jungle. Rattans (of an almost valueless variety) abound, and the jungle is so matted up with rattans and their flagella as to be impenetrable. In some places the jungle seems to have been cleared at some

previous period, as at the head of the small bay on the north side. *Macacus cynomolgus* was the only monkey seen. There is no lotong (*Presbytis*). The ratufa is probably fairly common, as I frequently heard it. I only actually saw the three which were shot. I thought I saw and heard *Nannosciurus* on one occasion, but am not certain. There is no napu or large tragulus. No deer occurs; no otter tracks seen; and the tangalunga trapped was the only musang seen. The small *Hipposideros* was very common, flying about in the daytime; the larger one was less common. There were several other species of bats flying about in the forest in daylight, but I failed to secure any. No *Rhinolophus* were seen. Another musang is said to occur and also a red flying squirrel. Pigs were plentiful. All those noticed upon the beach seemed to be males. We did not once see a small one out of two or three dozen individuals. Possibly the old males appropriate the beaches and reefs, which are the best feeding grounds, and drive away intruders. The pigs were all very lean and gaunt. Up to the present there are no inhabitants, although there are many durians, mangos, and chempadak. We heard that some Karimata people propose to come in July, 1907, and form plantations.

PULO PELAPIS, May 29-June 1, 1907. Pelapis, a group of four islands, lies $3\frac{1}{2}$ miles southwest of Panebangan and 17 miles from Karimata. The islands are all hilly and rocky and covered with forest. The highest point is about 1,200 feet. The total area is about 5,000 acres. South Island (also called Pelapis Tengah) is the largest and is nearly $2\frac{3}{4}$ miles long. All collecting was done upon this island. Some years ago some Malays and Karimata people settled upon South Island and farmed some plantations of coconuts, etc., but three years ago an epidemic broke out, many died and the rest of the settlers fled, and to-day scarce a trace of human occupancy can be seen. Besides the animals obtained, the flying lemur and the common long-tailed macaque occur. No tragulus, no musangs, or no ratufas occur. The pigs come out upon the sand beaches and reefs at low tide, and can be shot without much difficulty. Bats were flying about in the forest on Pelapis, but not nearly so many as upon Panebangan. None were obtained.

KARIMATA ISLANDS, Telok Edar, Karimata Island, October 4-7, 1908. (First visited by Dr. W. L. Abbott in 1905.)

PULO JUANTA, September 10-11, 1907. Pulo Juanta is a small island, $6\frac{1}{2}$ miles from the mainland, about 1 kilometer long by $\frac{1}{2}$ wide. It is about 300 feet high. The greater part is covered with heavy forest, but a clearing was made about four years ago and an attempt made to plant coconuts, but nothing could be grown owing to the rats and pigs. About thirty pigs were killed, but many remained. There are still a few on the island, but I could neither shoot nor trap them. There are no squirrels on the island.

PULO BAUWAL, June 12-16, 1908. Pulo Bauwal (or Rendezvous Island) lies near the southwest corner of Borneo. It is about 15 miles from Tanjong Sambar, which is the extreme southwest point. Bauwal is about 6 geographic miles long by 5 in extreme width and contains about 12,000 acres. The strait separating it from the mainland is from 4 to 6 miles wide and 4 to 12 fathoms deep. The island is surrounded by wide coral reefs and hard rocks. The island is composed of hard red rock (iron ore?) and is rather low. There are two or three hills, rising to about 300 feet to the tops of the trees. The surface is rolling and covered with forest. There is some mangrove swamp. A house, inhabited by Pontianak Malays, is on the east coast, and five houses inhabited by Orang Laut from Karimata were established near the northwest corner about three years ago. The fauna is rather peculiar in that there are no squirrels, traguli, rusa, or pigs. Muntjacs and tangalungas are common.

SOLOMBO (not shown on map), December 4-6, 1907. The island of Solombo, or Masolombo Besar, is about 4 miles long by about 2 wide. The surface is mostly rather low and rolling, and there is one hill about 250 feet high. The rock seems to be nearly all volcanic, except, of course, the coral around the shore. The island is surrounded

by a coral reef. It lies midway between Madura and Borneo, 84 miles to each. There is quite a large population, 300 to 400 of Bugis and Madurese. The island has been settled about forty years. Most of the heavy forest has been cleared, except about the hill. The soil, dark red, with many stones and rocks of lava upon the surface, is very fertile, and produces large crops of paddy and maize. The only mammals I saw were flying foxes, which were quite common. Rats were said to be plentiful. There are no monkeys or squirrels. There are said to be many sapi or feral cattle (*Bos sondaicus*), and the natives were very anxious for me to go and shoot some, but I did not have time to do so. They are said to have been running wild a long time. Birds are very plentiful. The anxiety as to the safety of my schooner prevented me from doing as much as I would have liked, besides cutting short my stay, for the wind went around to the northwest and we had to get out on short notice. I should like to have put in several more days and visited Pulo Solombo Kitchil. There are no people upon the latter and it is still uncleared forest. Birds are said to be very plentiful there.

BAWEAN ISLAND, November 24–27, 1907. (Not shown on map.) Bawean Island lies about 60 miles north of the Straits of Madura. It is about 11 miles long by 10 wide, the area being about 100 square miles. The surface is mountainous, several of the hills rising from 2,000 to 2,200 feet. The island is volcanic, the rocks being mostly lava and basalt, with some limestone. There are extensive coral reefs around the coast. Many volcanic cones are scattered about and there are several hot springs. A beautiful lake of about 15 acres called the Telaga occupies the extinct crater of the mountain of the same name. The island is densely inhabited around the coasts, the population being about 50,000. Most of the men go to Java, the Straits, and Sumatra in search of work. Nearly all the saises in Singapore and Penang are Beyanese. One sees but few males between the ages of 18 and 40 in Bawean. The women weave the mats of pandanus, for which the island is famous, and which are exported all over the archipelago. Animal life is not plentiful. Remarkably few birds are to be seen. As for mammals, pigs are very common. The only ones obtained, however, were young—too small to be of any use as specimens. The rusa (*Cervus kuhli*) is not numerous, and is only found in a few localities. The only specimens obtained were three pairs of horns from the kampong of Tombak on the north side of the island. It is more numerous on the hills behind Tombak than at any other place. There is also a porcupine, possibly two species, a musang, a *Manis*, and what appears to be an otter, but they do not seem to be common, and none were obtained. *Pteropus* was very common, but no other bats were seen. The cattle are the tame variety of *Bos sondaicus*, which has been introduced from Bali. They are not used for milk, but are employed to some extent for draft and plowing. A few buffaloes are also kept. There is but little virgin forest left upon Bawean. The largest piece lies upon the northern slopes of the central mountain mass, especially Gunong Besar and the Telaga. There is also a tract upon the west coast which I did not visit, however, and there are some small patches on the eastern and southern slopes of the mountains. The rest of the island is to a great extent covered with small scrub and giant bamboos. Mangos and jack fruit escaped from cultivation form much of the jungle. The scrub is everywhere traversed by the trails formed by the numerous cattle.

ARENDS (OF KERAMIAN) ISLAND, November 24, 1908. (See map, p. 57.)

PULO MATA SIRI, December 7–11, 1907, and November 25–December 1, 1908. Mata Siri is the largest of the Laurot or Laut Kitchil Islands. It is $7\frac{1}{2}$ miles long by $1\frac{1}{2}$ broad, is 1,400 feet high. There is scarcely any level ground, the whole island being hilly, consisting of a long ridge dividing into two peninsulas at its northeast end, inclosing the bay of Telok Sungei. It is a good, safe harbor, and we lay there in security, although the westerly monsoon was blowing strong at the time. The other two islands of the group, Kalambau and Kadapangan, are each about one-half the size of Mata Siri, and each consists of one long ridge. The islands are of granite

formation, with but little coral reef around them. Rats of one species were very plentiful; a very pale *Sciurus vittatus* was common, so was the ordinary long-tailed macaque. I shot one *Pteropus* and a pair of *Cynopterus*, also another bat (*Megaderma?*), but it was lost in the jungle. A muntjac (or kijang) is common, but I only had a glimpse of one. As the island is covered with dense unbroken jungle it is almost impossible to shoot them. The animal only occurs on Mata Siri. It is possible it may have been introduced by man. We heard them barking daily, and they must be very numerous. None of the group is permanently inhabited, but Malays visit the islands from Pulo Laut and Pasir to collect turtles' eggs and birds' nests. Evidently there have been some clearings and cultivations in the past, as there is secondary jungle in some places which is now almost indistinguishable from the original forest. My crew saw a dugong in the bay.

PULO LAUT, December 16-29, 1907. Pulo Laut is a large island lying at the southeast corner of Borneo. The strait separating it is about 30 miles long and from 1 to 3 miles wide. The depth is 4 to 10 fathoms. The island is 55 geographic miles long by 20 wide. The north end is very hilly, the highest points being about 2,300 feet. Most of the rest of the surface is comparatively flat, with isolated hills. There is a large population of Bugis and Banjar people. The higher hills are still mostly covered with heavy forest, but much of the lower land has been cleared for paddy and pepper cultivation. This last is the staple production of the island. Some coal is mined in the hills at the north end. Kota Baru, near the northern entrance to the strait, is the seat of the Dutch Kontroleur of the district, and is quite a busy little place. The mammals of Pulo Laut are as follows: *Rusa* and *Sus barbatus*, both common; some very big pig (*Sus gargantua?*) said to occur; there is said to be a large red flying squirrel; napus were common, and a smaller kanchil was said to be less common, but I did not see it; *Bos sondaicus* may be truly wild (not feral) on Pulo Laut, as it is common on the opposite mainland; it is said to be numerous on Pulo Bira Birahan on the south coast of Pulo Laut; it is only one mile long and must have been introduced there. Gibbons, *Nasalis larvatus*, pig-tailed macaques, and *Mydaus* do not occur on Pulo Laut.

PULO SEBUKU, December 31, 1907-January 5, 1908. Pulo Sebuku lies east of Pulo Laut, from which it is separated by a shallow strait only a mile wide in some places. The strait about the middle has only about a foot of water at low tide. Sebuku is 17½ geographic miles long by about 5 wide. The highest point is only about 400 feet and the whole island is low but not swampy. The surface is mostly rolling. The inhabitants are mostly Bugis and Banjar people. It is thinly inhabited and the surface is still covered with heavy forest. The soil is red. Some black pepper is grown, and billian wood is cut. The Bugis build small praus here. As the strait separating Sebuku from Laut is so shallow, particularly at the northern end, I had to anchor the schooner near the northern end of the island, between the northwest point and the small coconut-covered island of Manti. Here we lay a mile offshore, just afloat at low tide. Rats were very plentiful in the jungle, *Sciurus* "*vittatus*" common; so was the ratufa, which seems much the same as that of Pulo Laut, but is a little smaller. The ordinary long-tailed macaque is the only monkey. A small napu is very common, although I secured but one pair. Pigs and rusa occur, and musangs are said to occur, although I did not meet with them. No tupaias were noticed.

DESCRIPTIONS OF SPECIES, WITH CRITICAL ANNOTATIONS
AND LISTS OF SPECIMENS.

MANIS JAVANICA Desmarest.

1907. *Manis javanica*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 548, December 24, 1907.

Two specimens from Pontianak, collected in 1905.

BOS SONDAICUS Schlegel and Müller.

1839-1844. *Bos sondaicus* SCHLEGEL AND MÜLLER, Verh. Nat. Gesch. Nederl. Bezitt., p. 197, pls. 35-39.

Two specimens, skins and skulls, from Pamukang Bay—an adult female, Cat. No. 154385, collected in 1909, and a female calf, Cat. No. 151865, collected in 1908. The general body color of the adult lies between Ridgway's hazel and chestnut; a conspicuous narrow black stripe extends down the back from behind the shoulders to base of tail; from the base of the neck to the beginning of the black stripe there is an inconspicuous reddish stripe due to a general brightening of the general body color; the general color effect of the head and neck is something between russet and wood brown; the underparts are almost blackish; the "stockings," buttock patch, inside of ears, and the chin vary from dirty white to cream-buff; the tail is long-haired, the upper two-thirds being of the body color, the terminal third blackish. The calf is similarly colored to the adult, but much duller, so that the general effect is much like russet. The colored illustrations of *Bos sondaicus* by Schlegel and Müller are good representations of the present specimens except that the adult female in the plate is rather dull.

Measurements of the adult female: Head and body, 2,060 mm.; tail, 670; hind foot, 560; height at shoulder, 1,280; at rump, 1,310; weight of cut-up carcass without entrails, 386 pounds (175 kilos); estimated live weight, 500 pounds (227 kilos); basal length of skull, 405 mm.; condylo-basal length, 434; zygomatic width, 175; maxillary toothrow, 128; mandibular tooth row, 135.

This was quite common about Pamukang Bay, and I wasted much time in trying to get a specimen. Twice I was close to herds containing good bulls, but all my heavy rifle cartridges had gone bad. The cartridges had been five years on the *Terrapin* [Doctor Abbott's schooner] and the caps would not explode. To what extent these cattle are indigenous and to what extent, if any, feral, it is impossible to say. They are also found wild upon Pulo Laut, and even it is said on the small island of Bira Birahan, near the south end of Laut. They could not have been indigenous on that little island, only a mile long. At the present day very few cattle are kept by the natives. But the praus from Madura and Bali bring up many Bali cattle for beef every year. These and the wild ones look just alike.—W. L. A.

TRAGULUS NAPU BORNEANUS (Miller).

1902. *Tragulus borneanus* MILLER, Proc. Biol. Soc. Wash., vol. 15, p. 174, August 6, 1902.
1907. *Tragulus borneanus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 550, December 24, 1907.

Doctor Abbott has collected thirty specimens of *Tragulus* of the *napu* group in Borneo and on the large Pulo Laut. A careful comparison of these with a large number of specimens from various localities in Sumatra, the type-locality of *napu*, shows that the Sumatran and Bornean *napus* are almost identical in point of size, color, and cranial characters. The Bornean animal averages a very little smaller in most external and cranial measurements. (See table of measurements, p. 66.) At the same time the throat markings are slightly darker and the collar slightly wider than they are in typical *napu*. These differences, however, are very slight and not at all constant, and it is only possible to identify with certainty a little over half the specimens in each series. The specimens from Pulo Laut average slightly smaller in their cranial measurements than do those from Borneo proper, but not enough to justify their recognition as a distinct race. Externally there are no differences. Mr. Gerrit S. Miller, jr.,¹ has lately intimated that the Bornean *napu* would prove to be very closely related to if not identical with the Sumatran one. The following localities are represented in Doctor Abbott's series: Kapuas River, 3; Sempang River, 2; Matan River, 4; Kendawangan River, 3; Saratok River, 1; Pamukang Bay, 4; Pulo Laut, 13.

(For measurements of the adults of this series, together with those of the original series of *Tragulus borneanus* and of Sumatran *napus*, see table, p. 66.)

TRAGULUS SEBUCUS, new species.

Type.—Skin and skull of adult male; Cat. No. 151810, U.S.N.M.; collected on Pulo Subuku, off southeastern Borneo, January 4, 1908, by Dr. W. L. Abbott. Original number, 5736.

Diagnostic characters.—A small member of the *napu* group, similar in size and color to *Tragulus pretiellus* Miller² of Pulo Bakong, Rhio-Linga Archipelago, but blacker above and with posterior pair of dark throat markings almost clear blackish instead of mixed blackish and ochraceous.

Color.—Upper parts of body, a mixture of black and ochraceous, the former in excess; sides of body similar, but the ochraceous lightening to ochraceous buff, or buff; under parts of body white, but much suffused in the middle line with pale ochraceous buff, this latter color also forming a fairly well defined line between the color of the sides and

¹ The Mouse Deer of the Rhio-Linga Archipelago: A Study of Specific Differentiation under Uniform Environment. Proc. U. S. Nat. Mus., vol. 37, p. 4, September 1, 1909.

² Proc. U. S. Nat. Mus., vol. 31, p. 253, September 11, 1906.

that of the under parts; top and sides of head and neck a rather pale or dull tawny ochraceous mixed with some black. A blackish line extends from inner canthus of eye to nose, and on either side of this the tawny ochraceous is rather clear, over a narrow triangular area on top of head it is considerably mixed with black. The usual black nape stripe is barely indicated. Throat pattern composed of four Vs. The first or most anterior V white and bordering the interramial glandular area, except near the middle of the area where there is a small ochraceous spot; second V ochraceous, lined by a few blackish hairs; third V white; fourth V black, except at the point which is prolonged into an ochraceous, slightly mixed with blackish, line about 25 mm. long and passes through the point of the third V to blend with the point of the second V. The sides of the black V are broad and conspicuous. The collar is a mixture of blackish and ochraceous in nearly equal proportions. A narrow line, 2 to 5 mm. wide, mixed blackish and ochraceous in varying proportions, extends from the collar across the white of the chest and into the ochraceous suffusion of the under parts. Outer side of legs mixed tawny ochraceous and blackish, inner side with a narrow white line, bordered on either side by almost clear ochraceous or tawny ochraceous; tail above like back, beneath and at tip white.

Skull and teeth.—Aside from their smaller size for a member of the *napu* group, these show no noteworthy characters.

Measurements.—External measurements of the type and of a paratype, a female with the last permanent molars not yet cut; Cat. No. 151809. Head and body, 485, 490 mm.; tail, 70, 75; hind foot, including hoofs, 123, 125; weight, 2.3, 2.7 kilos. Cranial measurements: Greatest length, 102.7, 95.7 mm.; upper length, 94, 88.2; condylo-basal length, 94.4, 90; greatest length of nasals, 28.6, 27.9; zygomatic breadth, 46.1, 43.5; breadth of braincase above roots of zygomata, 33.8, 32.8; mandible, back of condyle to front of symphysis, 79.7, 74.5; maxillary toothrow, alveoli, 34.6, —¹; mandibular toothrow, alveoli, 38.8, —¹.

Specimens examined.—Two, both from Pulo Sebuku.

Remarks.—Aside from *Tragulus pretiellus*, the only species with which *T. sebecus* needs comparison is *T. nigricans* Thomas.² The latter, however, is a larger animal, “apparently about the size of *T. napu*,” has a more distinct nape stripe, and the throat pattern considerably different. The posterior dark V is black in color to and including the apex of the V, and the apex is not prolonged into a pronounced line different in color from the rest of the V.

¹ Last molars not through alveoli.

² Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 254, March, 1892.

Measurements of adult *napus*.

| Name. | Locality. | Catalogue No. | Sex. | Head and body. ¹ | | Hind foot, including hoofs. ² | Weight. ³ | Condyle-basal length of skull. | Zygomatic width. | Maxillary toothrow (alveoli). |
|----------------------------|-----------------------------|-------------------|-----------|-----------------------------|-------|--|----------------------|--------------------------------|------------------|-------------------------------|
| | | | | mm. | mm. | | | | | |
| <i>T. napu napu</i> | Sumatra, Tapanuli Bay. | 114434 | Male..... | 550 | 70 | 146 | 4.0 | 107.6 | 50.4 | 36.8 |
| Do..... | Sumatra, Siak region.. | 144132 | ..do..... | 554 | 83 | 152 | 4.1 | 103.9 | 51.6 | 36.0 |
| Do..... | ..do..... | 144133 | ..do..... | 590 | 100 | 156 | 4.2 | 108.5 | 50.8 | 34.8 |
| Do..... | ..do..... | 144136 | Female | 550 | 90 | 154 | 4.1 | 104.4 | 53.2 | 38.7 |
| Do..... | ..do..... | 144139 | ..do..... | 550 | 100 | 150 | 4.2 | 103.8 | 51.3 | 36.4 |
| Do..... | Sumatra, Aru Bay..... | 143481 | Male | 583 | 92 | 147 | 4.0 | 111.9 | 52.3 | 41.7 |
| Do..... | ..do..... | 143483 | ..do..... | 565 | 90 | 146 | 3.6 | 107.7 | 51.2 | 40.5 |
| <i>T. napu borneanus</i> . | Borneo, Suanalamba River. | 413222 | ..do..... | ..... | ..... | ⁵ 146 | ..... | 101.8 | 49.2 | 39.6 |
| Do..... | Borneo, Kinabatangan River. | 34905 | Female | ..... | ..... | ..... | ..... | 107.8 | 50.0 | 34.3 |
| Do..... | ..do..... | 12188 | ..do..... | ..... | ..... | ⁵ 145 | ..... | 103.8 | 51.4 | 37.8 |
| Do..... | Borneo, Sapagaya River. | 34833 | ..do..... | ..... | ..... | ⁵ 136 | ..... | 103.7 | 52.4 | 36.6 |
| Do..... | ..do..... | 13215 | ..do..... | ..... | ..... | ⁵ 130 | ..... | 107.6 | 46.3 | 36.0 |
| Do..... | ..do..... | 34336 | ..do..... | ..... | ..... | ⁵ 131 | ..... | 108.5 | ..... | 31.0 |
| Do..... | Borneo, Kapuas River | 49772 | Male | ..... | ..... | ..... | ..... | 103.6 | 48.3 | 36.9 |
| Do..... | ..do..... | 142345 | ..do..... | ..... | ..... | ..... | ..... | 96.7 | 48.6 | 36.5 |
| Do..... | ..do..... | 142346 | Female | 545 | 85 | 140 | 4.6 | 100.8 | 49.6 | 37.7 |
| Do..... | Borneo, Matan River.. | 145345 | Male | 565 | 85 | 157 | 4.1 | 105.5 | 50.9 | 37.8 |
| Do..... | Borneo, Kendawangan River. | 153753 | ..do..... | 525 | 65 | 147 | 3.2 | 104.9 | 49.4 | 35.5 |
| Do..... | ..do..... | 153743 | Female | 560 | ..... | 148 | 4.5 | 107.0 | 52.7 | 36.8 |
| Do..... | ..do..... | 153755 | ..do..... | 531 | 85 | 143 | 2.8 | 101.1 | 48.6 | 36.3 |
| Do..... | Borneo, Saratok River | 151811 | Male | 545 | 83 | 147 | 4.0 | 108.5 | 50.5 | 36.3 |
| Do..... | Borneo, Pamukang Bay. | 151813 | ..do..... | 550 | 90 | 140 | 3.5 | 104.0 | 52.3 | 38.0 |
| Do..... | ..do..... | 151814 | ..do..... | 565 | 70 | 148 | 3.7 | 111.0 | 51.6 | 36.9 |
| Do..... | Borneo, Balik Papan Bay. | 154344 | ..do..... | 535 | 100 | 142 | ..... | 107.0 | 50.0 | 37.5 |
| Do..... | ..do..... | 154346 | ..do..... | 550 | 70 | 142 | ..... | 105.0 | 48.0 | 37.6 |
| Do..... | ..do..... | 154345 | Female | 572 | 98 | 147 | ..... | 105.5 | 49.0 | 37.8 |
| Do..... | Pulo Laut..... | 151798 | Male | 550 | 90 | 150 | ..... | 101.3 | 46.8 | 39.1 |
| Do..... | ..do..... | 151800 | ..do..... | 520 | 80 | 145 | 3.2 | 100.7 | 46.5 | 38.5 |
| Do..... | ..do..... | 151802 | ..do..... | 550 | 80 | 148 | 3.5 | 103.0 | 48.0 | 38.0 |
| Do..... | ..do..... | 151806 | ..do..... | 525 | 90 | 144 | 3.3 | 101.0 | 47.7 | 38.8 |
| Do..... | ..do..... | 151808 | ..do..... | 532 | 80 | 141 | 3.6 | 101.6 | 49.5 | 37.3 |
| Do..... | ..do..... | 151796 | Female | 520 | 80 | 146 | ..... | 106.4 | 48.6 | 37.7 |
| Do..... | ..do..... | 151801 | ..do..... | 570 | 83 | 152 | 4.2 | 103.4 | 49.7 | 38.7 |
| Do..... | ..do..... | 151803 | ..do..... | 572 | 75 | 149 | 4.1 | 105.7 | 50.0 | 35.8 |

¹ Collector's measurements.² Measured by writer.³ Collector's measurements in pounds and quarters computed into kilograms.⁴ Type.⁵ This measurement can be considered approximate only.

TRAGULUS KANCHIL LONGIPES Lyon.

1907. *Tragulus hosei*, LYON (not of Bonhote), Proc. U. S. Nat. Mus., vol. 33, p. 549, December 24, 1907.1908. *Tragulus kanchil longipes* LYON, Proc. U. S. Nat. Mus., vol. 34, p. 628, September 14, 1908.

Doctor Abbott has collected a total of twenty-five specimens of *Tragulus* of the *kanchil* group in western and southwestern Borneo and one in southeastern Borneo. The following localities are represented: Kapuas River, 1; Sempang River, 9; Batu Jurong, 1; Kendawangan River, 14, and Balik Papan Bay, 1. It is with much hesitation that I have referred them to *Tragulus kanchil longipes*, the type-locality of which is the lowlands of eastern Sumatra, but I can find no essential

differences, however, between them. The necks of the Bornean specimens are perhaps not so brightly colored as are those of the Sumatran examples. Only one Bornean skin, Cat. No. 153740, from the Kendawangan River, has a distinct yellowish coloration, resembling the *Tragulus fulvicollis*¹ type, instead of several such specimens, as in the case of the Sumatran series. The length of hind foot, including the hoof, is essentially the same in the two series, and it is distinctly longer than it is in the typical Sumatran kanchils from Aru Bay and Tapanuli Bay. (See table of measurements, p. 68.) A careful study of this table shows that the range of variation of the Bornean skulls is slightly greater than that of typical *kanchil* skulls from Sumatra; and that the skulls of males and females in Borneo are of essentially the same size, the males showing, however, more variation. In the Sumatran series, on the contrary, the skulls of females average larger than do those of the males.

The relationship of the present series of kanchils from southwestern Borneo with *Tragulus hosei* (Bonhote)² of northern Borneo is not at all clear. The latter species is represented in the National Museum by the type of *T. virgicollis* Miller³ and two poor skins, badly made up and much discolored by a salt-and-alum pickling fluid, from northern Borneo. The skulls of these three specimens are indistinguishable from skulls of *T. kanchil* or *T. kanchil longipes*. The skins, however, show the nape stripe to be darker, narrower, and better defined than it is in any of the Sumatran or west Bornean specimens. The Mount Dulit specimen has rather long hind feet; the hind feet of the other two from north Borneo appear shorter, but reliable measurements can not be taken from them.

At present, judging by the material at hand, I believe that three forms of small *Tragulus* occur in Sumatra and Borneo: *T. kanchil kanchil*, from northern and western Sumatra; *T. kanchil longipes*, from the swampy lowlands of eastern Sumatra and the swampy lowlands of western and southwestern Borneo; *T. kanchil hosei*, from northern Borneo.

(For measurements see table, p. 68.)

TRAGULUS CARIMATÆ Miller.

1906. *Tragulus carimatæ* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 55, July 23, 1906.

Four specimens of a kanchil taken on Pulo Panebangan may be referred to *Tragulus carimatæ* Miller. The skins average darker and the nape stripe wider and darker than they do in specimens from the mainland of Borneo. Of the four specimens only one is adult. It

¹ Proc. U. S. Nat. Mus., vol. 34, p. 630, September 14, 1908. Type-locality, Pulo Bengkalis, off east coast of Sumatra.

² Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 239, March 1903.

³ Proc. Biol. Soc. Wash., vol. 16, p. 37, March 19, 1903.

has the long maxillary tooth-row of *T. carimatæ*. Sixteen specimens from Karimata in 1904.

Measurements of the adult, Cat. No. 145352, male: Head and body, 475 mm.; tail, 78; hind foot, including hoofs, 125; weight, 2.2 kilos; condylo-basal length of skull, 90.2; zygomatic width, 44.1; maxillary tooth-row, alveoli, 35.

Measurements of adult kanchils.

| Name. | Locality. | Catalogue No. | Sex. | Head and body. ¹ | | Hind foot, including hoofs, ² | Weight. ³ | Condylo-basal length of skull. | Zygomatic width. | Maxillary toothrow (alveoli). |
|-----------------------------|-----------------------------|------------------|-----------|-----------------------------|-------|--|----------------------|--------------------------------|------------------|-------------------------------|
| | | | | Tall. ¹ | mm. | | | | | |
| <i>T. kanchil</i> | Sumatra, Aru Bay..... | 143488 | Male..... | 442 | 75 | 123 | 1.7 | 86.0 | 43.0 | 31.7 |
| Do..... | do..... | 143489 | do..... | 456 | 70 | 126 | 1.5 | 87.4 | 43.3 | 32.0 |
| Do..... | do..... | 143492 | do..... | 445 | 65 | 116 | 1.7 | 84.0 | 43.5 | 30.6 |
| Do..... | do..... | 143497 | do..... | 460 | 70 | 122 | ..... | 87.5 | 43.3 | 33.0 |
| Do..... | do..... | 143493 | Female.. | 470 | 80 | 125 | 1.8 | 88.6 | 45.0 | 33.3 |
| Do..... | do..... | 143494 | do..... | 450 | 70 | 120 | ..... | 88.2 | ..... | 30.5 |
| Do..... | do..... | 143495 | do..... | 455 | 75 | 114 | 1.9 | 90.3 | 44.7 | 34.4 |
| Do..... | do..... | 143496 | do..... | 490 | 85 | 128 | 2.2 | 92.2 | 45.7 | 32.9 |
| Do..... | do..... | 143498 | do..... | 457 | 70 | 121 | ..... | 89.9 | 43.2 | 32.9 |
| Do..... | do..... | 143499 | do..... | 470 | 80 | 124 | 2.2 | 91.4 | 42.9 | 32.2 |
| Do..... | Sumatra, Tapanuli Bay. | 114419 | Male..... | 432 | 75 | 117 | 1.6 | 84.4 | 40.6 | 31.7 |
| Do..... | do..... | 114420 | do..... | 442 | 95 | 129 | 1.6 | 85.9 | 41.8 | 32.7 |
| Do..... | do..... | 114427 | do..... | 430 | 70 | 123 | 1.6 | 87.0 | 41.7 | 33.0 |
| Do..... | do..... | 114426 | do..... | 425 | 60 | 121 | 1.5 | 85.8 | 41.6 | 31.3 |
| Do..... | do..... | 114421 | Female.. | 468 | 80 | 128 | 1.8 | 88.7 | 42.4 | 32.2 |
| Do..... | do..... | 114422 | do..... | 457 | 80 | 128 | 1.8 | 86.6 | 42.2 | 33.4 |
| Do..... | do..... | 114423 | do..... | 470 | 75 | 121 | 1.8 | 84.4 | 41.4 | 31.5 |
| Do..... | do..... | 114424 | do..... | 465 | 70 | 122 | 1.8 | 87.5 | 42.5 | 33.8 |
| Do..... | do..... | 114425 | do..... | ..... | ..... | ..... | ..... | 87.3 | 39.9 | 32.0 |
| <i>T. k. hosii</i> | Borneo, Kinabatangan River. | 143191 143192 | Male..... | ..... | ..... | 126 | ..... | 92.4 | 46.5 | 31.3 |
| Do..... | Borneo, Sandakan | 143182 143183 | Female.. | ..... | ..... | 133 | ..... | 87.7 | 43.0 | 33.0 |
| Do..... | Borneo, Mount Dulit..... | 5 83941 | Male..... | ..... | ..... | 133 | ..... | ..... | ..... | ..... |
| <i>T. k. longipes</i> | Borneo, Kapuas River.. | 142348 | do..... | 482 | ..... | 135 | 2.2 | 88.2 | 43.6 | 34.3 |
| Do..... | Borneo, Sempang River. | 145354 | do..... | 475 | 77 | 142 | 1.9 | 86.4 | 43.5 | 32.8 |
| Do..... | do..... | 145355 | do..... | 460 | 77 | 141 | ..... | 92.4 | 43.8 | 30.4 |
| Do..... | do..... | 145357 | do..... | 432 | 75 | 139 | 1.6 | 84.1 | 41.7 | 30.2 |
| Do..... | do..... | 145358 | do..... | 458 | 77 | 144 | 2.0 | 91.4 | 42.1 | 32.8 |
| Do..... | do..... | 145359 | do..... | 440 | 60 | 139 | ..... | 88.0 | 41.2 | 30.4 |
| Do..... | do..... | 145360 | do..... | 450 | 60 | 139 | ..... | 84.9 | 43.4 | 29.9 |
| Do..... | do..... | 145361 | do..... | 485 | 70 | 148 | ..... | 93.8 | 43.9 | 31.0 |
| Do..... | do..... | 145356 | Female.. | 470 | 75 | 140 | ..... | 86.3 | 41.7 | 30.0 |
| Do..... | do..... | 145362 | do..... | 461 | 75 | 137 | ..... | 85.4 | 40.3 | 33.8 |
| Do..... | Borneo, Kendawangan River. | 153740 | Male..... | 450 | 75 | 131 | ..... | 89.9 | 42.9 | 32.2 |
| Do..... | do..... | 153742 | do..... | 445 | 75 | 130 | ..... | 87.5 | 42.0 | 33.8 |
| Do..... | do..... | 153744 | do..... | 445 | 65 | 130 | ..... | 88.3 | 42.5 | 31.7 |
| Do..... | do..... | 153748 | do..... | 450 | 85 | 133 | ..... | 92.2 | 42.4 | 32.4 |
| Do..... | do..... | 6 153752 | do..... | 455 | 65 | 135 | ..... | 84.2 | 40.8 | 29.4 |
| Do..... | do..... | 153754 | do..... | ..... | ..... | ..... | ..... | 81.5 | 40.3 | 29.9 |
| Do..... | do..... | 153739 | Female.. | 465 | 75 | 127 | ..... | 88.8 | 40.6 | 34.0 |
| Do..... | do..... | 153745 | do..... | 425 | 65 | 125 | ..... | 82.5 | 40.4 | 30.4 |
| Do..... | do..... | 153749 | do..... | ..... | ..... | 135 | ..... | 88.4 | 41.8 | 32.2 |
| Do..... | do..... | 153751 | do..... | 460 | 75 | 128 | ..... | 87.7 | 43.0 | 32.6 |
| Do..... | Borneo, Balik Papan Bay. | 154350 | Male..... | 460 | 85 | 126 | ..... | 89.0 | 44.0 | 32.4 |

¹ Collector's measurements.

² Measured by writer.

³ Collector's measurements in pounds and quarters computed to kilograms.

⁴ Measurements only approximate.

⁵ Type of *Tragulus virgicollis*.

⁶ Skulls only.

RUSA BROOKEI (Hose).

1893. *Cervus brookei* HOSE, Ann. Mag. Nat. Hist., ser. 6, vol. 12, p. 206.
1906. *Rusa brookei*, LYON, Proc. U. S. Nat. Mus., vol. 31, p. 585, December 18, 1906.
1907. *Rusa brookei*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 550, December 24, 1907.

Twenty-three individuals of *Rusa brookei* are represented in Doctor Abbott's recent collections from southwestern and southeastern Borneo, sixteen of them by antlers obtained from natives, and four by skins and skulls, and the remaining three by skulls and scalps. Two specimens were obtained along the Kapuas River in 1905. (For exact localities and the external, cranial, and antler measurements see tables, p. 70.)

It is possible that more than one species is represented by this material. The skulls of the male specimens from southeastern Borneo average somewhat smaller than the skull of a fully adult male from the Sempang River. The skins of those from southeastern Borneo are decidedly different from that obtained in southwestern Borneo, but the difference is probably one of pelage. It is seen most clearly on the lower back. In the Sempang skin the color appears uniformly dark brownish, although the hairs are very light in color at the base; none of the hairs are annulated. In the specimens from southeastern Borneo the color is very bright and "reddish," and a distinct grizzling is conspicuous. The individual hairs are almost whitish at their bases, gradually changing to a dark brownish about the middle portion, followed by a well-marked bright hazel ring and a blackish terminal band. A more or less well-defined blackish-brown stripe extends along the back of the animal. The pelage difference appears to be independent of season. The three specimens showing the grizzling were collected in February, April, and November, respectively; the dark ungrizzled skin was collected in August.

The single specimen from Pulo Laut shows no noteworthy difference from the mainland individuals.

Generally common, especially about Pamukang Bay. Those found on Pulo Laut had much finer horns than those on the mainland. Two heads obtained at Pamukang Bay have extremely poor horns, but they are certainly not immature. Probably the food is better on Laut. There is good pasturage there. The carcasses of deer from both places are about the same size.—W. L. A.

External and cranial measurements of Bornean sambars.

| Locality. | Catalogue No. | Sex. | Age. | Head and body. ¹ | Tail. ¹ | Hind foot. ¹ | Height at shoulders. ¹ | Weight. ² | Condylo-basal length of skull. | Maxillary tooththrow. | Zygomatic width. |
|--------------------|---------------|---------------------|-----------------------------|-----------------------------|--------------------|-------------------------|-----------------------------------|----------------------|--------------------------------|-----------------------|------------------|
| | | | | mm. | mm. | mm. | mm. | kilos. | mm. | mm. | mm. |
| Sempang River..... | 145369 | Male..... | Nearly adult ³ . | 1,720 | 320 | 570 | 980 | ..... | 339 | 107 | 124 |
| Do..... | 145370 | do..... | Adult..... | ..... | ..... | ..... | ..... | ..... | 364 | 103 | 134 |
| Saratok River..... | 151859 | Female ⁴ | do..... | 1,780 | 290 | 540 | 1,050 | ⁵ 91 | 338 | 104 | 138 |
| Pamukang Bay..... | 151860 | Male..... | Old..... | ..... | ..... | ..... | ..... | ..... | 333 | 90 | 133 |
| Do..... | 151861 | do..... | Adult, young. | 1,600 | 240 | 480 | 1,040 | ..... | 320 | 103 | 136 |
| Do..... | 154382 | Female | do..... | 1,670 | 220 | 510 | 1,000 | ⁶ 69 | 320 | 96 | 134 |
| Pulo Laut..... | 151858 | do..... | Adult..... | ..... | ..... | ..... | ..... | ..... | 321 | 97 | 136 |

RUSA KUHLII (Müller and Schlegel).

1839-44. *Cervus kuhlii* MÜLLER AND SCHLEGEL, Verh. Nat. Gesch. Nederl. Bezitt., p. 223.

Three pairs of antlers of this small deer were brought back by Doctor Abbott, from the island of Bawean, the type-locality. (For measurements see the last three specimens mentioned in the table below.)

Measurements of antlers of Sambars from Borneo and Pulo Bawean.

| Locality. | Catalogue No. | Circumference of antler above burr. | Circumference of antler above brow tine. | Length of antler along convexity of curve. | Burr to tip of brow tine along convexity. | Tip of apical tine to its angle with main trunk of antler. |
|--------------------------|----------------------|-------------------------------------|--|--|---|--|
| | | mm. ⁷ | mm. ⁷ | mm. ⁷ | mm. ⁷ | mm. ⁷ |
| Upper Sempang River..... | 145369 | 80 (8) | 65 (8) | 231 (8) | (9) (8) | (9) (8) |
| Do..... | 145370 | 154 143 | 109 102 | 370 406 | 122 115 | 67 70 |
| Pulo Bauwal..... | 153773 | 146 147 | 107 107 | 412 410 | 234 236 | 30 37 |
| Kendawangan River..... | 153774 | 175 178 | 131 130 | 409 395 | 128 122 | 50 80 |
| Do..... | 153775 | 164 160 | 118 115 | 435 442 | 208 217 | 75 67 |
| Do..... | 153776 | 136 135 | 100 95 | 394 405 | 215 212 | (10) 15 |
| Do..... | 153777 | 112 111 | 93 90 | 435 423 | 167 161 | 51 46 |
| Do..... | 153778 | 172 177 | 102 105 | 415 407 | 200 187 | 52 50 |
| Do..... | 153779 | 145 146 | 122 116 | 416 405 | 235 239 | 108 80 |
| Do..... | 153780 | 145 142 | 160 103 | 496 467 | 147 188 | 43 39 |
| Do..... | 153781 | 171 75 | 122 (11) | 450 195 | 215 (11) | 1270 (11) |
| Mambulah River..... | 153782 | 163 163 | 108 103 | 466 440 | 245 248 | 70 78 |
| Do..... | 153783 | 220 (13) | 178 (13) | 445 (13) | 218 (13) | 140 (13) |
| Mankol..... | 153784 | 200 204 | 167 170 | 432 435 | 205 233 | 72 60 |
| Pulo Laut..... | 151856 | 167 163 | 148 146 | 545 562 | 200 195 | 108 125 |
| Do..... | 151857 | 157 167 | 110 110 | 436 435 | 240 230 | 72 76 |
| Pamukang Bay..... | ¹⁴ 151860 | 98 98 | 82 81 | 319 341 | 68 60 | 78 5 |
| Do..... | 151861 | 101 100 | 85 81 | 287 274 | 105 95 | (15) (15) |
| Upper Pasir River..... | 154413 | 172 173 | 139 139 | 438 435 | (16) 255 | 70 65 |
| Saratok River..... | 154414 | 150 149 | 120 112 | 472 485 | 185 172 | 136 111 |
| Bawean Island..... | 151853 | 95 95 | 62 64 | 324 315 | 118 110 | 73 80 |
| Do..... | 151854 | 112 115 | 75 75 | 372 374 | 192 165 | 60 66 |
| Do..... | 151855 | 102 105 | 70 70 | 354 358 | 142 136 | 90 83 |

¹ Collector's measurements.

² Collector's figures in pounds computed to kilograms.

³ Last molars about half way through alveoli.

⁴ Embryo in uterus.

⁵ Estimated by collector.

⁶ Gutted.

⁷ First figure, left antler; second, right antler.

⁸ Broken off.

⁹ Immature, last molars just coming through, brow tine alone present.

¹⁰ Absent.

¹¹ Spike antler on right side.

¹² A two pointed tine.

¹³ A left dropped antler only.

¹⁴ Fully adult as judged by toothwear, but note small size of antlers.

¹⁵ Antlers deformed.

¹⁶ Broken.

MUNTIACUS PLEIHARICUS Kohlbrugge.

1896. *Cervulus pleiharicus* KOHLBRUGGE, Natuurk Tijdschr. Nederlandsch-Indië, vol. 55, p. 192, and plate facing p. 260. Type-locality, Pleihari, southeastern Borneo.

In 1906¹ I described as new a muntjac from the island of Banka, comparing it with specimens of *Muntiacus moschatus* from Sumatra, and with three Bornean muntjacs. At that time I assumed that there was only one species of muntjac on Borneo and used Kohlbrugge's name *pleiharicus* for it, thinking that the antlers he figured were slight variations from the normal type and having seen a pair of similar looking antlers from Tenasserim. Two of those Bornean specimens are females and the third is a pair of antlers from the Sakaïam River. With the much more abundant material that has been collected by Doctor Abbott in Borneo, I quite agree with Kohlbrugge that two distinct forms of muntjac occur on Borneo, and now consider that the two female specimens were correctly identified as *M. pleiharicus* in 1906, but that the single pair of antlers do not represent *M. pleiharicus* but belong to a species to be described below and of which the Banka animal is merely a slightly smaller geographic race.

Doctor Abbott secured six specimens of *Muntiacus pleiharicus*, three from southwestern and three from southeastern Borneo; one young female, two immature males, and three adult males. The antlers of the adult males represent a much more extreme type than do those figured by Kohlbrugge. It is not improbable, however, that they are newly-formed antlers, although the bone forming them looks fully mature and as if they had not been recently covered with velvet. The following is a description of *M. pleiharicus* based on Doctor Abbott's specimens:

General color of the animal a light, dull ochraceous, somewhat like ochraceous-buff, darker and brighter along the middle line of the back and neck, where there is a considerable admixture of a brown somewhat like Prout's forming an indistinct dorsal line; ears dull brownish on the outside, whitish on the inside; bases of ears similar to adjacent portions of head; chin, under side of neck, inner side of fore legs, and inguinal region whitish to cream-buff; hind legs and outer side of fore legs similar to the general pale ochraceous head and body color, except for a slight admixture of brownish along the lower legs, most marked on the fore legs; tail whitish, with a narrow dorsal stripe of dark brownish slightly mixed with ochraceous. Compared with the other species of Bornean muntjac, Cat. No. 151863, adult male from Pamukang Bay, *M. pleiharicus* is very different. The general color of the other is a bright reddish-brown,

¹ Proc. U. S. Nat. Mus., vol. 31, p. 582, December 24, 1906.

very similar to Ridgway's ferruginous, with a fine black grizzle, while the legs are dark brownish, in marked contrast to the ochraceous legs of *M. pleiharicus*.

There are three good adult male skulls of *M. pleiharicus*, each of them with little short spike antlers terminating much longer, slender pedicles. Unlike the antlers figured by Kohlbrugge, none of them show burrs. The length of the antlers vary between 22 and 35 mm., decidedly shorter than those figured by Kohlbrugge. The skulls of the other two males are immature, showing long, slender pedicles of soft, spongy bone, with as yet no differentiation of the tip into hard antler substance.

The most striking characters of the skull of *M. pleiharicus* are its smaller size and shorter and much slenderer antler pedicles. In addition to these, it differs in several minor details, such as extensive articulation of the upper extremity of the premaxilla with the nasal instead of just meeting the nasal; superior portion of the lachrymal, above the large pit, much narrower, the anterior supero-external surface of the malar narrower and more pointed; the arch over the posterior nares not smooth and rounded but marked by a more or less well-defined, rounded ridge, part of the basisphenoids; and interparietal about twice as wide as it is long, instead of about three times. The teeth of the two forms of Bornean muntjac do not show any striking differences; they are about the same size in the two species, hence relatively larger in *M. pleiharicus*. (See pl. 1, figs. 2 and 4, and pl. 2, upper figure.)

(For external and cranial measurements, see table below.)

External and cranial measurements of Bornean muntjacs.

| Name. | Locality. | Catalogue No. | Sex. | Age. | Head and body. ¹ | | Hind foot. ¹ | Height of shoulders. ¹ | Weight. ² | Condylar-basal length of skull. | Maxillary toothrow. | Zygomatic width. |
|--------------------------|--------------------|---------------------|--------|--------------------|-----------------------------|-------|-------------------------|-----------------------------------|----------------------|---------------------------------|---------------------|------------------|
| | | | | | mm. | mm. | | | | | | |
| <i>M. pleiharicus</i> .. | Kendawangan River. | 153769 | Female | Young ³ | 820 | 170 | 270 | 490 | 10 | 147 | 335 | 62 |
| Do..... | do..... | 153770 | Male | do. ⁴ | 913 | 170 | 272 | ..... | 13 | 158 | 447 | 75 |
| Do..... | do..... | 153771 | do. | Old | ..... | ..... | ..... | ..... | ..... | 171 | 46 | 77 |
| Do..... | Klumpang Bay. | 151862 | do. | Adult | 905 | 170 | 275 | 520 | 16 | 178 | 57 | 82 |
| Do..... | Pamukang Bay. | 151864 | do. | Young ⁴ | 850 | 185 | 270 | 525 | ⁶ 9 | 166 | 447 | 73 |
| Do..... | do..... | 154384 | do. | Adult | 900 | 150 | 272 | 540 | 14.5 | 167 | 52 | 78 |
| <i>M. rubidus</i> | do..... | ⁶ 151863 | do. | do. | 1,000 | 170 | 290 | 580 | ⁶ 16.3 | 186 | 54 | 88 |
| Do..... | Pulo Mata Siri | 154383 | Female | do. | 1,006 | 150 | 254 | 518 | 25 | 185 | 54 | 88 |
| <i>M. bancanus</i> | Banka | ⁶ 124726 | do. | do. | 920 | 120 | 235 | 450 | 14 | 177 | 54 | 74 |
| Do..... | do..... | 124752 | do. | do. | 970 | 110 | 250 | 470 | ⁷ 19 | 179 | 55 | 77 |

¹ Collector's measurements.

² Collector's measurements in pounds and quarters computed to kilograms.

³ Second and third molars not through alveoli.

⁴ Last molars not through alveoli.

⁵ Gutted.

⁶ Type.

⁷ Uterus contained a nearly mature embryo.

MUNTIACUS RUBIDUS, new species.

1907. *Muntiacus pleiharicus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 550, December 24, 1907. (One pair of antlers from the Sakaïam River.)

Type.—Skin and skull of adult male, Cat. No. 151863, U.S.N.M., collected at Pamukang Bay, southeastern Borneo, March 20, 1908, by Dr. W. L. Abbott. Original number, 5907.

Diagnostic characters.—A medium-sized member of the genus, much larger and darker in color than *Muntiacus pleiharicus* of Borneo, smaller than *M. moschatus* of Sumatra, and closely resembling *M. bancanus*¹ of Banka, but slightly larger and with darker and longer legs.

Color.—*Type*: General color of upper parts of body hazel, richer and darker in the median line and over the hind quarters, everywhere with a fine blackish grizzle, on the shoulders the hazel paling almost to ochraceous; neck a mixture of dull tawny ochraceous and blackish, the two colors about equally mixed on the sides, and the blackish in excess above; face dull brownish; top of head bright hazel; outer surface of ears dull hazel, except blackish margins; inner surface of ears whitish; covering of pedicles hazel, with a conspicuous black line running down them and continued down on the face over the eyes; sides of head similar to sides of neck; chin and upper portion of throat whitish; underside of neck generally clay color with darker grizzling; middle line of chest and upper belly brownish, something like hair brown, lightening laterally to drab, which gradually blends with the grizzle of tawny ochraceous and blackish of the sides of the body; inguinal and axillary regions whitish, the light color extending part way down the inner side of the legs; outer side of forelegs blackish brown, a narrow area on inner side tawny ochraceous, a small indistinct tawny ochraceous spot above each half hoof; hind legs somewhat darker than forelegs, the inner side being lighter only as far as the heel, a very ill-defined tawny spot above each half hoof; tail deep rich hazel above, white on the sides and below.

Antlers.—Normal for the genus, those on the type rather smaller than usual, and the left one injured. (See pl. 3, figs. 1 to 7, pl. 1, figs. 1 and 3, and pl. 2, lower figure.)

Skull and teeth.—The skull of *Muntiacus rubidus* is at once distinguished from that of *M. pleiharicus* by its much larger size, stouter antler pedicles, and a marked concavity on its dorsal aspect at the posterior end of the nasals. It is, however, very similar to the skull of *M. bancanus*, the main distinguishing characters being larger size and shorter antero-posterior diameter of the interparietal. The teeth in *M. rubidus* have about the same size that they do in *M. bancanus*

¹ Lyon, Proc. U. S. Nat. Mus., vol. 31, p. 582, December 18, 1906.

and hence are relatively smaller. (See pl. 1, figs. 1 and 3, and pl. 2, lower figure.)

Measurements.—See table, p. 72.

Specimens examined.—Two, the type and an adult female, Cat. No. 154383, from Pulo Mata Siri, and the frontlets and antlers of twenty specimens, one from the Sakaiam River and nineteen from the Kendawangan River.

Remarks.—*Muntiacus rubidus* is very distinct from the other Bornean muntjac, and is very readily separable from the larger Sumatran animal. It closely approaches the muntjac of Banka, of which it is scarcely more than a subspecies. This is another illustration of the close relation existing between the animals of Borneo and Banka. I have referred the adult female from Pulo Mata Siri to *M. rubidus*, because the skulls of the two specimens are almost exactly alike. The skin of the Mata Siri specimen, however, is lighter in color, and the legs are not nearly so dark. I can not believe that the muntjac on Mata Siri is indigenous, but think it must have been brought rather recently to the island from the mainland of Borneo.

SUS "VITTATUS."

1906. *Sus vittatus*, MILLER, Proc. U. S. Nat. Mus., vol. 30, p. 748, June 13, 1906.

Two pigs of the *Sus vittatus* groups were collected on Bawean Island. Neither of them is fully mature. The older, Cat. No. 151841, has the last molars not quite level with the rest of the toothrow; the younger, Cat. No. 151840, has the last molars just breaking through the alveoli. The skull measurements of the two specimens are respectively: Upper length of skull, 330, 290; zygomatic width, 132, 120; parietal constriction, 37, 31; maxillary toothrow, 108, —; m^2 , 20 x 16, 20 x 16; m^3 , 31 x 18, —.

SUS BARBATUS Müller.

1839. *Sus barbatus* MÜLLER, Tijdschr. Natuurl. Gesch. Physiol., vol. 5, p. 149.
(Type-locality, Banjermassing.)

1906. *Sus barbatus*, MILLER, Proc. U. S. Nat. Mus., vol. 30, p. 739, June 13, 1906.

1907. *Sus barbatus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 550, December 24, 1907.

In addition to the six skulls of *Sus barbatus* obtained from the natives along the Landak River in 1905, Doctor Abbott has since obtained twenty-nine adult specimens of this pig from Borneo, and adjacent islands. (See tables on pp. 76 and 77 for a list of these specimens, with their external and cranial measurements.) The four adult specimens from Pulos Pelapis and Panebangan average somewhat smaller than specimens from the mainland, and their teeth show relatively more wear in proportion to their age, as judged by skull sutures. I can find no satisfactory structural characters by which they may be distinguished from mainland animals. The

excessive wear of the teeth on these island specimens is probably due to some difference in the character of the food on the island as compared with the Bornean mainland.

One of the females had four fetuses in utero, another seven, one nine, one ten, and another eleven. One female had seven young with her.

Very common about Pamukang Bay. Have never been in a place where pigs were as common as in some localities in this district. For some reason I got only three boars, but the sows with their young simply abounded. Twice while the schooner was anchored at Tanjong Kramet droves of pigs attempted to swim across Klumpang Bay. I was absent up river at the time. My Malay skipper went after them in a small boat and bagged an old boar with a club. On the other occasion thirteen pigs swam close to the vessel, but no boat was available and they passed without molestation. Sometimes they get into kelongs (fish fykes) at low tide. The sows appear to go in gangs of three to five, both when pregnant and when they have their young. It appears to take most of their time to procure sufficient food when suckling, for I met with these gangs roaming about nearly all day. *Sus gargantua* does not appear to occur in this district (Klumpang Bay region). No one had ever seen or heard of it. A small black hairy pig is said to be locally plentiful. The Dyaks call it "By wangi" (literally moon-pig). I saw nothing of it. It was said to be very small, the males, with tusks, the size of goats or less. It is probably some sort of *Sus vittatus*.—W. L. A.

Measurements of male *Sus barbatus* from Borneo.

| Dimensions. | Pulo Panebangan, Cat. No. 145290, male, m^3 very much worn. | Pulo Panebangan, Cat. No. 145291, male, m^3 moderately worn. | Pulo Pelapis, Cat. No. 145288, male, m^3 very much worn. | Pulo Pelapis, (cat. No. 145289, male, m^3 moderately worn. | Sempang River, Cat. No. 145292, male, m^3 much worn. | Sempang River, Cat. No. 145293, male, m^3 slightly worn. | Sempang River, Cat. No. 145296, male, m^3 moderately worn. | Sempang River, Cat. No. 145299, male, m^3 slightly worn. | Sungai Matan, Cat. No. 145297, male, m^3 much worn. | Selok, Cat. No. 145298, male, m^3 very slightly worn. | Kumpang Bay, Cat. No. 15158, male, m^3 moderately worn. | Pangkajene River, Cat. No. 15159, male, m^3 very much worn. | Pamaukang Bay, Cat. No. 151581, male, m^3 much worn. | Pasi River, Cat. No. 145276, male, m^3 moderately worn. |
|---|---|--|--|--|--|--|--|--|---|---|---|---|--|---|
| Head and body*..... | mm. 1,410 | mm. 1,470 | mm. 1,475 | mm. 1,500 | mm. 1,440 | mm. 1,467 | mm. 1,485 | mm. 1,431 | mm. 1,429 | mm. 427 | mm. 427 | mm. 447 | mm. 454 | mm. 436 |
| Tail*..... | mm. 230 | mm. 235 | mm. 250 | mm. 250 | mm. 245 | mm. 245 | mm. 245 | mm. 214 | mm. 230 | mm. 220 | mm. 220 | mm. 226 | mm. 235 | mm. 227 |
| Hind foot*..... | mm. 277 | mm. 280 | mm. 304 | mm. 310 | mm. 146 | mm. 146 | mm. 146 | mm. 131 | mm. 125 | mm. 124 | mm. 124 | mm. 150 | mm. 135 | mm. 128 |
| Height at shoulder*..... | mm. 710 | mm. 770 | mm. 720 | mm. 790 | mm. 361 | mm. 361 | mm. 361 | mm. 333 | mm. 350 | mm. 332 | mm. 332 | mm. 350 | mm. 351 | mm. 332 |
| Weight in pounds*..... | lbs. 140 | lbs. 138 | lbs. 178 | lbs. 188 | lbs. 146 | lbs. 146 | lbs. 146 | lbs. 128 | lbs. 122 | lbs. 131 | lbs. 131 | lbs. 135 | lbs. 124 | lbs. 128 |
| Weight in kilograms..... | kilos. 64 | kilos. 63 | kilos. 81 | kilos. 84 | kilos. 66 | kilos. 66 | kilos. 66 | kilos. 58 | kilos. 55 | kilos. 59 | kilos. 59 | kilos. 61 | kilos. 56 | kilos. 58 |
| Upper length of skull..... | mm. 428 | mm. 428 | mm. 428 | mm. 440 | mm. 467 | mm. 467 | mm. 446 | mm. 431 | mm. 429 | mm. 427 | mm. 427 | mm. 447 | mm. 454 | mm. 436 |
| Basal length..... | mm. 378 | mm. 365 | mm. 376 | mm. 397 | mm. 417 | mm. 417 | mm. 402 | mm. 380 | mm. 373 | mm. 378 | mm. 378 | mm. 400 | mm. 397 | mm. 386 |
| Basilar length..... | mm. 356 | mm. 346 | mm. 356 | mm. 373 | mm. 395 | mm. 395 | mm. 382 | mm. 352 | mm. 355 | mm. 359 | mm. 359 | mm. 380 | mm. 375 | mm. 362 |
| Palatal length..... | mm. 300 | mm. 294 | mm. 295 | mm. 315 | mm. 317 | mm. 317 | mm. 319 | mm. 289 | mm. 298 | mm. 293 | mm. 314 | mm. 317 | mm. 312 | mm. 300 |
| Width of palate at pm^1 | mm. 48 | mm. 51 | mm. 42 | mm. 49 | mm. 57 | mm. 57 | mm. 54 | mm. 48 | mm. 46 | mm. 49 | mm. 49 | mm. 52 | mm. 47 | mm. 46 |
| Width of palate, including m^3 | mm. 69 | mm. 68 | mm. 65 | mm. 72 | mm. 75 | mm. 75 | mm. 71 | mm. 73 | mm. 71 | mm. 67 | mm. 75 | mm. 74 | mm. 68 | mm. 72 |
| Least width of palate at front of m^3 | mm. 25 | mm. 28 | mm. 24 | mm. 26 | mm. 29 | mm. 29 | mm. 31 | mm. 30 | mm. 32 | mm. 30 | mm. 27 | mm. 29 | mm. 25 | mm. 28 |
| Zygomatic breadth..... | mm. 149 | mm. 144 | mm. 152 | mm. 145 | mm. 161 | mm. 161 | mm. 168 | mm. 151 | mm. 155 | mm. 149 | mm. 165 | mm. 165 | mm. 155 | mm. 154 |
| Least interorbital breadth..... | mm. 71 | mm. 67 | mm. 62 | mm. 75 | mm. 79 | mm. 79 | mm. 76 | mm. 66 | mm. 69 | mm. 68 | mm. 79 | mm. 80 | mm. 63 | mm. 63 |
| Palatal constriction..... | mm. 13.5 | mm. 8.5 | mm. 15 | mm. 17 | mm. 11 | mm. 11 | mm. 10 | mm. 8 | mm. 12 | mm. 17 | mm. 17 | mm. 15 | mm. 4 | mm. 6 |
| Nasal breadth at posterior extremity of premaxilla..... | mm. 33.5 | mm. 30.5 | mm. 34 | mm. 42 | mm. 37 | mm. 37 | mm. 41 | mm. 32 | mm. 36 | mm. 28 | mm. 35 | mm. 35 | mm. 32 | mm. 29 |
| Length of nasals..... | mm. 240 | mm. 216 | mm. 222 | mm. 220 | mm. 245 | mm. 245 | mm. 235 | mm. 214 | mm. 230 | mm. 220 | mm. 220 | mm. 226 | mm. 233 | mm. 227 |
| Occipital depth to basion..... | mm. 122 | mm. 116 | mm. 123 | mm. 146 | mm. 146 | mm. 146 | mm. 140 | mm. 121 | mm. 125 | mm. 124 | mm. 124 | mm. 150 | mm. 135 | mm. 128 |
| Mandible..... | mm. 327 | mm. 335 | mm. 328 | mm. 337 | mm. 361 | mm. 361 | mm. 360 | mm. 333 | mm. 350 | mm. 332 | mm. 332 | mm. 350 | mm. 351 | mm. 332 |
| Maxillary toothrow..... | mm. 122 | mm. 123 | mm. 135 | mm. 137 | mm. 146 | mm. 146 | mm. 136 | mm. 128 | mm. 122 | mm. 131 | mm. 131 | mm. 135 | mm. 124 | mm. 128 |
| Second upper molar..... | mm. 21 x 21 | mm. 22 x 20 | mm. 23 x 19 | mm. 25 x 22 | mm. 25 x 20 | mm. 25 x 20 | mm. 26 x 21 | mm. 25 x 20 | mm. 22 x 19 | mm. 23 x 19 | mm. 24 x 21 | mm. 23 x 21 | mm. 24 x 19.5 | mm. 24 x 20 |
| Third upper molar..... | mm. 34 x 22 | mm. 30 x 19.5 | mm. 35 x 20 | mm. 37 x 23.5 | mm. 38 x 21 | mm. 38 x 21 | mm. 37 x 24 | mm. 35 x 20 | mm. 35 x 22 | mm. 34 x 20 | mm. 37 x 24 | mm. 39 x 23 | mm. 38 x 22 | mm. 34 x 22 |
| Mandibular toothrow..... | mm. 119 | mm. 120 | mm. 131 | mm. 143 | mm. 133 | mm. 133 | mm. 133 | mm. 125 | mm. 125 | mm. 120 | mm. 132 | mm. 137 | mm. 123 | mm. 121 |
| Second lower molar..... | mm. 21 x 18 | mm. 22.5 x 15 | mm. 24 x 15 | mm. 25 x 18.5 | mm. 25 x 18 | mm. 25 x 18 | mm. 25 x 17 | mm. 25 x 16 | mm. 23 x 16 | mm. 23 x 15 | mm. 23 x 15 | mm. 24 x 16 | mm. 23 x 16 | mm. 24 x 16 |
| Third lower molar..... | mm. 38 x 18 | mm. 37 x 16 | mm. 44 x 18 | mm. 47 x 19 | mm. 40 x 20 | mm. 40 x 20 | mm. 39 x 21 | mm. 37 x 18 | mm. 37 x 17 | mm. 34 x 17 | mm. 40 x 20 | mm. 48 x 17 | mm. 37 x 18 | mm. 37 x 19 |

† Gutted.

* Collector's measurements.

Measurements of female *Sus barbatus* from Borneo—Continued.

| | Sempan River, female, m ³ almost unworm. | Pulo Bauwal, Cat. No. 15378, female, m ³ moderately worm. | Kendawangan River, male, m ³ unworm. | Kumpang Bay, Cat. No. 15183, female, m ³ moderately worm. | Kumpang Bay, Cat. No. 15784, female, m ³ slightly worm. | Kumpang Bay, Cat. No. 15185, female, m ³ slightly worm. | Panting River, Cat. No. 15186, female, m ³ much worm. | Kumpang Bay, Cat. No. 15180, female, m ³ slightly worm. | Punkang Bay, Cat. No. 15181, female, m ³ moderately worm. | Sampangan River, Cat. No. 15182, female, m ³ moderately worm. | Punkang Bay, Cat. No. 15439, female, m ³ moderately worm. | Punkang Bay, Cat. No. 15437, female, m ³ slightly worm. | Balik Japan Bay, Cat. No. 15378, female, m ³ much worm. |
|--|---|--|---|--|--|--|--|--|--|--|--|--|--|
| Head and body* | 1,440 | 1,270 | 1,440 | 1,320 | 1,300 | 1,300 | 1,300 | 1,350 | 1,375 | 1,400 | 1,350 | 1,350 | 1,350 |
| Tail* | 210 | 220 | 210 | 210 | 240 | 240 | 215 | 240 | 240 | 250 | 290 | 290 | 290 |
| Hind foot* | 85 | 95 | 85 | 95 | 280 | 280 | 280 | 290 | 285 | 280 | 290 | 290 | 285 |
| Height at shoulder* | 140 | 140 | 140 | 140 | 630 | 630 | 630 | 670 | 680 | 770 | 750 | 750 | 700 |
| Weight in pounds* | 182 | 182 | 182 | 182 | 120 | 120 | 120 | 130 | 130 | 130 | 130 | 135 | 135 |
| Weight in kilograms | 83 | 83 | 83 | 83 | 57 | 57 | 57 | 60 | 60 | 60 | 60 | 61 | 61 |
| Upper length of skull | 437 | 424 | 437 | 424 | 378 | 378 | 378 | 380 | 395 | 402 | 395 | 400 | 391 |
| Basal length | 384 | 360 | 382 | 347 | 340 | 340 | 347 | 370 | 362 | 366 | 351 | 351 | 352 |
| Palatal length | 304 | 340 | 308 | 328 | 320 | 328 | 328 | 347 | 342 | 347 | 332 | 330 | 332 |
| Width of palate at pm ¹ | 48 | 44 | 44 | 44 | 272 | 268 | 272 | 291 | 288 | 289 | 256 | 273 | 268 |
| Width of palate, including m ³ | 73 | 64 | 65 | 71 | 40 | 41 | 41 | 39 | 43 | 41 | 39 | 43 | 41 |
| Least width of palate at front of m ³ | 28 | 24 | 25 | 30 | 25 | 27 | 27 | 29 | 25 | 28 | 24 | 26 | 19 |
| Zygomatic breadth | 155 | 139 | 132 | 146 | 138 | 132 | 132 | 149 | 145 | 154 | 130 | 142 | 139 |
| Least interorbital breadth | 69 | 63 | 57 | 68 | 64 | 58 | 58 | 58 | 66 | 65 | 65 | 65 | 70 |
| Parietal constriction | 20 | 9 | 20 | 21 | 11 | 11 | 19 | 19 | 20 | 19 | 10 | 17 | 27 |
| Nasal breadth at posterior extremity of premaxilla | 35 | 31 | 29 | 34 | 27 | 30 | 30 | 30 | 37 | 33 | 30 | 33 | 32 |
| Length of nasals | 220 | 220 | 183 | 200 | 188 | 192 | 210 | 198 | 188 | 212 | 189 | 200 | 200 |
| Occipital depth to basion | 132 | 115 | 102 | 103 | 113 | 114 | 104 | 120 | 113 | 119 | 112 | 113 | 123 |
| Mandible | 332 | 305 | 290 | 296 | 293 | 301 | 314 | 308 | 314 | 322 | 292 | 311 | 302 |
| Maxillary toothrow | 145 | 122 | 127 | 124 | 124 | 125 | 122 | 126 | 116 | 124 | 128 | 126 | 125 |
| Second upper molar | 25 x 20 | 23 x 18 | 23 x 18 | 23 x 19 | 25 x 18 | 24 x 18 | 24 x 18 | 25 x 20 | 22 x 17 | 22 x 20 | 25 x 21 | 24 x 19 | 24 x 22 |
| Third upper molar | 36 x 23 | 33 x 19 | 34 x 21 | 35 x 20 | 30 x 18 | 31 x 20 | 32 x 20 | 34 x 21 | 30 x 19 | 35 x 22 | 35 x 22 | 33 x 21 | 34 x 25 |
| Mandibular toothrow | 130 | 116 | 121 | 113 | 120 | 122 | 119 | 122 | 115 | 116 | 124 | 121 | 123 |
| Second lower molar | 24 x 16 | 22 x 15 | 22 x 15 | 21 x 16 | 23 x 16 | 23 x 16 | 23 x 15 | 24 x 16 | 22 x 15 | 23 x 16 | 24 x 16 | 22 x 15 | 23 x 16 |
| Third lower molar | 40 x 20 | 39 x 16 | 37 x 17 | 33 x 18 | 34 x 16 | 36 x 18 | 34 x 18 | 35 x 17 | 34 x 17 | 35 x 19 | 37 x 19 | 36 x 17 | 38 x 18 |

* Collector's measurements.

† Gutted.

IOMYS LEPIDUS, new species.

Type.—Skin and skull of adult male, Cat. No. 153684, U.S.N.M., collected at Batu Jurong, southwestern Borneo, June 27, 1908, by Dr. W. L. Abbott. Original number 6005.

Diagnostic characters.—Related to *Iomys thomsoni* (Thomas)¹ from which it differs in its smaller size.

Color.—Type: General color of upper parts of head and body, of upper surface of parachute, and of outer surface of fore and hind legs dark, hair brown, irregularly and finely lined with the buffy or cream buff subterminal annulations of the hairs, the buffy color darker and the annulations wider about the sides and the shoulders; under surface of parachute and inner side of forelegs bright ochraceous buff, under surface of neck and body, and inner surface of hind legs, and scrotum, pinkish buff, a small spot on chin whitish; upper surface of tail an indefinite brownish color, but much "reddened" by the showing through of the ochraceous to ochraceous-rufous of the hairs of the underside of tail; underside of tail nearly a clear, but rather dull ochraceous-rufous; sides of head and neck, below eye and ear, buffy to ochraceous-buff; inner side of ears with only a few short hairs, not enough to color them, outer side of ears nearly naked on distal half, basal half with hairs colored like those on top of head.

Measurements.—External: Type, Cat. No. 153684, from Batu Jurong and paratype, Cat. No. 151792, young adult male, from Klumpang Bay, and those of the type of *Iomys thomsoni*, respectively: Head and body, 190, 189, 231 mm.; tail, 190, 176, 199; hind foot with claws, 38, 40, 40.5. Cranial measurements: Greatest length of skull, 42.7, 42.3, 46.5; basilar length, 32.5, 33.5, 37; greatest breadth, 27.4, —, 29.6; length of nasals, 13, 12.2, 13; upper cheek teeth, 8.7, 9.3, 9.2.

Specimens examined.—Two.

Remarks.—While *Iomys lepidus* is closely related to *I. thomsoni*, yet its smaller size serves to distinguish it. In color both forms are very much alike as far as can be told without an actual comparison of specimens. *I. lepidus* probably ranges throughout southern Borneo, while *I. thomsoni* is very likely confined to the northern portions of the island.

This squirrel was one of a pair which had a nest of leaves about 11 inches in diameter, in the top of a small sapling, about 20 feet from the ground. They both flew out on the tree being shaken, the male going to a large tree trunk, where he was shot. The other was lost sight of.—W. L. A.

¹Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 275, March 1900. Type-locality, Bakong River, Eastern Sarawak, Borneo.

LARISCUS DIVERSUS (Thomas).

1898. *Funambulus insignis diversus* THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 2, p. 248. September, 1898. Type-locality, Baram River, Eastern Sarawak, Borneo.

Seven specimens of *Lariscus* collected in southern Borneo by Doctor Abbott differ in no essential respects from north Bornean specimens as described by Thomas. The latter's remarks about the Bornean form "perhaps averaging slightly larger" than the Sumatran form does not hold good as regards the present specimens and Sumatran examples from Tarussan Bay. The Borneo skulls are distinctly smaller and more slender than are the Tarussan Bay skulls.

(For measurements and exact localities of the seven specimens, see table, p. 92.)

Doctor Abbott has collected four distinct forms of *prevostii* squirrel on the Bornean mainland. They are *Sciurus borneocensis borneocensis* from the higher ground north of the Kapuas River, *S. b. palustris* from the swampy region north of the Kapuas River, *S. sanggaus* from southwestern Borneo, south of the Kapuas River, and *S. atricapillus* from southeastern Borneo. Colored illustrations of all four forms are well shown on plate 4 which was made directly from the skins.

SCIURUS SANGGAUS Lyon.

1907. *Sciurus sanggaus* LYON, Proc. U. S. Nat. Mus., vol. 33, No. 1577, p. 554, December 24, 1907.

In addition to the original large series of squirrels of this species taken along the south bank of the Kapuas River in 1905, Doctor Abbott has secured twenty-seven others from the coast region of southwestern Borneo. (For exact localities, see table of measurements, p. 83.) Although the large series of specimens of this squirrel taken as a whole are fairly uniform in coloration, yet there is a tendency toward differentiation shown by specimens from certain localities in the range of the species. Skins from Sukadana agree in every respect with those from Sanggau. One from the mouth of the Sempang River, Cat. no. 145441, and two others from the Semendang River have darker and "redder" shoulders than usual, in this respect being very much like the two specimens from Pulo Kubu in the original series of *S. sanggaus*, but not quite so dark. Nearly all the squirrels from along the Kapuas River below Sanggau have the underparts darker in color than the Sanggau and the Sukadana skins. Specimens from the Kendawangan River region have the underparts a lighter "red" and the shoulder area and sides of head and neck lighter in color and the white of the thighs less grizzled with black than have the Sanggau or Sukadana specimens. The different members of this species may be roughly placed in three groups: 1. The Sanggau-Sukadana specimens, typical of the species. 2. The

specimens from the lower Kapuas, and some from the Sempang and Semendang rivers, with darker underparts and "reddish" shoulders. 3. The Kendawangan River specimens with lighter underparts and shoulders, and a clearer white on the thighs. In any of the three groups a few intergrading specimens may be found. As none of the three forms has a definite range, so far as known, it does not seem advisable to recognize them by name. The characters of the Kendawangan River series, however, are nearly as distinctive as are those of some of the insular forms of the *prevostii* group of squirrels.

(For measurements, see table, p. 83.)

See figure next to the bottom one on plate 4.

SCIURUS ATRICAPILLUS Schlegel.

1863. *Sciurus atricapillus* SCHLEGEL, Nederl. Tijdschr. Dierk., vol. 1, 1863, p. 27; Zoogdieren, pl. 2, fig. 1.

Doctor Abbott collected one squirrel of the *Sciurus prevostii* group at Balik Papan Bay, which is referable to *S. atricapillus*.

Mr. Miller has made the following notes on the original material of this species in the Leyden Museum:

Sciurus atricapillus.—Seven mounted specimens from Borneo—four from Kapuas River, one from Duson River, one from southeastern Borneo, and one from Borneo—also one skin from Liang Koeboeng, back of Pontianak. They are very uniform, and agree perfectly with a specimen of this species in Berlin. In two of the Kapuas specimens the hairs of the tail are clear black throughout except for the narrow light base; in the third adult a few light annulations can be detected; in the immature individual there is conspicuous annulation beneath the surface. This is also present in the four others to a variable extent, but never appearing distinctly at the surface unless the hairs are disarranged. Muzzle always black, usually to a little behind eyes; feet always black; red area, dark rufous, shading toward chestnut; pale side stripe cream color, 10 mm. wide; dark stripe about same width; cheeks grizzled buffy brown.

Doctor Abbott's specimen agrees in every way with the above description, as well as with the original account. The type-locality may be taken as the Kapuas River, 4° or about 270 miles east of Pontianak, as that locality is the first mentioned in the description and the majority of the specimens came from there. The species is seen to have quite an extensive range—from the center of the island to the southeast coast, at least. *Sciurus atricapillus* probably intergrades with *S. caroli*¹ and its subspecies in northern Borneo.

It resembles *S. caroli griseicauda* in general external appearance more than any other member of the group that I have seen. The black color of the tail, of the nose, and adjacent parts of head, including an ill-defined ring about the eye, and the black feet of *S. atricapillus* serve to distinguish the two forms.

(For measurements, see table, p. 83.)

See bottom figure on plate 4.

¹ Bonhote, Ann. Mag. Nat Hist., ser. 7, vol. 7, February, 1901, p. 174.

SCIURUS BORNEOENSIS BORNEOENSIS (Müller and Schlegel).

1907. *Sciurus borneoensis borneoensis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 552, December 24, 1907.

Ten specimens from the Kapuas River region, northern bank, and inland on the higher ground, collected in 1905.

See figure next to the top one on plate 4.

SCIURUS BORNEOENSIS PALUSTRIS Lyon.

1907. *Sciurus borneoensis palustris* LYON, Proc. U. S. Nat. Mus., vol. 33, p. 553, December 24, 1907.

Fifteen specimens from the Kapuas River region, northern bank, and in the lowlands, collected in 1905.

See top figure on plate 4.

SCIURUS CARIMATÆ Miller.

1906. *Sciurus carimatae* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 57, July 23, 1906.

In addition to the original series of specimens collected on Karimata Island, Doctor Abbott secured three additional specimens in 1908.

(For measurements, see table, p. 83.)

SCIURUS PROSERPINÆ Lyon.

1907. *Sciurus proserpinæ* LYON, Smiths. Misc. Coll., vol. 48, No. 1659, p. 275, February 4, 1907.

Since securing the two original specimens of this species in 1905, Doctor Abbott took three others from Pulo Temaju in 1907. They differ in no respects from the earlier specimens.

(For measurements of the series, see table, p. 83.)

The relations of this squirrel are with *Sciurus borneoensis palustris* and *S. borneoensis borneoensis* from the adjacent mainland of Borneo on the north side of the Kapuas River. This is most clearly shown by its gray tail. The squirrels of the *S. prevostii* group from the islands of Karimata, Pelapis, and Panebangan, with their solid black tails and brightly colored underparts, are clearly related to *Sciurus sanggau* from the mainland of Borneo south of the Kapuas River. The relationships of these squirrels and the positions of the islands on which they occur would indicate that the Kapuas is an ancient river, and has long separated the gray-tailed group of squirrels from the black-tailed group, and that as the land has subsided members of the two groups have been left on the elevated portions of the land, now forming islands to the north and south of the Kapuas. The river is thus older than the islands. Should *prevostii* squirrels be found on Pulo Lamakotan or Pulo Kabung they would probably be found to belong to the gray-tailed group.

SCIURUS ARMALIS, new species.

Type.—Skin and skull of adult male, Cat. No. 145420, U.S.N.M., collected on Pulo Panebangan, off west coast of Borneo, May 19, 1907, by Dr. W. L. Abbott. Original number, 5257.

Diagnostic characters.—A member of the *prevostii* group of squirrels related to *Sciurus carimatæ* Miller,¹ differing in having the light shoulder area larger and practically clear gray (grizzle of black and white), without buffy admixture, and lighter colored feet.

Color.—Upper parts of head and body, and entire tail, black or blackish, under parts, inner sides of fore and hind legs, dull orange-rufous to ferruginous; upper surfaces of hands and feet, ochraceous to orange buff; side stripe extending from behind shoulder to heel, white or whitish, quite pure throughout its extent, but slightly mixed with blackish along the thighs; sides of head and neck, grayish, a grizzle of blackish and whitish, the darker color predominating except about the base of whiskers which is quite light; light area of shoulder largely developed, a coarse grizzle of whitish or cream color and blackish, the lighter color much in excess; outer side of upper arm, nearly clear whitish or cream color becoming buffy toward the lower arm.

Skull and teeth.—These show no special peculiarities. The audital bullæ are of the type found in *Sciurus carimatæ*.

Measurements.—For external and cranial measurements of the type and series, see table, page 83. *S. armalis* is one of the smaller members of the *prevostii* group, about like *S. carimatæ* and *S. pelapius* in size, and distinctly smaller than the form of *prevostii* squirrel found on the adjacent mainland of Borneo.

Specimens examined.—Twelve, all from Pulo Panebangan.

SCIURUS PELAPIUS, new species.

Type.—Skin and skull of adult female, Cat. No. 145417, collected on Pulo Pelapis (South Island) off west coast of Borneo, May 30, 1907, by Dr. W. L. Abbott. Original number, 5335.

Diagnostic characters.—A member of the *prevostii* group; very similar to *Sciurus carimatæ* Miller,¹ but differing in possessing a darker shoulder and larger audital bullæ.

Color.—Upper parts of head and body and entire tail, black or blackish; underparts, inner sides of fore and hind legs, and upper surfaces of feet and hands, dull orange-rufous to ferruginous; side stripe, extending from behind shoulder nearly to heel, whitish or cream color, quite pure throughout its whole extent, but slightly mixed with blackish along the thighs; sides of head and neck, grayish, a grizzle of blackish and whitish, the darker color being in excess,

¹ Proc. U. S. Nat. Mus., vol. 31, No. 1481, p. 57, July 26, 1906.

except about base of whiskers which is quite light; upper arm, orange-ochraceous, which color spreads over the shoulder where it is not so clear due to showing of the dark bases of the hairs, and the admixture of some buffy hairs.

Measurements of squirrels of the prevostii group.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail vertebrae. ¹ | Hind foot, with claws. ² | Greatest length of skull. | Interorbital constriction. | Zygomastic breadth. |
|----------------------------|------------------------------------|---------------|----------------------|-----------------------------|------------------------------|-------------------------------------|---------------------------|----------------------------|---------------------|
| | | | | mm. | mm. | mm. | mm. | mm. | mm. |
| <i>S. proserpinæ</i> ... | Pulo Temaju..... | 142284 | Female, adult. | 233 | 230 | 57 | 53.7 | 22.7 | 34.8 |
| Do..... | do..... | 3 142285 | Male, adult. | 235 | 235 | 56 | 53.9 | ..... | 34.0 |
| Do..... | do..... | 145412 | do..... | 238 | 225 | 57 | 53.7 | 22.2 | 33.6 |
| Do..... | do..... | 145413 | Female, adult. | 240 | 225 | 58 | 54.0 | 22.5 | 33.7 |
| Do..... | do..... | 145414 | Female, young | 205 | 215 | 55 | 48.4 | 20.0 | 29.6 |
| <i>S. pelapius</i> | Pulo Pelapis, South Island. | 145415 | Female, old..... | 230 | 200 | 53 | 52.0 | 22.4 | 33.0 |
| Do..... | do..... | 145416 | Male, adult..... | 223 | 157 | 50 | 51.6 | 22.0 | 32.0 |
| Do..... | do..... | 3 145417 | Female, adult. | 232 | 190 | 50 | 52.0 | 20.8 | 31.7 |
| <i>S. armalis</i> | Panehangan Island..... | 145418 | Male, old..... | 222 | 204 | 54 | 52.7 | 20.2 | 31.5 |
| Do..... | do..... | 145419 | Female, adult. | 228 | 204 | 52 | 52.2 | 20.8 | 32.5 |
| Do..... | do..... | 3 145420 | Male, adult..... | 230 | 210 | 50 | 54.0 | 20.5 | 31.8 |
| Do..... | do..... | 145421 | do..... | 223 | 175 | 52 | 51.2 | 20.0 | 31.2 |
| Do..... | do..... | 145422 | do..... | 220 | 205 | 55 | 53.0 | 20.5 | 32.0 |
| Do..... | do..... | 145423 | do..... | 230 | 200 | 53 | 51.8 | 19.6 | 30.6 |
| Do..... | do..... | 145424 | do..... | 214 | 208 | 53 | 51.5 | 20.8 | 30.6 |
| Do..... | do..... | 145425 | Male, old..... | 222 | 200 | 51 | 51.3 | 19.5 | 32.0 |
| Do..... | do..... | 145426 | Male, adult..... | 220 | 204 | 52 | 51.4 | 19.6 | 30.0 |
| Do..... | do..... | 145427 | Male, young..... | 205 | 220 | 53 | 50.0 | 19.4 | 29.9 |
| Do..... | do..... | 145428 | Male, old..... | 212 | 205 | 54 | 52.3 | 20.0 | 31.5 |
| Do..... | do..... | 145429 | Female, old..... | 225 | 205 | 53 | 53.8 | 21.0 | 32.4 |
| <i>S. carimatæ</i> | Karimata Island..... | 153672 | do..... | 220 | 195 | 52 | 51.2 | 20.0 | 31.4 |
| Do..... | do..... | 153673 | Female, adult. | 220 | 213 | 54 | 51.9 | 19.8 | 30.8 |
| Do..... | do..... | 153674 | Female, young adult. | 220 | 202 | 54 | 51.2 | 19.2 | 30.6 |
| <i>S. sanggaus</i> | Sukadana, west Borneo..... | 145430 | Male, old..... | 260 | 240 | 59 | 58.0 | 23.8 | 33.6 |
| Do..... | do..... | 145431 | do..... | 258 | 225 | 61 | 55.7 | 22.3 | 33.3 |
| Do..... | do..... | 145432 | Female, adult. | 255 | 215 | 57 | 56.0 | 22.0 | 34.4 |
| Do..... | do..... | 145433 | Male, adult..... | 235 | 230 | 55 | 55.1 | 20.8 | 32.5 |
| Do..... | do..... | 145434 | do..... | 241 | 250 | 60 | 54.6 | 21.0 | 33.3 |
| Do..... | do..... | 145435 | Female, old..... | 250 | 241 | 55 | 55.2 | 22.0 | 33.8 |
| Do..... | Mouth of Sempang River..... | 145441 | Male, adult..... | 252 | 212 | 61 | 57.0 | 22.5 | 34.2 |
| Do..... | Sempang River..... | 145436 | Female, adult. | 245 | 235 | 58 | 54.5 | 20.4 | 33.0 |
| Do..... | do..... | 145437 | do..... | 246 | 252 | 61 | 57.8 | 22.0 | 32.8 |
| Do..... | do..... | 145438 | do..... | 240 | 225 | 59 | 55.0 | 22.6 | 34.3 |
| Do..... | Semandang River..... | 145439 | do..... | 260 | 240 | 60 | 56.7 | 23.4 | 33.7 |
| Do..... | do..... | 145440 | Male, adult..... | 248 | 250 | 60 | 55.6 | 23.3 | 35.2 |
| Do..... | Batu Jurong, southwest Borneo. | 153657 | Female, old..... | 263 | 250 | 62 | 58.2 | 22.5 | 33.5 |
| Do..... | Mankol, southwest Borneo. | 153658 | do..... | 240 | 240 | 57 | 56.5 | 23.2 | 34.3 |
| Do..... | do..... | 153659 | Female, young adult. | 245 | 245 | 53 | 56.1 | 22.4 | 32.6 |
| Do..... | do..... | 153660 | Female, old..... | 255 | 235 | 60 | 57.0 | 21.8 | 33.6 |
| Do..... | do..... | 153661 | Female, young adult. | 230 | 240 | 57 | 53.5 | 22.2 | 32.2 |
| Do..... | do..... | 153662 | Female, adult. | 243 | 200 | 60 | 57.0 | 22.3 | 33.6 |
| Do..... | do..... | 153663 | Female, young adult. | 245 | 245 | 60 | 53.4 | 20.6 | 30.0 |
| Do..... | Kalang Anyar, southwest Borneo. | 153664 | Male, adult..... | 248 | 225 | 58 | 55.8 | 22.3 | 33.5 |
| Do..... | Lanchut, southwest Borneo | 153665 | Female, old..... | 259 | 230 | 62 | 56.7 | 23.0 | 34.2 |
| Do..... | do..... | 153666 | Male, adult..... | 253 | 250 | 60 | 56.1 | 22.8 | 33.5 |
| Do..... | do..... | 153667 | Female, adult. | 248 | 254 | 59 | 57.2 | 22.6 | 34.2 |
| Do..... | do..... | 153668 | Female, old..... | 243 | 220 | 59 | 57.4 | 23.4 | 35.0 |
| Do..... | Surok, southwest Borneo..... | 153669 | Male, adult..... | 260 | 255 | 64 | 57.4 | 22.8 | 33.4 |
| Do..... | do..... | 153670 | Male, old..... | 260 | 260 | 62 | 57.0 | 24.2 | 34.6 |
| Do..... | Mankol, southwest Borneo. | 153671 | Female, adult. | 260 | 215 | 62 | 57.5 | 23.7 | 34.5 |
| <i>S. atricapillus</i> ... | Balik Papan Bay, southeast Borneo. | 154292 | do..... | 256 | 245 | 60 | 56.4 | 21.5 | 34.5 |

¹ Collector's measurements.

² Measured by writer after relaxing feet in water.

³ Type.

Skull and teeth.—These show no striking peculiarities, but the audital bullæ are distinctly more inflated than they are in the closely related *Sciurus carimatæ*, especially noticeable in the anterior segment of the bullæ.

Measurements.—For external and cranial measurements of the type and series, see table on p. 83. *S. pelapius* is one of the smaller members of the *prevostii* group, about the same size as *S. carimatæ*.

Specimens examined.—Three, all from South Island, Pelapis.

Remarks.—*Sciurus pelapius* is very closely related to the near-by *S. carimatæ*, the only distinguishing characters being its darker and "redder" shoulder and larger audital bullæ. Two specimens in the *carimatæ* series have shoulders nearly as dark as those of *pelapius*, but none that I have seen shows the more inflated bullæ.

SCIURUS DULITENSIS (Bonhote).

1901. *Sciurus vittatus dulitensis* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 451, May, 1901.

1907. *Sciurus dulitensis*, LYON, Proc. U. S. Nat. Mus., vol. 33, No. 1577, p. 555, December 24, 1907. (Kapuas River region.)

Since he collected nine specimens of plantain squirrels from the Kapuas River region Dr. W. L. Abbott has secured eleven additional specimens in southwestern Borneo, eight in southeastern Borneo, and one on Pulo Laut. As far as the general coloration of the upper parts and side stripes is concerned all the Bornean specimens are fairly constant. They vary considerably, however, as to the brightness of the under parts, as may be seen even in specimens from one locality. The single specimen from Pulo Laut does not seem to be separable from the others.

It is noteworthy that nearly all the specimens from the Kapuas River region, as well as several in the U. S. National Museum from northern Borneo, have the entire under side of the tails distinctly reddish or rufous, while nearly all the others from Borneo have the entire under side of the tail generally grayish. This character is not absolutely constant and at best could only be considered a subspecific one. The difference can not be attributed to season, sex, or age. Without more specimens, especially well-prepared skins from northern Borneo, it does not for the present seem advisable to recognize this difference by name.

It may not be without interest to point out how easily the "red" color of the underparts of the *Sciurus vittatus* group of squirrels may become altered. There are in the museum two specimens of *Sciurus dulitensis* from north Borneo, collected by C. F. Adams in 1887. At that time they were preserved by some pickling solution, probably salt and alum. The underparts are now a dull vinaceous-cinnamon, instead of the usual bright ochraceous colors. Some other specimens

collected in Sarawak by Hose, which have recently had their skulls removed, and have been made over into modern study skins, have the original colors of the underparts more or less dulled and rendered somewhat pinkish. The fluid used to relax these skins in the remaking was probably alcohol and water. In order to relax the feet in the large number of squirrels of the *vittatus* group recently collected by Dr. W. L. Abbott, the unlabeled hind foot and adjacent part of leg of each specimen was soaked for about twenty-four hours in tap water placed in a galvanized-iron receptacle. In a great many of the specimens the bright ochraceous-rufous colors of the inner side of the leg have become dulled and more pinkish on the foot and leg that was soaked. In the last case it can hardly be probable that the plain water brought about the change in color. It is more likely due to the preservative, probably arsenic or a mixture of arsenic and alum, used on the inside of the skin, and which had come through the skin to the hairs by solution and osmosis.

SCIURUS LAMUCOTANUS, new species.

Type.—Skin and skull of adult female, Cat. No. 145405, collected on Pulo Lamukotan, off west coast of Borneo, May 8, 1907, by Dr. W. L. Abbott. Original number, 5201.

Diagnostic characters.—A “red” bellied, “red” footed member of the *Sciurus vittatus* group, differing from *S. dubitensis* of the neighboring mainland of Borneo in having a generally more ochraceous tone on the upper parts, lighter under parts, broader but less clear dark sides tripe and more buffy light side stripe.

Color.—Type: Upper parts of head and body, a fine grizzle of ochraceous-buff and blackish, the two colors about equally prominent; upper surface of tail similar but grizzle coarser, and the ochraceous-buff darkening to ochraceous and tawny ochraceous at the tip; underside of tail with the ochraceous-buff replaced by ochraceous and tawny ochraceous, the latter colors being in excess of the black; light side stripe (5 by 65 mm.) buffy; dark side stripe (12 by 80 mm.) blackish, sprinkled with a few light hairs; under parts and inner sides of fore and hind legs ochraceous-buff; outer sides of fore and hind legs similar to adjacent parts of body; fore and hind feet similar to outer side of legs, but more ochraceous-buff; inner side of ears dull tawney ochraceous; outer side similar to head; orbital ring and region about mouth ochraceous-buff. There is some little difference shown in certain individuals of the series as to brightness of under parts, but all are essentially like the type.

Skull and teeth.—These show no special characteristics and apparently do not differ from those of examples of *Sciurus dubitensis* from Borneo.

Measurements.—For external and cranial measurements see table, pages 90 and 91.

Specimens examined.—Eight, all from Pulo Lamukotan.

Remarks.—While *Sciurus lamucotanus* is sufficiently distinct from the Bornean *S. dubitensis* to be regarded as a separate species, it is not, however, a highly differentiated form.

SCIURUS SERUTUS Miller.

1906. *Sciurus serutus* MILLER, Proc. U. S. Nat. Mus., vol. 33, p. 58, July 23, 1906.

One specimen collected on Pulo Serutu, Karimata Islands, in 1904.

SCIURUS DATUS, new species.

Type.—Skin and skull of adult female, Cat. No. 145393, U.S.N.M., collected on Pulo Datu, off west coast of Borneo, May 2, 1907, by Dr. W. L. Abbott. Original number, 5153.

Diagnostic characters.—A “red” bellied, “red” footed member of the *Sciurus vittatus* group, similar to *S. dubitensis* of Borneo, but distinctly smaller, and with wider dark side stripes.

Color.—Type: Upper parts of head and body a fine grizzle of blackish and a dull light cream-buff, in some lights appearing dull olive-buff, the outer light annulations of the hairs being lighter than the inner more buffy ones; upper surface of tail similar in color to upper parts of body, but grizzling much coarser, underside of tail with the cream-buff largely replaced by ochraceous, especially in middle line, where it is the predominating color; light side stripe (4 by 65 mm.) dull cream color; dark side stripe (10–15 by 80 mm.) blackish, sprinkled with a few light hairs; underparts and inner sides of fore and hind legs ochraceous-buff, rather bright; outer side of fore and hind legs similar to adjacent parts of body; fore and hind feet generally similar to legs, but more ochraceous-buffy; outside of ears, like top of head, inside more ochraceous buffy; orbital ring pinkish-buff. The series of specimens of *Sciurus datus* is very uniform in coloration, and differs in no essentials from the type. Two examples have the hairs of the underparts rather worn, allowing the bases to show and darken and dull the ochraceous buff.

Skull and teeth.—Aside from their distinctly smaller size these show no noteworthy characteristics.

Measurements.—For external and cranial measurements see table page 90.

Specimens examined.—Six, all from Pulo Datu.

Remarks.—In the color of the under parts and of the side stripes *Sciurus datus* closely resembles *S. lamucotanus*; in the color of the upper parts it more nearly resembles *S. dubitensis* from Borneo. It can be readily distinguished from either, however, by its distinctly smaller size.

SCIURUS SIRIENSIS, new species.

Type.—Skin and skull of adult male, Cat. No. 151768, U.S.N.M., collected on Pulo Mata Siri, Java Sea, December 7, 1907, by Dr. W. L. Abbott. Original number, 5580.

Diagnostic characters.—A very pale form of the "red" footed, "red" bellied *Sciurus vittatus* group of squirrels, generally similar to *S. lautensis* Miller,¹ but slightly more pallid, and with larger audital bullæ.

Color.—Upper parts of body a fine grizzle of cream-buff and blackish, the cream-buff being in excess; tail both above and below similar, but the grizzle much coarser; under parts, including throat and inner side of fore and hind legs, pale ochraceous buff; light side stripe (17 by 60 mm.) whitish cream color; dark side stripe about the same length and width, dull pale blackish; top of head a grizzle of buffy and blackish, the former in excess; sides of head generally buffy; outside of hind legs similar in color to back; outside of forelegs similar to adjoining parts of body, but more buffy; fore and hind feet generally buffy to ochraceous buffy; ears similar to adjoining parts of body; whiskers black.

Skull and teeth.—These show no special peculiarities and very closely resemble those of *Sciurus lautensis*. The bullæ, however, are distinctly larger in *S. siriensis*, so that the two species are easily distinguished.

Measurements.—See table, page 90.

Specimens examined.—Six, all from Pulo Mata Siri.

Remarks.—The occurrence of two species so closely resembling each other as *Sciurus lautensis* and *S. siriensis* on islands of opposite coasts of Borneo is interesting. It is probably the result of similar environments, but I have been unable to find any details concerning the conditions on the two islands.

SCIURUS ARENSIS, new species.

Type.—Skin and skull of adult male, Cat. No. 154276, U.S.N.M., collected on Arends Island, Java Sea, November 24, 1908, by Dr. W. L. Abbott. Original number, 6251.

Diagnostic characters.—A member of the *Sciurus vittatus* group of squirrels, distinguished by its small size, light under parts, and whitish axillary hairs; rather closely related to its geographic neighbor, *Sciurus siriensis*, from Pulo Mata Siri (see above), but smaller, with more whitish hairs on under parts, and with darker upper parts.

Color.—Type: Upper parts of head, neck, and body, and outer surfaces of fore and hind legs and upper surface of feet, a fine grizzle

¹ Proc. Wash. Acad. Sci., vol. 3, p. 128, March 26, 1901, Pulo Laut. Natuna Islands.

of pale ochraceous buff and blackish, the two colors about equally mixed; tail, both above and below similar, but the grizzle coarser and the ochraceous buff predominating on the underside; under parts, and inner side of hind legs, a color closely approaching Ridgway's pink buff, becoming whitish cream color in axillary region and about chin, and nearly as light on inner side of fore legs; light side stripe (6 by 50 mm.) buffy cream color, ill defined; black side stripe (12 by 45 mm.) blackish, strongly lined with whitish, and many of the hairs with narrow ochraceous buff rings; region of nose, sides of head and neck similar to upper parts, but the ochraceous buff deeper and more conspicuous; a rather poorly defined eyering; ears, inside and out, similar to upper parts.

Skull and teeth.—Aside from its slightly smaller size and relatively heavier teeth, the skull and teeth of *Sciurus arendsis* show no differences from those of numerous related forms.

Measurements.—See table, page 90.

Specimens examined.—Five, all from Pulo Arends.

Remarks.—*Sciurus arendsis* is simply another of the numerous races of *Sciurus vittatus*, produced by isolation on various Malayan islands. It closely resembles its geographic neighbors, *S. siriensis*, from Pulo Mata Siri, and *S. dulitensis*, from the Bornean mainland. It differs from *S. siriensis* in its smaller size, darker upper parts, and in the possession of numerous white hairs on the under parts, as in *S. vittatus albescens* (Bonhote)¹ from northern Sumatra. From the mainland *S. dulitensis* it is distinguished by its smaller size, lighter coloration, both above and below, and less conspicuous side stripes.

SCIURUS POLIOPUS, new species.

Type.—Skin and skull of adult male, Cat. No. 151789, U.S.N.M., collected at Pamukang Bay, southern Borneo, April 5, 1908, by Dr. W. L. Abbott. Original number, 5923.

Diagnostic characters.—A member of the *vittatus* group distinguished by a very dull "red" belly and conspicuous gray legs and feet.

Color.—Upper parts of head and body, a fine grizzle of pale dull buff-yellow and blackish, the two colors about equally mixed; thighs and shoulders similar, but the buffy color becoming gradually replaced by a light gray on the outer side of the fore and hind legs and on feet, lower parts of inner side of fore and hind legs also grayish; tail, similar to upper parts of body but the grizzle very coarse, appearing somewhat annulated, and with the buffy color very light above, but darker underneath; under parts, a very dull ochraceous color, ranging from almost clay color in the type to a very dark

¹ Ann. Mag. Nat. Hist., ser. 7, vol. 7, May, 1901, p. 446.

tawny ochraceous in the specimen from Klumpang Bay; inner side of the upper portions of fore and hind legs similar to under parts of body; light side stripe (about 75 by 7 mm.), dull cream color; dark side stripe about the same length, but nearly twice as wide, blackish, fairly clear in color or sprinkled with a few buffy hairs. A suggestion of the grayish color of the feet is seen about the extreme anterior portion of head.

Skull and teeth.—These show no special peculiarities, and I have been unable to find characters in them by which they may be distinguished from related forms.

Measurements.—See table, page 91.

Specimens examined.—Three, the type from Pamukang Bay, one from Klumpang Bay, and one from the Saratok River.

Remarks.—*Sciurus poliopus* needs no comparison with any of the other known members of the *vittatus* group. The combination of "red" belly and gray feet occurs in no other members of the group so far as I am aware, with the exception of the species to be described below.

SCIURUS MARINSULARIS, new species.

Type.—Skin and skull of adult male, Cat. No. 151777, collected on Pulo Laut, off southeastern Borneo, December 17, 1907, by Dr. W. L. Abbott. Original number, 5619.

Diagnostic characters.—A member of the *vittatus* group, with a red belly and gray feet similar to *Sciurus poliopus*, described above, but with the under parts ochraceous-rufous and with less gray appearing on portion of legs adjacent to feet.

Color—*Type*: Upper parts of head and body and outer surfaces of fore and hind legs a fine grizzle of blackish and a color intermediate between a light tawny-olive and buff-yellow, the two colors about in equal proportions; under parts, including inner sides of fore and hind legs, ochraceous-rufous; upper surfaces of fore and hind feet, with the buffy color of the upper parts replaced by light grayish, tail similar to the upper parts, but the buffy portions of the hair lighter and the grizzle coarser, the tail in certain lights and portions appearing annulated; light side stripe (about 75 by 10 mm.), buff; dark side stripe (about 75 by 5 mm.), blackish. A suggestion of the grayish color of the feet is seen about the extreme anterior portion of the head.

Skull and teeth.—These show no special peculiarities, and I have been unable to find characters in them by which they may be distinguished from related forms.

Measurements.—See table, page 91.

Specimens examined.—Six from Pulo Laut and two from Pulo Sebuku.

Remarks.—*Sciurus marinsularis* needs comparison only with *S. poliopus*, described above. The two species may be more closely related than the descriptions would indicate. The specimens representing the mainland species are evidently in not so fresh a pelage, which might account, in part at least, for the striking difference in color of the under parts of the two forms. The greater extension of gray about the feet and legs of the mainland animal serves to distinguish them readily, and would not appear to be produced by wear. It is unfortunate that no cranial or dental characters can be found to separate the gray-footed squirrels from the buffy-footed forms. It hardly seems probable that the difference in color of the feet and legs can be dimorphic. Among the many squirrels of the *vittatus* group collected by Doctor Abbott it has never been noticed before. The only other gray-footed squirrels of this group in the U. S. National Museum are specimens of the gray-bellied *Sciurus notatus* from Java. All the other gray-bellied and "red"-bellied species have the feet in general concolor with the upper parts, or often more buffy or ochraceous in color.

Measurements of squirrels of the vittatus group.

| Name. | Locality. | Catalogue No. | Sex and age. | | | | | | |
|---------------------------|---------------------|---------------------|----------------------|-----------------------------|-----------------------------|-------------------------------------|---------------------------|----------------------------|--------------------|
| | | | | Head and body. ¹ | Tail vertebra. ¹ | Hind foot, with claws. ² | Greatest length of skull. | Interorbital constriction. | Zygomatic breadth. |
| <i>S. siriensis</i> | Pulo Mata Siri..... | ³ 151768 | Male, adult.... | mm. 198 | mm. 174 | mm. 43 | mm. 47.3 | mm. 17.0 | mm. 28.9 |
| Do..... | do..... | 151769 | do..... | 202 | 150 | 46 | 47.3 | 16.7 | 28.0 |
| Do..... | do..... | 151771 | do..... | 195 | 175 | 44 | ..... | 17.0 | 28.2 |
| Do..... | do..... | 154281 | do..... | 210 | 150 | 49 | 47.8 | 17.3 | ..... |
| Do..... | do..... | 154283 | do..... | 210 | 173 | 47 | 46.5 | 17.3 | 28.7 |
| Do..... | do..... | 154284 | Male, young adult. | 180 | 180 | 49 | 41.6 | 16.3 | 26.2 |
| Do..... | do..... | 154286 | Male, adult.... | 207 | 185 | 49 | 47.7 | 16.4 | 27.8 |
| Do..... | do..... | 151770 | Female, adult. | 198 | 175 | 44 | 46.7 | 16.7 | 28.0 |
| Do..... | do..... | 151772 | do..... | 195 | 175 | 45 | 46.2 | 16.2 | 27.2 |
| Do..... | do..... | 151773 | do..... | 198 | 172 | 46 | 46.3 | 15.6 | 27.7 |
| Do..... | do..... | 154282 | do..... | 200 | 195 | 47 | 46.8 | 17.6 | ..... |
| Do..... | do..... | 154285 | Female, young adult. | 200 | 173 | 48 | 46.5 | 16.1 | 26.0 |
| Do..... | do..... | 154287 | Female, adult. | 200 | 165 | 46 | 45.5 | 16.0 | 27.5 |
| <i>S. arendsis</i> | Pulo Arends..... | ³ 154276 | Male, old..... | 194 | 152 | 45 | 46.5 | 16.6 | 26.0 |
| Do..... | do..... | 154277 | Male, adult.... | 192 | 128 | 45 | ..... | ..... | ..... |
| Do..... | do..... | 154278 | Female, young adult. | 187 | 165 | 43 | ..... | 16.3 | 25.5 |
| Do..... | do..... | 154279 | do..... | 183 | 172 | 44 | ..... | 16.0 | 25.2 |
| Do..... | do..... | 154280 | Female, adult. | 195 | 150 | 44 | 46.0 | 16.4 | 25.8 |
| <i>S. datus</i> | Pulo Datu..... | 145395 | Male, adult.... | 202 | 195 | 48 | 46.0 | 16.2 | 27.0 |
| Do..... | do..... | 145396 | Male, old..... | 208 | 180 | 48 | 47.3 | 15.6 | 27.5 |
| Do..... | do..... | 145397 | Male, young adult. | 196 | 180 | 48 | 45.0 | 15.7 | 25.2 |
| Do..... | do..... | ³ 145393 | Female, adult. | 208 | 195 | 50 | 46.4 | 15.3 | 26.2 |
| Do..... | do..... | 145394 | Female, young adult. | 205 | 185 | 47 | 45.7 | 15.3 | 25.7 |
| Do..... | do..... | 145398 | Female, adult. | 204 | 186 | 48 | 46.7 | 16.0 | 27.0 |
| <i>S. lamucotanus</i> .. | Pulo Lamucotan..... | 145399 | Male, old..... | 225 | 185 | 49 | 50.2 | 16.5 | 29.5 |
| Do..... | do..... | 145400 | Male, adult.... | 225 | 190 | 50 | 51.8 | 18.0 | 29.5 |
| Do..... | do..... | 145401 | do..... | 217 | 195 | 50 | 51.2 | ..... | ..... |

¹ Collector's measurements.

² Measured by writer after feet had been relaxed by soaking in water 24 hours.

³ Type.

Measurements of squirrels of the vittatus group—Continued.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. | Tail vertebra. | Hind foot, with claws. | Greatest length of skull. | Interorbital constriction. | Zygomastic breadth. |
|------------------------|---------------------------|---------------|----------------------|----------------|----------------|------------------------|---------------------------|----------------------------|---------------------|
| | | | | mm. | mm. | mm. | mm. | mm. | mm. |
| <i>S. lamucotanus</i> | Pulo Lamukotan..... | 145406 | Male adult.... | 214 | 198 | 51 | 51.3 | 17.0 | 29.8 |
| Do. | do..... | 145402 | Female, adult. | 220 | 178 | 50 | 50.6 | 17.5 | 30.2 |
| Do. | do..... | 145403 | do..... | 225 | 158 | 50 | 50.8 | 17.2 | 30.0 |
| Do. | do..... | 145404 | Female, young adult. | 216 | 190 | 51 | 49.8 | 18.7 | 29.6 |
| Do. | do..... | 145405 | Female, adult. | 224 | 196 | 51 | 50.4 | 16.8 | 29.0 |
| <i>S. dulitensis</i> | Sukadana..... | 145407 | Male, adult.... | 210 | 175 | 48 | 49.4 | 17.7 | 29.0 |
| Do. | do..... | 145408 | do..... | 212 | 190 | 50 | 48.3 | 16.4 | 28.5 |
| Do. | do..... | 145409 | do..... | 215 | 185 | 47 | 49.0 | 17.5 | 28.4 |
| Do. | do..... | 145410 | Female, adult. | 215 | 185 | 49 | 48.8 | 17.3 | 29.5 |
| Do. | Sempang River..... | 145411 | do..... | 221 | 182 | 50 | 51.4 | 18.7 | 30.5 |
| Do. | Batu Jurong..... | 153675 | Male, immature. | 185 | 180 | 48 | 47.3 | 16.3 | 27.5 |
| Do. | do..... | 153676 | Male, young adult. | 190 | 175 | 47 | 45.6 | 15.2 | 27.2 |
| Do. | do..... | 153677 | Male, adult.... | 206 | 182 | 50 | 49.6 | 17.2 | 28.4 |
| Do. | do..... | 153678 | Male..... | 213 | 190 | 49 | ..... | ..... | ..... |
| Do. | Kendawangan River..... | 153679 | Female, adult. | 215 | 180 | 47 | 47.9 | 18.4 | ..... |
| Do. | do..... | 153680 | do..... | 206 | 192 | 49 | 49.0 | 16.5 | 28.1 |
| Do. | Klumpang Bay..... | 151785 | Male..... | 190 | 190 | 49 | ..... | ..... | ..... |
| Do. | do..... | 151784 | Female, adult. | 205 | 195 | 49 | 49.2 | 17.3 | 28.3 |
| Do. | do..... | 151786 | do..... | 215 | 185 | 47 | 49.8 | 16.5 | 29.8 |
| Do. | Tjantung..... | 151787 | Male, adult.... | 203 | 190 | 48 | 48.0 | 17.4 | 28.4 |
| Do. | Balik Papan Bay..... | 154289 | do..... | 203 | 185 | 50 | 49.1 | 18.6 | 30.0 |
| Do. | do..... | 154290 | do..... | 203 | 177 | 51 | 49.7 | 18.0 | 28.7 |
| Do. | do..... | 154291 | Male, young adult. | 206 | 195 | 53 | 50.7 | 17.7 | 28.8 |
| Do. | do..... | 154288 | Female, adult. | 210 | 184 | 51 | 50.0 | 17.9 | 29.4 |
| Do. | Pulo Laut..... | 151779 | Female..... | 205 | 190 | 48 | 49.7 | 17.5 | 27.7 |
| <i>S. poliopus</i> | Klumpang Bay..... | 151783 | Male..... | 195 | 170 | 46 | 45.5 | 19.0 | 28.5 |
| Do. | Saratok River..... | 151788 | do..... | 200 | 195 | 48 | 48.0 | 18.0 | 30.8 |
| Do. | Pamukang Bay..... | 151789 | Male, adult.... | 205 | 190 | 48 | 48.6 | 17.8 | ..... |
| <i>S. marinsularis</i> | Pulo Laut, east side..... | 151774 | Male..... | 212 | 198 | 49 | ..... | ..... | ..... |
| Do. | Pulo Laut..... | 151776 | do..... | 210 | 175 | 49 | 46.8 | 18.3 | 29.8 |
| Do. | do..... | 151777 | Male, young adult. | 205 | 180 | 48 | 48.6 | ..... | ..... |
| Do. | do..... | 151780 | Male..... | 205 | 190 | 49 | 48.4 | 18.0 | 30.3 |
| Do. | do..... | 151778 | Female..... | 210 | 200 | 49 | ..... | 18.0 | 30.2 |
| Do. | do..... | 151775 | Female, adult. | 211 | 185 | 48 | 48.8 | 17.4 | 29.5 |
| Do. | Pulo Sebuku..... | 151781 | do..... | 205 | 176 | 47 | 47.3 | 17.2 | 28.7 |
| Do. | do..... | 151782 | Female..... | 205 | 175 | 47 | 48.0 | 18.0 | 29.8 |

¹ Type.

SCIURUS LOWII Thomas.

1892. *Sciurus lowii* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 253, March, 1892.

Two specimens were secured, an adult male from the Kendawangan River, southwestern Borneo, and an adult female from the Saratok River, southeastern Borneo.

(For measurements, see table, p. 92.)

SCIURUS PARVUS Miller.

1901. *Sciurus parvus* MILLER, Proc. Biol. Soc. Wash., vol. 14, p. 33, April 5, 1901.

Type-locality, Nulu, Sarawak, Borneo.

Three small squirrels, members of the *tenuis* group, were secured along the Sempang River. They do not differ essentially from specimens of *Sciurus parvus* from northern Borneo.

(For measurements, see table, p. 92.)

SCIURUS BORNEENSIS (Gray).

1867. *Macroxus rufogaster*, var. *borneensis* GRAY, Ann. Mag. Nat. Hist., ser. 3, vol. 20, 1867, p. 283.
 1901. *Sciurus hippurus grayi* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 7, February, 1901, p. 171, footnote.
 1907. *Sciurus grayi*, LYON, Smiths. Misc. Coll., vol. 50, April 8, 1907, p. 28.

One specimen, an adult male (Cat. No. 154293), from Balik Papan Bay, is apparently indistinguishable from specimens of *Sciurus borneensis* in the U. S. National Museum collection from North Borneo. (For measurements, see table, below.)

SCIURUS HIPPURELLUS Lyon.

1907. *Sciurus hippurellus* LYON, Smiths. Misc. Coll., vol. 50, p. 27, April 8, 1907.
 1907. *Sciurus hippurellus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 557, December 24, 1907.

Two from the Landak River and one from the Kapuas, collected in 1905.

Measurements of squirrels.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail vertebrae. ¹ | Hind foot, with claws. ² | Greatest length of skull. | Zygomatic breadth. | Interorbital constriction. |
|-------------------------------|------------------------|---------------|--------------------------|-----------------------------|------------------------------|-------------------------------------|---------------------------|--------------------|----------------------------|
| <i>Lariscus diversus</i> | Sukadana..... | 145383 | Male, old..... | mm. 193 | mm. 100 | mm. 48 | mm. 49.6 | mm. 26.6 | mm. 13.0 |
| Do..... | Kendawangan River..... | 153683 | Female, adult..... | 196 | 104 | 48 | 49.4 | 25.8 | 13.0 |
| Do..... | Saratok River..... | 151791 | Male, young..... | 142 | 95 | 44 | ..... | ..... | ..... |
| Do..... | Balik Papan Bay..... | 154294 | Male, adult..... | 187 | 113 | 50 | 49.0 | 26.4 | 12.8 |
| Do..... | do..... | 154295 | Female, adult..... | 197 | 110 | 50 | 49.7 | 27.6 | 13.3 |
| Do..... | do..... | 154296 | do..... | 185 | 115 | 50 | 49.7 | 26.7 | 13.8 |
| Do..... | do..... | 154297 | Female, young adult..... | ..... | ..... | ..... | 46.0 | 25.3 | 12.4 |
| <i>Sciurus lowii</i> | Kendawangan River..... | 153681 | Male, adult..... | 140 | ..... | 38 | 38.6 | 21.5 | 11.5 |
| Do..... | Saratok River..... | 151790 | Female, adult..... | 150 | 80 | 38 | 39.4 | 23.2 | 12.5 |
| <i>Sciurus parvus</i> | Sempang River..... | 145384 | Female, young adult..... | 140 | 112 | 38 | 36.9 | 20.8 | 12.2 |
| Do..... | do..... | 145385 | Male, adult..... | 155 | 126 | 39 | ..... | 22.7 | 13.0 |
| Do..... | do..... | 145386 | Female, adult..... | 142 | 123 | 38 | 38.5 | 22.4 | 12.0 |
| <i>Sciurus borneensis</i> .. | Balik Papan Bay..... | 154293 | Male, adult..... | 244 | 271 | 64 | 57.7 | 33.0 | 19.9 |

RATUFA EPHIPIIUM (Müller).

- 1838-39. *Sciurus ephippium* MÜLLER, Tijdschr. Natuurl. Gesch. Physiol., vol. 5, p. 147.

Doctor Abbott secured seventeen specimens, practically topotypes, of *R. ephippium* from the region of Klumpang and Pamukang bays. Müller's figure³ is an excellent representation of this species as shown by unbleached specimens of the present series. The side of head and top of nose in the plate, however, are too "red." In Doctor Abbott's specimens those portions of the head are similar in

¹ Collector's measurements.

² Measured by writer after relaxing in water for 24 hours.

³ Verh. Nat. Gesch. Nederl. Bezitt., pl. 13, 1839-1844.

color to the base of whiskers in Müller's plate. The grizzling seen along the edge of the dorsal stripe in the plate is less noticeable in the specimens.

Regarding the type-locality of this species, Mr. Gerrit S. Miller, jr., who examined in Leiden, in 1904, the type, an adult male mounted, remarked: "No locality can be given beyond southeastern Borneo, in the low country."

(For measurements, see table, p. 96.)

RATUFA COTHURNATA, new species.

Type.—Skin and skull of adult female, Cat. No. 145378, collected at foot of Mount Palung, near Sukadana, western Borneo, February 9, 1907, by Dr. W. L. Abbott. Original number, 5537.

Diagnostic characters.—A member of the *ephippium* group, differing from true *ephippium* in having the dark dorsal area less sharply defined and general coloration not so bright, most closely related to *Ratufa ephippium baramensis* Bonhote,¹ but differing in having the thighs concolor with under parts of body.

Color.—Type: Upper parts of head and body a mixture of tawny ochraceous and blackish, the former more conspicuous anteriorly and laterally, the latter more prominent in the dorsal line and posteriorly. The mixture occurs as a grizzle, except over the shoulders, where the tawny-ochraceous is essentially clear and unmixed, and on the lower back, where the blackish is unmixed and spreads out laterally nearly as far as the femoral spots. On the head between the ears the blackish is quite pure. Cheeks and sides of neck rather dark tawny-ochraceous. Under parts buff or buffy. Fore and hind legs and feet buff to ochraceous-buff, the inner sides of the legs lighter than the outer. General color of tail above blackish, the bases of the hairs whitish, marginal portions of under side of tail blackish; central portion, including short appressed hairs, ochraceous-buff. Ears inside and out dull ochraceous. The type is one of the brightest and freshest-looking in the series. The majority of specimens are duller and lighter in color, the tawny-ochraceous becoming ochraceous-buff or buffy and the under parts correspondingly lighter, the blackish becoming brownish. One specimen, Cat. No. 145381, from Kumbang River, is very much bleached and worn, the pelage in places having a singed appearance.

Skull and teeth.—Apparently there are no characters by which the skulls and teeth of *R. cothurnata* can be distinguished from those of *R. ephippium*.

Measurements.—The external and cranial measurements of *R. cothurnata* are essentially the same as they are in *R. ephippium*, the hind foot and greatest length of skull averaging, however, a trifle less. The hind foot in *R. cothurnata* ranges from 81 to 87 mm. and

¹Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 496, June, 1900. Type-locality, Baram district, Sarawak.

the skull from 62.5 to 66; in *R. ephippium* these ranges are 85 to 90 and 63.4 to 68.5. (For measurements of the series see table, p. 96.)

Specimens examined.—Twenty-three, from western and southwestern Borneo. (For exact localities see table, p. 96, four from along the Kapuas River not included.)

Remarks.—This is the same species that I called *Ratufa ephippium* (Müller) in 1907.¹ At that time there were no specimens of true *ephippium* in the museum collection. It is not at all unlikely that the forms of *Ratufa* on the mainland of Borneo, *baramensis*, *sandakanensis*, *cothurnata*, and *ephippium*, represent local races of one species, but at present intergradation is not known.

RATUFA GRISEICOLLIS, new species.

Type.—Skin and skull of adult male, Cat. No. 145372, collected on Panebangan Island, west coast of Borneo, May 24, 1907, by Dr. W. L. Abbott. Original number, 5315.

Diagnostic characters.—A richly colored species of the *ephippium* group related to *Ratufa cothurnata* above, from the neighboring mainland of Borneo, but back darker, sides and under parts more rufous, and sides of neck gray.

Color.—Upper parts of head and body in the middle line blackish; some light-colored hairs over nose, and in the type over back of neck; sides of body and shoulders rich cinnamon-rufous, grizzled with blackish; the shoulders contrasting with the black of the back, but elsewhere the latter color blends in with the sides; under parts of neck and body and inner side of thighs and legs orange-buff, rather richer than that of Ridgway; thighs similar to sides, becoming dull orange-rufous on the hind feet; upper and lateral aspect of tail brownish black, inner half of the long hairs on under side of tail buffy, the short hairs in median line tawny with slight grizzling of blackish.

Skull and teeth.—I can find no characters by which the skull and teeth of *Ratufa griseicollis* may be distinguished from those of *R. ephippium* or *R. cothurnata*.

Measurements.—See table, page 96.

Specimens examined.—Three, all from Pulo Panebangan.

Remarks.—*Ratufa griseicollis*, while clearly related to *R. cothurnata*, from Borneo, is very distinct and easily recognized by its gray neck, rufous under parts, and generally richer coloration. Head and body measurements of *R. griseicollis* are somewhat greater than corresponding measurements in mainland specimens.

RATUFA VITTATA, new species.

Type.—Skin and skull of adult female, Cat. No. 151758, collected at Saratok, on Pulo Laut, off southeast coast of Borneo, December 19, 1907, by Dr. W. L. Abbott. Original number, 5632.

¹ Proc. U. S. Nat. Mus., vol. 33, No. 1577, p. 557, December 24, 1907.

Diagnostic characters.—A member of the *ephippium* group, but differing from typical *ephippium* in having a more sharply defined dorsal stripe which does not extend forward beyond the shoulders, and in having a lighter cream-colored head.

Color.—Upper parts and sides of body with exception of dorsal stripe nearest Ridgway's ochraceous. This color is almost pure, but on close inspection, especially with a glass, dark tips to many of the hairs may be seen. The basal portions of the hairs on this part of the body are blackish slate. Dorsal stripe and all of the tail except in the middle line on the underside black or blackish. The stripe gradually begins, due to increasing extent of dark tips of the hairs, just behind the shoulders. It soon becomes prominent, varying in width in different specimens from about 30 to 50 mm. It is continuous with the color of the tail. Top and sides of head, just posterior to the ears, whitish, irregularly sprinkled with blackish due to dark-colored tips to the hairs. The dark-colored tips have a tendency to accumulate on the point of the nose and on the top of the head just anterior to the ears. Ears concolor with head. Underparts of body and throat varying from light buff to buff-yellow. Outer sides of legs and feet generally similar to sides of body, but slightly lighter, inner side of legs and femoral spot similar to underparts. Middle line of underside of tail similar to underparts or slightly darker.

Skull and teeth.—There are no evident peculiarities by which the skulls and teeth of *R. vittata* can be distinguished from those of *R. ephippium*.

Measurements.—For external and cranial measurements of the type and series see table, page 96.

Specimens examined.—Five, all from Saratok, Pulo Laut, south-eastern Borneo.

RATUFA VITTATULA, new species.

Type.—Skin and skull of adult male, Cat. No. 151762, collected on Pulo Sebuku, southeastern Borneo, January 2, 1908, by Dr. W. L. Abbott. Original number, 5720.

Diagnostic characters.—Practically identical with *R. vittata*, but smaller; hind foot 78–81 mm. instead of 84–89, and greatest length of skull 61–63.2 instead of 66–66.8.

Color.—The colors of *R. vittatula* are identical with those of *R. vittata* except that the light color of the head extends back on the side of the neck.

Skull and teeth.—The skulls and teeth of *R. vittatula* are distinctly smaller than they are in *R. vittata*. The rostrum in the smaller species is relatively shorter than it is in the larger one.

Measurements.—The external and cranial measurements of *R. vittatula* are all smaller than the corresponding measurements of *R. vittata*. (See table below.)

Specimens examined.—Seven, all from Pulo Sebuku.

Measurements of ratufas.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail vertebrae. ¹ | Hind foot, with claws. ² | Greatest length of skull. | Zygomatic breadth. | Interorbital constriction. |
|-----------------------------|--------------------------------|---------------------|---------------------|-----------------------------|------------------------------|-------------------------------------|---------------------------|--------------------|----------------------------|
| <i>R. griseicollis</i> | Pulo Panebangan..... | ³ 145372 | Male, adult.... | 366 | 420 | 86 | 67.0 | mm. | mm. |
| Do..... | do..... | 145371 | Female, adult. | 360 | 442 | 85 | 65.2 | 40.0 | 27.5 |
| Do..... | do..... | 145373 |do..... | 360 | 415 | 83 | 65.6 | 40.2 | 27.5 |
| <i>R. cothurnata</i> ... | Sukadana..... | 145375 |do..... | 335 | 415 | 84 | 66.0 | 41.4 | 26.0 |
| Do..... | do..... | 145376 |do..... | 340 | 420 | 86 | 65.6 | 41.8 | 27.3 |
| Do..... | Sempang River, mouth..... | 145379 | Male, adult.... | 330 | 380 | 81 | 62.5 | 38.2 | 25.0 |
| Do..... | do..... | 145380 | Female, adult. | 335 | 405 | 82 | 65.3 | 40.0 | 27.0 |
| Do..... | Sungei Matan..... | 145374 | Male, adult.... | 345 | 390 | 87 | 65.4 | 39.0 | 26.0 |
| Do..... | Kumbang River..... | 145381 |do..... | 330 | 387 | 84 | 65.0 | 39.6 | 27.2 |
| Do..... | do..... | 145382 | Male, young... | 300 | 390 | 81 | 63.3 | 37.0 | 25.0 |
| Do..... | Mount Palung..... | 145377 | Female, youngish. | 340 | 455 | 86 | 65.4 | 39.2 | 25.8 |
| Do..... | Mount Palung, foot of..... | ³ 145378 | Female, adult. | 350 | 390 | 83 | 64.0 | 38.5 | 25.5 |
| Do..... | Kendawangan River..... | 153647 |do..... | 330 | 395 | 83 | 66.5 | 40.0 | 25.4 |
| Do..... | do..... | 153648 | Male, adult.... | 340 | 393 | 84 | 65.8 | 39.2 | 25.5 |
| Do..... | do..... | 153649 |do..... | 333 | 388 | 77 | 64.2 | 40.7 | 25.6 |
| Do..... | do..... | 153650 | Female, old.... | 335 | 385 | 82 | 63.9 | 38.4 | 25.6 |
| Do..... | do..... | 153651 | Male, adult.... | 315 | 373 | 80 | 61.3 | 36.2 | 24.2 |
| Do..... | do..... | 153652 | Female, old.... | 345 | 405 | 79 | 63.1 | 40.6 | 26.5 |
| Do..... | do..... | 153653 | Male, young adult. | 305 | 335 | 79 | 61.8 | 36.8 | 23.0 |
| Do..... | do..... | 153654 | Male, adult.... | 345 | 410 | 82 | 63.5 | 40.3 | 25.0 |
| Do..... | do..... | 153655 | Female, adult. | 345 | 410 | 84 | 65.0 | 40.4 | 27.8 |
| Do..... | do..... | 153656 | Male, nearly adult. | 295 | 420 | 80 | 60.8 | 36.5 | 24.2 |
| <i>R. ephippium</i> ... | T. Batu, Klumpang Bay... | 151743 | Male, adult.... | 355 | 415 | 85 | 67.0 | 41.7 | 26.5 |
| Do..... | do..... | 151744 |do..... | 355 | 405 | 86 | 66.4 | 39.5 | 25.5 |
| Do..... | do..... | 151745 |do..... | 330 | 380 | 84 | 65.7 | 41.0 | 27.0 |
| Do..... | do..... | 151746 |do..... | 368 | 445 | 90 | 67.2 | 39.8 | 24.5 |
| Do..... | do..... | 151747 | Female, adult. | 350 | 410 | 86 | 65.5 | 40.2 | 26.8 |
| Do..... | Pulo Soren, Klumpang Bay | 151748 | Female, old.... | 343 | 420 | 87 | 68.5 | 40.6 | 25.3 |
| Do..... | Saratok R., Klumpang Bay | 151750 | Male, adult.... | 342 | 450 | 88 | 65.5 | 40.0 | 24.5 |
| Do..... | Pangkallahan R., Klumpang Bay. | 151749 | Female, old.... | 335 | 385 | 85 | 64.7 | 40.5 | 25.2 |
| Do..... | Klumpang Bay..... | 154300 | Male, old.... | 340 | 422 | 82 | 66.4 | 41.3 | 26.0 |
| Do..... | do..... | 154301 | Male, adult.... | 336 | 410 | 82 | 65.8 | 42.3 | 27.0 |
| Do..... | Pamukang Bay..... | 151751 | Female, adult. | 315 | 415 | 85 | 63.4 | 39.7 | 24.0 |
| Do..... | do..... | 154298 | Male, adult.... | 320 | 400 | 81 | 63.0 | ..... | 24.6 |
| Do..... | do..... | 154299 |do..... | 325 | 395 | 81 | 64.7 | 40.0 | 24.8 |
| Do..... | Sampanahan R., Pamukang Bay. | 151752 | Female, young | 300 | 400 | 80 | 61.5 | 34.4 | 21.8 |
| Do..... | do..... | 151753 | Female, adult. | 345 | 420 | 85 | 66.3 | 41.7 | 27.0 |
| Do..... | do..... | 151754 | Male, old.... | 338 | 420 | 86 | 67.0 | 37.8 | 27.0 |
| Do..... | do..... | 151755 | Female, adult. | 348 | 410 | 86 | 65.0 | 39.3 | 24.6 |
| <i>R. vittata</i> | Saratok, Pulo Laut..... | 151756 | Male, adult.... | 355 | 425 | 86 | ..... | ..... | 27.0 |
| Do..... | do..... | 151757 |do..... | 370 | 425 | 89 | 66.8 | 41.0 | 27.0 |
| Do..... | do..... | ³ 151758 | Female, adult. | 355 | 400 | 84 | 66.7 | 41.2 | 26.7 |
| Do..... | do..... | 151759 | Male, old.... | 345 | 400 | 84 | 66.0 | 41.5 | 27.3 |
| Do..... | do..... | 151760 | Male, adult.... | 345 | 390 | 84 | 66.0 | 41.4 | 27.0 |
| <i>R. vittatula</i> | Pulo Sebuku..... | 151761 |do..... | 340 | 385 | 80 | 63.2 | 41.0 | 27.0 |
| Do..... | do..... | ³ 151762 | Male, old.... | 333 | 395 | 80 | 62.8 | 41.6 | 27.0 |
| Do..... | do..... | 151763 | Female, adult. | 330 | 400 | 80 | 62.0 | 39.5 | 26.8 |
| Do..... | do..... | 151764 |do..... | 325 | 365 | 78 | 61.8 | 39.6 | 24.5 |
| Do..... | do..... | 151765 | Male, adult.... | 343 | 360 | 81 | 62.7 | 40.0 | 26.3 |
| Do..... | do..... | 151766 | Male, old.... | 338 | 380 | 80 | 62.5 | 39.0 | 24.0 |
| Do..... | do..... | 151767 | Male, adult.... | 335 | 380 | 80 | 61.0 | 39.0 | 25.0 |

¹ Collector's measurements.

² Measured by writer after relaxing feet in water.

³ Type.

Specimens examined.—Seven, all from Pulo Sebuku.

Remarks.—Superficially the two species, *R. vittata* and *R. vittatula*, appear identical, but the difference in size is absolutely constant, and there is no doubt as to their specific distinctness. The light coloring of the neck in *R. vittatula* is also constant. Both species are clearly offshoots from the mainland *R. cphippium*. The smallness of the Sebuku specimens was noticed by Doctor Abbott in the field.

NANNOSCIURUS EXILIS (Müller).

1907. *Nannosciurus exilis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 558, December 24, 1907.

One specimen collected at Sanggau in 1905.

NANNOSCIURUS BORNEANUS Lyon.

1906. *Nannosciurus borneanus* LYON, Proc. Biol. Soc. Wash., vol. 19, p. 54, May 1, 1906.

1907. *Nannosciurus borneanus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 558, December 24, 1907.

Fourteen additional specimens of this species of pigmy squirrel were secured, five from southeastern Borneo and nine from southwestern Borneo. They differ in no essential respects from the original series.

(For measurements and exact localities see table below. Three specimens from Matan River and one immature individual from Tjantung, all in alcohol, are not included in the table.)

Measurements of pigmy squirrels.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail vertebrae. ¹ | Hind foot, with claws. ² | Skull, gnathion to occipito-sphenoid suture. | Greatest breadth. | Interorbital constriction. |
|--------------------------------|------------------------|---------------------|----------------|-----------------------------|------------------------------|-------------------------------------|--|-------------------|----------------------------|
| <i>Nannosciurus borneanus.</i> | Pangkallahan River.. | 151793 | Male, adult... | mm. | mm. | mm. | mm. | mm. | mm. |
| Do..... | Saratok River..... | 151794 |do..... | 83 | 62 | 23 | 15.5 | 15.7 | 10.2 |
| Do..... | Klumpang Bay..... | 151795 | Female, adult. | 85 | 70 | 24 | 15.6 | 15.8 | 10.8 |
| Do..... | Upper Pasir River..... | ³ 154407 | Male, adult... | 75 | 52 | 21 | ..... | ..... | ..... |
| Do..... | Kendawangan River. | 153682 |do..... | 85 | 60 | 25 | ..... | ..... | ..... |
| Do..... | Sempang River..... | 145387 |do..... | 80 | 60 | 24 | 15.2 | 16.3 | 10.2 |
| Do..... |do..... | 145388 |do..... | 80 | 65 | 24 | 15.0 | 15.7 | 9.7 |
| Do..... | Sungei Matan..... | 145389 | Female, adult. | 87 | 63 | 26 | 16.0 | 16.4 | 10.3 |
| Do..... |do..... | 145390 | Male, adult... | 77 | 75 | 25 | 15.6 | 16.7 | 11.0 |
| Do..... |do..... | 145391 | Female, adult. | 80 | 60 | 24 | 16.8 | 16.4 | 10.0 |

¹ Collector's measurements.

² Measured by writer after relaxing feet in water.

³ In alcohol.

EPIMYS EPHIPIUM Jentink.

1880. *Mus ephippium* JENTINK, Notes Leyden Museum, vol. 2, p. 15.

1894. *Mus ephippium*, THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 14, p. 453.

1907. *Mus ephippium*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 558, December 24, 1907.

In addition to the nine specimens of *Epimys ephippium* taken in western Borneo in 1905, Doctor Abbott secured twelve others, on later expeditions; two from Mount Palung, nine from Sempang River, one from Kendawangan River. None were taken in southeastern Borneo. (For measurements see table below.)

Measurements of *Epimys ephippium*.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. | | Hind foot. | Greatest length of skull. | Zygomatic width. | Maxillary toothrow (alveoli). |
|-------------------------|--------------------|---------------|-----------|----------------------------|----------------|-----|------------|---------------------------|------------------|-------------------------------|
| | | | | | mm. | mm. | | | | |
| <i>E. ephippium</i> ... | Gunong Palung | 145553 | Male.... | Slightly worn... | (1) | (1) | (1) | 31.9 | 14.8 | 5.4 |
| Do..... | do..... | 145555 | Female... | do..... | (1) | (1) | (1) | 31.9 | 14.7 | 5.7 |
| Do..... | Sempang River | 145556 | do..... | do..... | 125 | 127 | 24 | 31.1 | 13.9 | 5.2 |
| Do..... | do..... | 145557 | do..... | do..... | 130 | 127 | 24 | 31.1 | 14.8 | 5.2 |
| Do..... | do..... | 145558 | Male.... | Unworn..... | 106 | 120 | 25 | ..... | ..... | 5.3 |
| Do..... | do..... | 145559 | Female... | do..... | 108 | 128 | 24 | 28.0 | ..... | 4.9 |
| Do..... | do..... | 145560 | do..... | Slightly worn ² | 130 | 135 | 25 | 30.7 | ..... | 5.3 |
| Do..... | do..... | 145561 | do..... | do..... | 127 | 140 | 25 | 31.8 | 14.0 | 5.3 |
| Do..... | do..... | 145562 | Male.... | do. ³ | 131 | 138 | 28 | 32.8 | 14.6 | 5.5 |
| Do..... | do..... | 145563 | Female... | do. ⁴ | 140 | 136 | 26 | 31.6 | 14.8 | 5.6 |
| Do..... | do..... | 145564 | Male.... | do. ² | 135 | 126 | 26 | 32.3 | 14.9 | 5.3 |
| Do..... | Kendawangan River. | 153720 | Female... | do..... | 121 | 126 | 27 | ..... | ..... | ..... |

¹ Skull only.

² Uterus contained 7 embryos.

³ Scrotum very large.

⁴ Mammaræ 2-2=8, evidently nursing.

EPIMYS NEGLECTUS Jentink.

1880. *Epimys neglectus* JENTINK, Notes Leyden Museum, vol. 2, p. 14, January, 1880. Type-locality, Banjarmasin.

Doctor Abbott collected a large number of rats which may be referred to Jentink's *Epimys neglectus*. Most of them are from small islands lying off the coast of Borneo. Two only are from the mainland of Borneo and none were taken on the comparatively large Pulos Laut and Sebuku. As a whole the 83 specimens are fairly uniform in size, color, and cranial characters, after due allowance has been made for age. The dimensions of head and body, tail, and condylo-basal length of skull are increased as the animal advances toward old age. I have used the amount of wear of the check teeth for comparing ages. The measurements of hind foot and the alveoli of the maxillary tooth row are quite constant, irrespective of age. (See table of measurements, p. 101.) The great majority of the specimens are dark brownish in color but in nearly every island series certain of the skins tend to reddish brown. This is merely an individual characteristic and I am

unable to see that a series from one island differs as a whole from a series from another island. On the basis of measurements of the hind feet and the maxillary tooth row these rats may be separated into three groups: A group with small feet and small teeth characteristic of the specimens from the mainland and from the small and close-lying islands of Junata and Bauwal. These are here considered as typical *Epimys neglectus*. They agree closely with Jentink's measurements of the type. A group with small feet and large teeth, embracing the specimens from Pulos Panebangan, Lamukotan, and Mata Siri. A group with large feet and large teeth from Pulos Pelapis and Datu. Each of the last two groups are described below as subspecies of *Epimys neglectus*. They are not well marked forms and without a series of specimens it would be impossible to identify them, but they present average differences in size which can not be disregarded. It should be noted that the islands in geographic relation to each other, Pelapis and Panebangan, and Datu and Lamukotan are not in relation to each other so far as the forms of *neglectus* rats are concerned.

EPIMYS NEGLECTUS DUCIS, new subspecies.

Type.—Skin and skull of adult male, Cat. No. 145511, collected on Pulo Datu, off west coast of Borneo, May 4, 1907, by Dr. W. L. Abbott. Original number, 5174.

Diagnostic characters.—A form of *Epimys neglectus* Jentink characterized by longer hind feet and longer maxillary tooth row.

Distribution.—The islands of Pelapis and Datu off the west coast of Borneo.

Color.—Type: Upper parts and sides of head, neck and body, a mixture of blackish brown and a color between ochraceous buff and clay color, the blackish brown slightly in excess; under parts, cream buff, more or less dirty; outer sides of legs, similar to upper parts, inner sides, similar to under parts; tail light brownish; scantily haired, 3 brownish hairs to a scale, and each hair about the length of $1\frac{1}{2}$ scales; outside of ears with short brownish hairs, inside with light dull buffy hairs.

Pelage.—Pelage of the back is composed of (1) rather long slender hairs, slaty at the base with a conspicuous ochraceous-buff-clay colored subterminal band, and a small dark brownish tip; (2) less numerous flattened, grooved bristles, somewhat spine-like, but not stiff enough for true spines, colored light grayish basally, and with a conspicuous brownish tip; (3) a few long slender bristles nearly twice the length of the grooved bristles, uniformly dark brownish in color.

Skull and teeth.—These are of the same general form and size as in the *alexandrinus-rattus* group of rats. The maxillary tooth row averages longer, from about 7 to 7.7 mm., than it does in typical *Mus neglectus*, about 6.5 to 7.

Measurements.—For external and cranial measurements of the type and series, see table, pages 101 and 102. The length of hind foot of this subspecies runs from 38 to 44 mm. nearly always over 40 mm., of the typical subspecies, 35 to 39, always under 40.

EPIMYS NEGLECTUS LAMUCOTANUS, new subspecies.

Type.—Skin and skull of adult female, Cat. No. 145497, collected on Pulo Lamukotan, off west coast of Borneo, May 10, 1907, by Dr. W. L. Abbott. Original number, 5224.

Diagnostic characters.—A form of *Epimys neglectus* Jentink, characterized by a longer maxillary tooth row.

Distribution.—The islands of Lamukotan and Panebangan, off the west coast of Borneo, and Pulo Mata Siri, off the southeast coast of Borneo.

Color.—Type: Upper parts and sides of head, neck, and body, a mixture in about equal proportions of blackish brown and a color between ochraceous buff and clay color; under parts, cream buff; outside of legs similar to upper parts; inner side similar to under parts; tail light brownish, scantily haired, three brownish hairs to each scale, and each hair about the length of one and one-half scales; outside of ears with short brownish hairs, inside with light dull buffy hairs.

Pelage.—As in *Epimys neglectus ducis* above.

Skull and teeth.—These are of the same general form and size as in the *alexandrinus-rattus* group of rats. The maxillary tooth row averages longer, from about 7 to 7.6 mm., than it does in typical *Epimys neglectus*, about 6.5 to 7.

Measurements.—For external and cranial measurements of the type and series, see table, page 101. The length of hind foot of this subspecies runs from 35 to 40 mm., nearly always under 40, about the same as in the typical subspecies.

Remarks.—The Mata Siri skins have on the average slightly longer hind feet than do skins from Panebangan and Lamukotan. Some of them have feet quite as large as do the members of the preceding subspecies, but they seem closest to the present form.

Measurements of *Epimys neglectus*.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. ¹ | | Hind foot. ¹ | Condylar-basal length. | Zygomatic width. | Maxillary tooththrow (alveol). |
|-----------------------------------|------------------|---------------------|---------|-------------------------|-----------------------------|-------|-------------------------|------------------------|------------------|--------------------------------|
| | | | | | mm. | mm. | | | | |
| <i>E. neglectus neglectus</i> . | Sempang River. | 145569 | Male | ..... | 154 | 173 | 36 | ..... | ..... | ..... |
| Do..... | do..... | 145570 | Female | Slightly worn... | 160 | 173 | 35 | 35.9 | 18.0 | 6.5 |
| Do..... | Pulo Junata..... | 145442 | Male | Moderately worn. | 195 | 192 | 37 | 40.6 | 20.4 | 6.7 |
| Do..... | do..... | 145443 | do..... | Much worn..... | 195 | 182 | 37 | 40.5 | 19.9 | 6.7 |
| Do..... | do..... | 145444 | do..... | Slightly worn... | 162 | 178 | 35 | 37.5 | 18.4 | 6.3 |
| Do..... | do..... | 145445 | do..... | Much worn..... | 193 | 184 | 37 | 40.2 | 19.4 | 6.5 |
| Do..... | do..... | 145446 | do..... | do..... | 194 | 185 | 37 | 40.7 | 19.7 | 6.7 |
| Do..... | do..... | 145447 | do..... | do..... | 198 | 193 | 39 | 41.5 | 19.6 | 6.8 |
| Do..... | do..... | 145448 | Female | Moderately worn. | 202 | 203 | 39 | 41.6 | 20.1 | 7.1 |
| Do..... | do..... | 145449 | do..... | Much worn..... | 198 | 193 | 39 | 42.3 | 20.2 | 6.7 |
| Do..... | Pulo Bauwal..... | 153731 | Male | Moderately worn. | 176 | 205 | 39 | ..... | 19.0 | 6.8 |
| Do..... | do..... | 153732 | do..... | do..... | 190 | 216 | 40 | 39.9 | 20.4 | 6.9 |
| Do..... | do..... | 153734 | do..... | Slightly worn... | 166 | 190 | 38 | 36.3 | 18.4 | 6.8 |
| Do..... | do..... | 153733 | Female | do..... | 153 | 195 | 39 | 35.8 | 17.9 | 6.9 |
| Do..... | do..... | 153735 | do..... | Moderately worn. | 181 | 212 | 39 | 39.5 | 20.0 | 6.7 |
| Do..... | do..... | 153736 | do..... | Slightly worn... | 175 | 213 | 39 | 37.5 | 18.3 | 7.2 |
| <i>E. neglectus tamucatanus</i> . | Pula Mata Siri | ² 151943 | Male | Moderately worn. | 177 | ..... | 38 | 37.9 | 18.7 | 7.3 |
| Do..... | do..... | 151946 | do..... | do..... | 182 | 171 | 38 | 37.9 | 19.5 | 7.2 |
| Do..... | do..... | 151947 | do..... | do..... | 183 | 183 | 38 | 38.2 | 20.2 | 7.4 |
| Do..... | do..... | 151948 | do..... | do..... | 177 | 189 | 39 | 39.0 | 19.7 | 7.6 |
| Do..... | do..... | 151951 | do..... | do..... | 184 | 192 | 38 | 39.6 | 20.5 | 7.2 |
| Do..... | do..... | ² 151953 | do..... | do..... | 196 | 215 | 41 | 41.7 | 21.4 | 7.3 |
| Do..... | do..... | ² 151955 | do..... | do..... | 192 | 204 | 41 | 40.8 | 20.4 | 7.3 |
| Do..... | do..... | ² 151956 | do..... | Much worn..... | 193 | 190 | 39 | 40.3 | 20.5 | 7.5 |
| Do..... | do..... | 151958 | do..... | Moderately worn. | 199 | 190 | 40 | 41.5 | 21.2 | 7.5 |
| Do..... | do..... | 151959 | do..... | do..... | 199 | ..... | 41 | 41.8 | 20.8 | 7.4 |
| Do..... | do..... | 151960 | do..... | do..... | 194 | 166 | 39 | 39.7 | 20.6 | 7.3 |
| Do..... | do..... | ² 151944 | Female | do..... | 185 | 185 | 39 | 39.8 | 20.5 | 7.3 |
| Do..... | do..... | ² 151945 | do..... | do..... | 184 | 186 | 39 | 40.0 | 19.8 | 7.4 |
| Do..... | do..... | 151949 | do..... | do..... | 194 | 196 | 39 | ..... | ..... | 7.4 |
| Do..... | do..... | 151950 | do..... | do..... | 190 | 182 | 37 | 38.7 | 20.7 | 7.5 |
| Do..... | do..... | ² 151952 | do..... | Much worn..... | ..... | ..... | ..... | 41.4 | 21.5 | 7.3 |
| Do..... | do..... | ² 151954 | do..... | Moderately worn. | 177 | 183 | 38 | 37.5 | ..... | 7.2 |
| Do..... | do..... | 151957 | do..... | Much worn..... | 199 | 207 | 41 | 43.2 | 22.5 | 7.3 |
| Do..... | do..... | 151961 | do..... | do..... | 200 | 187 | 40 | 41.9 | 22.3 | 7.2 |
| Do..... | Pulo Lamukotan. | 145485 | Male | Slightly worn... | 184 | 181 | 37 | 39.7 | 19.7 | 7.2 |
| Do..... | do..... | 145486 | do..... | do..... | 187 | 185 | 38 | 38.7 | 19.4 | 7.1 |
| Do..... | do..... | 145487 | do..... | do..... | 172 | 173 | 38 | 37.4 | 18.0 | 7.2 |
| Do..... | do..... | 145488 | do..... | do..... | 186 | 181 | 39 | 39.5 | 18.9 | 7.0 |
| Do..... | do..... | 145489 | do..... | do..... | 168 | 173 | 39 | 36.8 | 18.8 | 7.2 |
| Do..... | do..... | 145490 | do..... | do..... | 180 | 189 | 38 | 37.6 | 18.7 | 7.4 |
| Do..... | do..... | 145491 | do..... | Much worn..... | 201 | 179 | 39 | 41.5 | 20.6 | 7.4 |
| Do..... | do..... | 145492 | do..... | Slightly worn... | 156 | 164 | 38 | 35.5 | 17.5 | 7.1 |
| Do..... | do..... | 145493 | do..... | do..... | 158 | 147 | 37 | 35.7 | 18.4 | 7.2 |
| Do..... | do..... | 145494 | do..... | do..... | 158 | 167 | 37 | ..... | 17.7 | 7.2 |
| Do..... | do..... | 145495 | Female | do..... | 185 | 177 | 37 | ..... | ..... | 7.2 |
| Do..... | do..... | 145496 | do..... | Moderately worn. | 194 | 185 | 36 | 39.3 | 20.0 | 7.3 |
| Do..... | do..... | ² 145497 | do..... | do..... | 180 | 178 | 38 | 39.6 | 20.0 | 7.6 |
| Do..... | Pulo Panebangan. | 145544 | Male | Moderately worn. | 178 | 175 | 37 | 38.0 | 19.1 | 7.3 |
| Do..... | do..... | 145545 | do..... | do..... | 169 | 168 | 35 | 37.2 | 18.3 | 7.1 |
| Do..... | do..... | 145547 | do..... | do..... | 180 | 182 | 36 | 38.4 | ..... | 7.1 |
| Do..... | do..... | 145546 | Female | Slightly worn... | 145 | 160 | 36 | 34.4 | 18.2 | 7.6 |
| Do..... | do..... | 145548 | do..... | Moderately worn. | 181 | ..... | 37 | 40.0 | 20.5 | 7.5 |
| Do..... | do..... | ² 145550 | Male | Much worn..... | 188 | ..... | 37 | ..... | 19.6 | 6.8 |
| Do..... | do..... | ² 145551 | do..... | Moderately worn. | 177 | 154 | 35 | 37.4 | 19.5 | 7.4 |
| Do..... | do..... | ² 145552 | do..... | do..... | 173 | 166 | ..... | 37.3 | 19.3 | 6.9 |
| Do..... | do..... | ² 145549 | Female | Much worn..... | 184 | 186 | 37 | 39.5 | 21.2 | 7.3 |
| <i>E. neglectus ducis</i> . | Pulo Datu. | 145507 | Male | do..... | 206 | 202 | 43 | 42.7 | ..... | 7.7 |

¹ Collector's measurements.² Skull only, but specimen measured in flesh by collector.³ Type.

Measurements of *Epimys neglectus*—Continued.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. | | Hind foot. | Condyle-basal length. | Zygomatic width. | Maxillary tooththrow (alveoli). |
|----------------------------|-------------------|---------------------|----------|-------------------------|----------------|-----|------------|-----------------------|------------------|---------------------------------|
| | | | | | mm. | mm. | | | | |
| <i>E. neglectus ducis.</i> | Pulo Datu..... | 145508 | Male.... | Moderately worn. | 206 | 183 | 42 | 41.3 | 18.8 | 7.3 |
| Do..... | do..... | 145509 | do..... | Much worn. | 209 | 202 | 41 | 42.3 | 20.5 | 6.9 |
| Do..... | do..... | 145510 | do..... | Moderately worn. | 210 | 206 | 43 | 41.7 | 19.6 | 7.7 |
| Do..... | do..... | ¹ 145511 | do..... | do..... | 200 | 194 | 40 | 40.4 | 19.8 | 7.6 |
| Do..... | do..... | 145512 | do..... | do..... | 208 | 195 | 42 | 40.7 | 19.6 | 7.4 |
| Do..... | do..... | 145513 | Female | Much worn. | 199 | 198 | 42 | 41.5 | 19.8 | 7.2 |
| Do..... | do..... | 145514 | do..... | do..... | 212 | 198 | 42 | 43.6 | 19.9 | 6.9 |
| Do..... | do..... | 145515 | do..... | do..... | 216 | 216 | 44 | 43.1 | 21.4 | 7.6 |
| Do..... | do..... | 145516 | do..... | do..... | 210 | 182 | 41 | 42.5 | 21.0 | 7.2 |
| Do..... | do..... | 145517 | do..... | do..... | 207 | 195 | 41 | 42.5 | 20.3 | 7.4 |
| Do..... | Pulo Pelapis..... | 145450 | Male.... | Moderately worn. | 212 | 222 | 41 | 42.7 | 21.5 | 7.3 |
| Do..... | do..... | 145451 | do..... | Much worn. | 207 | 208 | 40 | 42.3 | 21.9 | 7.8 |
| Do..... | do..... | 145452 | do..... | do..... | 208 | 220 | 41 | 41.9 | 20.5 | 7.5 |
| Do..... | do..... | 145455 | do..... | Moderately worn. | 210 | 207 | 41 | 41.9 | 20.5 | 7.6 |
| Do..... | do..... | 145458 | do..... | Much worn. | 214 | 187 | 41 | 42.4 | 21.8 | 7.4 |
| Do..... | do..... | 145459 | do..... | do..... | 207 | 204 | 40 | 41.1 | 20.5 | 6.9 |
| Do..... | do..... | 145460 | do..... | Moderately worn. | 202 | 174 | 40 | 41.1 | 20.5 | 7.3 |
| Do..... | do..... | 145453 | Female | do..... | 208 | 220 | 40 | 41.7 | 22.0 | 7.3 |
| Do..... | do..... | 145454 | do..... | do..... | 197 | 213 | 40 | 41.6 | 20.5 | 7.5 |
| Do..... | do..... | 145456 | do..... | do..... | 190 | 200 | 40 | 40.9 | 20.8 | 7.2 |
| Do..... | do..... | 145457 | do..... | do..... | 215 | 220 | 41 | 42.5 | 22.0 | 7.5 |
| Do..... | do..... | ² 145461 | Male | do..... | 194 | 204 | 38 | 39.0 | 19.3 | 7.4 |
| Do..... | do..... | ² 145462 | do..... | do..... | 194 | --- | 38 | 39.3 | 19.7 | 7.2 |
| No..... | do..... | ² 145463 | Female | do..... | 195 | 200 | 41 | 39.8 | 20.0 | 7.3 |
| Do..... | do..... | ² 145464 | do..... | do..... | 197 | 193 | 39 | 39.8 | 19.8 | 7.4 |

¹ Type.² Skull only, but specimen measured in flesh by collector.

EPIMYS SEBUCUS, new species.

Type.—Skin and skull of adult male, Cat. No. 151964, collected on Pulo Sebuku, off southeastern coast of Borneo January 2, 1908, by Dr. W. L. Abbott. Original number, 5717.

Diagnostic characters.—A member of the *Epimys firmus*³ group, differing from the typical form in a more reddish brown general coloration.

Color.—Type: Upper parts and sides of head, neck, and body and outer sides of legs a coarse grizzly mixture of blackish and a color something between russet and tawny olive, the russet more conspicuous posteriorly; under parts and inner sides of legs, buff or buffy, the hairs practically the same color to their bases; tail uniformly brownish throughout; feet similar, ears dark brownish, very scantily haired with short dark hairs.

Pelage.—Pelage of three kinds of hairs, short, uniformly grayish colored under fur; longer hairs with dark bases, a russet-tawny olive middle portion and blackish tips; and long, slender grooved bristles, uniformly blackish in color; the three types named in the order of their abundance. Middle portion of tail with ten scales to the cen-

³ Miller, Proc. Acad. Nat. Sci. Phila., 1902, p. 155, June 11, 1902.

timeter, each scale subtended by three hairs, equalling a scale or a scale and a quarter in length.

Skull and teeth.—These show no special characters, and I can find no essential differences to distinguish them from the skulls and teeth of *Epimys firmus*.

Measurements.—For measurements of the type and series see table, page 104.

Specimens examined.—Eleven, all from Pulo Sebuk.

Remarks.—*Epimys sebuscus* at best can only be considered a slightly differentiated form of the widely distributed *Epimys firmus* group, of which there are many examples in the museum from Sumatra and adjacent islands and the Rhio-Linga Archipelago. No members of the group were taken on Borneo.

EPIMYS CRASSUS, new species.

Type.—Skin and skull of adult male, Cat, No. 145471, collected on Pulo Lamukotan, off the west coast of Borneo, May 8, 1907, by Dr. W. L. Abbott. Original number, 5190.

Diagnostic characters.—A large member of the *Epimys firmus*¹ group, differing from the typical form in larger size, larger and heavier skull, and a rather prominent swelling on the anterior portion of the nasal bones.

Color.—Type: Upper parts and sides of head, neck, and body, and outer sides of legs a coarse grizzly mixture of blackish and buff, slightly darker and rather duller than that of Ridgway; under parts and inner sides of legs cream color, the hairs essentially the same color throughout; tail and feet light brownish; ears dark brownish, very scantily covered with short, dark hairs.

Pelage.—Pelage of three kinds of hairs; short, uniformly grayish colored under fur; longer hairs with dark bases, a buffy middle portion, and blackish tips; and long, slender grooved bristles, blackish in color; the three types named in the order of their abundance. Middle portion of tail with eight and one-half scales to the centimeter, each scale subtended by three hairs, equally about a scale and a quarter in length.

Skull and teeth.—The skulls of *Epimys crassus* average larger and heavier than do those of *E. firmus* of like age, and most of the specimens have an elongated swelling on the outer side of the anterior half of the nasal bones, which is barely indicated on the skulls of other members of the *firmus* group. The teeth average slightly smaller than they do in *Epimys sebuscus*. The bullæ, also, are a trifle smaller in *E. crassus*.

Measurements.—For measurements of the type and series see table, page 104.

Specimens examined.—Fourteen, from Pulo Lamukotan.

¹ Miller, Proc. Acad. Nat. Sci. Phila., 1902, p. 155, June 11, 1902.

Remarks.—*Epimys crassus* appears to be a well-defined member of the *E. firmus* group. It is larger than any other members of the group in the U. S. National Museum. The swelling of the nasals is also quite characteristic. Externally it can not be differentiated from typical *firmus*.

Measurements of rats of the firmus group.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. ¹ | | Hind foot. ¹ | Condyle-basal length. | Zygomatic width. | Maxillary toothrow (alveoli). |
|-------------------------|-----------------|---------------|----------|-------------------------|-----------------------------|-------|-------------------------|-----------------------|------------------|-------------------------------|
| | | | | | mm. | mm. | | | | |
| <i>Epimys crassus</i> . | Pulo Lamukotan. | 2145471 | Male.... | Moderately worn | 255 | 260 | 50 | 54.2 | 27.7 | 8.8 |
| Do..... | do..... | 145472 | do..... | do..... | 259 | 291 | 51 | 55.3 | 28.8 | 9.0 |
| Do..... | do..... | 145473 | do..... | Much worn..... | 255 | 277 | 50 | 52.3 | 26.7 | 8.6 |
| Do..... | do..... | 145474 | Female | do..... | 249 | 275 | 49 | 50.5 | 26.5 | 8.6 |
| Do..... | do..... | 145475 | do..... | Moderately worn | 210 | 239 | 47 | ..... | ..... | 8.6 |
| Do..... | do..... | 145476 | Male | Slightly worn..... | 215 | 225 | 47 | ..... | ..... | 8.5 |
| Do..... | do..... | 145477 | do..... | Moderately worn | 240 | 262 | 49 | 50.5 | 26.3 | 8.8 |
| Do..... | do..... | 145478 | do..... | do..... | 232 | 258 | 49 | 50.0 | 24.5 | 8.7 |
| Do..... | do..... | 145479 | Female | do..... | 225 | 240 | 47 | 47.7 | 23.3 | 8.8 |
| Do..... | do..... | 145480 | Male | do..... | 227 | 239 | 50 | 47.9 | 24.6 | 8.9 |
| Do..... | do..... | 145481 | do..... | do..... | 241 | 279 | 53 | 49.6 | 24.5 | 8.7 |
| Do..... | do..... | 145482 | do..... | do..... | ..... | ..... | 48 | 48.2 | 24.9 | 8.9 |
| Do..... | do..... | 145483 | Female | do..... | 222 | 219 | 47 | 46.2 | 24.3 | 8.8 |
| Do..... | do..... | 145484 | do..... | Much worn..... | 242 | 255 | 49 | 52.9 | 26.2 | 8.5 |
| <i>Epimys sebucus</i> | Pulo Sebuku | 151962 | Male | do..... | 263 | 267 | 50 | 51.2 | 27.7 | 9.7 |
| Do..... | do..... | 151963 | Female | do..... | 254 | 255 | 46 | 48.8 | 25.7 | 9.3 |
| Do..... | do..... | 2151964 | Male | Moderately worn | 251 | 277 | 51 | 49.6 | 26.4 | 9.8 |
| Do..... | do..... | 151965 | Female | do..... | 225 | 242 | 46 | 48.0 | 25.3 | 9.4 |
| Do..... | do..... | 151966 | Male | Much worn..... | 241 | ..... | 51 | 50.5 | 27.5 | 9.6 |
| Do..... | do..... | 151967 | do..... | Slightly worn..... | 216 | 224 | 46 | 45.7 | 23.0 | 9.1 |
| Do..... | do..... | 151968 | Female | Much worn..... | 237 | 238 | 48 | 49.5 | 27.2 | 9.5 |
| Do..... | do..... | 151969 | do..... | do..... | 234 | 234 | 46 | 48.9 | 25.0 | 9.0 |
| Do..... | do..... | 151970 | Male | Unworn..... | 192 | 210 | 46 | 40.8 | 21.6 | 8.9 |
| Do..... | do..... | 151971 | do..... | Much worn..... | 247 | 233 | 46 | 49.9 | 26.7 | 9.1 |
| Do..... | do..... | 151972 | Female | Moderately worn | 230 | 250 | 46 | 48.2 | 24.9 | 9.4 |

¹ Collector's measurements.

² Type.

EPIMYS SABANUS Thomas.

1887. *Mus sabanus* THOMAS, Ann. Mag. Nat. Hist., ser. 5, vol. 20, p. 269, 1887.

Six specimens from the mainland of Borneo, a fully adult female from the foot of Mount Palung, a young adult female from the Saratok River, and four young adult females from Balik Papan Bay, and a young adult female from Pulo Laut. The fully adult specimen agrees in all essential respects with an example from northern Borneo. The younger specimens, however, are distinctly smaller, more so than their age would indicate. It is possible that they represent another form of the *Epimys sabanus* group, but the material at hand is too scanty to determine this.

(For measurements see table, p. 106.)

EPIMYS NASUTUS, new species.

Type.—Skin and skull of adult male, Cat. No. 145519, collected on Pulo Panebangan, off west coast of Borneo, May 21, 1907, by Dr. W. L. Abbott. Original number, 5270.

Diagnostic characters.—A member of the *Epimys sabanus*¹ group characterized by a shorter tail, somewhat smaller skull, and distinctly heavier rostrum.

Color.—Type: Upper parts and sides of head, neck, and body and outer sides of legs a mixture of blackish and orange buff, the former in excess in the median line, and the latter in excess along the sides and on the legs; underparts, including inner sides of legs, cream color, lighter on the throat than elsewhere; ears dark brownish, scantily clothed with a few dark hairs; tail brownish, not noticeably lighter below than above.

Pelage.—Pelage composed of three kinds of hairs—a rather scanty, dull, drab-gray colored underfur; hairs of normal texture, with dull grayish bases, succeeded by a dark brownish ring, then the conspicuous orange buff band and a small blackish apex; flattened and grooved spines, dull grayish at base and blackish at extremity. On the underparts the spinous hairs are shorter and weaker, and all the hairs are uniformly cream color throughout. Middle portion of tail with seven and one-half scales to the centimeter, each scale subtended by three hairs about a scale and a half in length.

Skull and teeth.—The skull and teeth are about the average in size for the group, but the skull is angular and massive; the brain case and interorbital region being wider than usual, and the rostrum unusually heavy.

Measurements.—Type: Head and body, 252 (253)² mm.; tail, 326 (329); hind foot, 54 (49); condylo-basal length of skull, 51.4 (51.7); zygomatic width, 25.8 (26.2); interorbital constriction, 9.3 (9.4); breadth of brain case above roots of zygomata 19.4 (19.4); greatest breadth of rostrum, 11 (10.6); depth of rostrum near incisors, 11.3 (11.5); maxillary tooth row, alveoli, 9.3 (9.3). (See table, p. 106.)

Specimens examined.—Three, all from Pulo Panebangan, two skins with skulls and one skull without skin.

Remarks.—*Epimys nasutus* differs by its heavy rostrum from all the rats of the *E. sabanus* group that I have seen with the exception of *E. balæ* from Tana Bala of the Batu Islands, off the west coast of Borneo. The skull of the Panebangan animal is decidedly larger, however, than that of the rat from Tana Bala. The tail of the latter is rather short and uniformly brownish in color, like the tail of *Epimys nasutus*. The tails of about half the members of the group are distinctly bicolor, brownish above and cream color beneath.

¹ Thomas, Ann. Mag. Nat. Hist., ser. 5, vol. 20, p. 269, 1887.

² Measurements in parentheses are those of a paratype, Cat. No. 145518, an old adult female.

Measurements of long-tailed rats.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. ¹ | | | | | |
|--------------------------|-----------------------|---------------------|----------------|-------------------------|-----------------------------|-------------------------|------------------------|------------------|----------------------------------|----------|
| | | | | | Tail. ¹ | Hind foot. ¹ | Condylar-basal length. | Zygomatic width. | Maxillary tooththrow (al. veol). | |
| <i>Epimys saba-nus</i> . | Base of Mount Palung. | 145565 | Female . | Much worn. | mm. 263 | mm. 382 | mm. 50 | mm. 53.5 | mm. 24.4 | mm. 10.0 |
| Do. | Saratok River. . . | 151942 | . . . do . . . | Moderately worn | 230 | 328 | 49 | 48.3 | 22.5 | 10.1 |
| Do. | Pulo Laut. | 151917 | . . . do . . . | . . . do | 210 | 290 | 44 | 45.8 | 23.0 | 9.4 |
| Do. | Balik Papan Bay | 154306 | . . . do . . . | . . . do | 247 | 370 | 50 | 51.5 | 24.9 | 10.5 |
| Do. | . . . do | 154307 | . . . do . . . | . . . do | 244 | 346 | 50 | 51.7 | 25.6 | 10.8 |
| Do. | . . . do | 154308 | . . . do . . . | . . . do | 231 | 354 | 47 | 49.2 | 24.7 | 9.8 |
| Do. | . . . do | ² 154309 | . . . do . . . | . . . do | 240 | 355 | 48 | 50.7 | 25.0 | 10.0 |
| <i>Epimys nasu-lus</i> . | Pulo Paneban-gan. | 145318 | . . . do . . . | Much worn. | 253 | 329 | 49 | 51.7 | 26.2 | 9.3 |
| Do. | . . . do | ² 145519 | Male . . . | Moderately worn | 252 | 326 | 54 | 51.4 | 25.8 | 9.3 |
| Do. | . . . do | ³ 145520 | Female . . | Slightly worn. . . | 188 | 272 | 46 | | | 9.3 |

EPIMYS WHITEHEADI (Thomas).

1894. *Mus whiteheadi* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 14, p. 457, December, 1894.

About fifty specimens of small reddish brown, spiny rats, with bicolor tails, were collected in various parts of Borneo or on islands near the coast by Doctor Abbott. (For the exact localities see table of measurements, p. 107.) I have called them all *Epimys whiteheadi*, although they show much variation, and I have been unable to compare them with topotypes from northern Borneo. Several of the present series have a strong tendency to be more brown and less "red" on the upper parts and to have gray instead of ochraceous bellies. Such specimens also average larger externally and cranially than do the others. These specimens are perhaps representatives of Thomas's recently described *Epimys whiteheadi perlutus*,⁴ but they have distinctly smaller skulls, shorter tails, and longer hindfeet, and are found in southwestern Borneo and Pulos Bauwal and Sebuku. The series of skins from Balik Papan Bay are very uniform in their bright "reddish" coloration and look exactly like a series of topotypes of *Epimys asper* (Miller)⁵ from Trong, Lower Siam.

(For measurements see table, p. 107.)

¹ Collector's measurements.

² Type.

³ Skull only.

⁴ Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 205, February, 1911.

⁵ Proc. Biol. Soc. Wash., vol. 13, p. 145, April 21, 1900.

Measurements of *Epimys whiteheadi*.

| Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. ¹ | | Hind foot. ¹ | Greatest length of skull. | Zygomatic width. | Maxillary tooththrow (chevel). |
|------------------------|---------------------|--------|-------------------------|-----------------------------|-------|-------------------------|---------------------------|------------------|--------------------------------|
| | | | | mm. | mm. | | | | |
| Summit of Mount Palang | 145553 | Male | ..... | 130 | 108 | 32 | ..... | ..... | ..... |
| Do | 145554 | Female | Moderately worn | 133 | 125 | 33 | 34.0 | 15.6 | 6.2 |
| Do | ² 145555 | do. | ..... | 128 | 102 | 30 | ..... | ..... | ..... |
| Kendawangen River | 155720 | do. | Unworn | ..... | ..... | ..... | 30.0 | 14.0 | 5.2 |
| Do | 155721 | ..... | Slightly worn | ..... | 90 | ..... | ..... | 13.0 | 5.2 |
| Do | 155722 | Female | Moderately worn | 129 | 105 | 28 | 30.4 | 14.0 | 5.2 |
| Do | 155723 | do. | Much worn | 131 | ..... | 26 | 32.2 | 14.5 | 4.9 |
| Do | ² 155724 | do. | Moderately worn | 139 | ..... | 32 | ..... | 15.6 | 5.7 |
| Do | 155725 | Male | do. | 120 | 115 | 31 | 31.5 | 14.0 | 5.7 |
| Do | 155726 | Female | do. | 111 | 101 | 27 | 30.5 | 14.0 | 5.4 |
| Do | ² 155727 | Male | do. | 129 | 127 | 33 | 33.0 | 15.3 | 5.9 |
| Do | ² 155728 | Female | do. | 113 | ..... | 32 | ..... | 14.6 | 5.9 |
| Do | 155729 | Male | do. | 125 | 108 | 30 | ..... | ..... | 5.4 |
| Do | 155730 | Female | do. | 112 | 95 | 28 | 29.7 | ..... | 5.3 |
| Pulo Bauwal | 153710 | do. | do. | 114 | 104 | 29 | 31.2 | 14.4 | 5.6 |
| Do | 153711 | do. | Slightly worn | 118 | 102 | 30 | 30.0 | 14.4 | 5.4 |
| Do | 153712 | ..... | do. | ..... | ..... | ..... | 31.0 | 14.3 | 5.7 |
| Do | 153713 | Female | Moderately worn | 125 | 108 | 30 | 30.7 | 14.7 | 5.4 |
| Do | 153714 | do. | do. | 120 | 102 | 31 | 31.4 | 14.0 | 5.5 |
| Do | 153715 | do. | do. | 125 | 98 | ..... | 30.0 | ..... | 5.5 |
| Do | 153716 | do. | Slightly worn | 113 | ..... | 28 | 28.7 | ..... | 5.5 |
| Do | 153717 | do. | Moderately worn | 117 | ..... | 28 | 30.8 | 14.8 | 5.3 |
| Do | 153718 | Male | Much worn | 146 | 130 | 32 | 34.0 | 15.4 | 5.4 |
| Do | 153719 | Female | Moderately worn | ..... | ..... | ..... | 30.4 | 14.4 | 5.4 |
| Pulo Sebuku | 151933 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5.8 |
| Do | 151934 | Male | Slightly worn | 136 | 88 | 30 | ..... | ..... | 5.8 |
| Do | 151937 | do. | Moderately worn | 133 | 94 | 28 | 32.7 | 15.0 | 5.7 |
| Do | 151938 | do. | do. | 135 | 105 | 29 | 34.0 | 15.4 | 5.9 |
| Do | 151939 | Female | Slightly worn | 130 | 93 | 27 | 31.4 | 15.0 | 5.6 |
| Do | ³ 151940 | do. | Moderately worn | 130 | 88 | 27 | ..... | 14.2 | 5.7 |
| Do | 151941 | Male | do. | 128 | ..... | 28 | 31.8 | 14.8 | 5.7 |
| Balik Papan Bay | 154321 | Female | do. | ..... | ..... | ..... | 30.6 | 14.8 | 5.3 |
| Do | 154322 | Male | do. | 117 | 105 | 27 | 31.5 | 14.6 | 5.2 |
| Do | 154323 | do. | do. | 125 | 103 | 29 | ..... | ..... | ..... |
| Do | 154324 | do. | Moderately worn | 112 | 98 | 29 | 31.5 | 14.5 | 5.6 |
| Do | 154325 | do. | do. | 118 | 100 | 28 | ..... | ..... | ..... |
| Do | 154326 | Female | do. | 120 | 99 | 27 | ..... | 14.5 | 5.2 |
| Do | 154327 | Male | do. | 128 | 118 | 30 | 33.0 | 14.7 | 5.5 |
| Do | 154328 | Female | do. | 113 | 102 | 29 | 30.6 | 14.2 | 5.3 |
| Do | 154329 | do. | do. | 122 | ..... | 28 | 31.6 | 14.9 | 5.6 |
| Do | 154330 | Male | do. | 122 | 98 | ..... | 31.0 | 14.7 | 5.3 |
| Do | 154331 | do. | do. | 134 | 109 | 29 | 32.4 | 14.2 | 5.4 |
| Do | 154332 | Female | do. | 115 | 92 | 25 | 31.0 | 14.3 | 5.6 |
| Do | 154333 | Male | do. | 122 | 105 | 29 | 32.0 | 14.2 | 5.2 |
| Do | 154335 | Female | do. | 119 | 94 | 28 | 33.1 | 14.0 | 5.8 |
| Do | 154336 | ..... | ..... | 128 | 104 | 28 | 31.3 | ..... | 5.4 |
| Do | 154337 | Male | Moderately worn | 117 | 95 | ..... | ..... | ..... | 5.2 |
| Do | 154338 | Female | do. | 125 | 103 | 29 | 31.3 | 14.0 | 5.6 |

¹ Collector's measurements.

² Belly gray.

³ Uterus contained two embryos.

EPIMYS RAJAH Thomas.

1894. *Mus rajah* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 14, p. 451, December, 1894.

About ninety specimens of rats belonging to the *Epimys rajah* group were collected on Borneo and many of the adjacent islands. About half of them, embracing all those from the mainland of Borneo, and from Pulos Lamukotan, Datu, and Bauwal, may be regarded as representing the typical form. Those from the other islands are referred to four different forms, three of which are described below as new. The specimens from southeastern Borneo average brighter

in color than do those from the western part of the island, in this respect resembling the form occurring on Pulo Laut.

(For measurements and localities, see table, pp. 110 and 111.)

EPIMYS SERUTUS.

1906. *Mus serutus* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 59, July 23, 1906.

Twelve specimens collected on Pulo Serutu, Karimata Islands.

EPIMYS CARIMATÆ MILLER.

1906. *Mus carimatæ* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 59, July 23, 1906.

Type-locality, Karimata Island.

Six rats of the *Epimys rajah-surifer* group collected on Pulo Pelapis do not show any material differences from *Epimys carimatæ*. There are more specimens inclined to be dark in the Pelapis series than in the Karimata series, but none of them are darker than the darkest of those from Karimata. Eleven specimens were collected on Karimata in 1904.

(For measurements, see table, p. 110.)

EPIMYS PERFLAVUS, new species.

Type.—Skin and skull of adult male, Cat. No. 151918, collected on Pulo Laut, off southeast coast of Borneo, December 25, 1907, by Dr. W. L. Abbott. Original number, 5684.

Diagnostic characters.—A member of the *Epimys rajah-surifer* group with the upper parts and sides strongly colored with bright ochraceous buff.

Color.—Type: Upper parts and sides of head, neck, and body and outer sides of legs bright ochraceous buff, sparingly mixed with light brownish along the middle of the back; under parts whitish to cream color, this color extending part way down the inner side of the legs; an indication of an ochraceous buff collar on throat (present in five of the paratypes and absent in three); feet whitish; upper surface of tail dark, under surface whitish; ears dark brownish, scantily clothed with dark hairs.

Skull and teeth.—These show no tangible differences from the skulls and teeth of *Epimys rajah*.

Measurements.—See table, pages 110 and 111.

Specimens examined.—Eleven skins with skulls and two skulls without skins, all from Pulo Laut.

Remarks.—*Epimys anambæ* Miller¹ shows the nearest approach in coloration to *E. perflavus*, but the upper parts in the Anamba rats are considerably darkened by brownish, and the external measurements are not so large. *Epimys anambæ* also appears to have a smaller skull, with a relatively shorter rostrum. The skulls of Malayan rats change

¹ Proc. Wash. Acad. Sci., vol. 2, p. 205, August 20, 1900.

so much in shape and size with increasing age and present so many apparent individual variations that not very much reliance can be placed upon them as determining species.

EPIMYS SATURATUS, new species.

Type.—Skin and skull of adult male, Cat. No. 145523, collected on Pulo Panebangan, off west coast of Borneo, May 17, 1907, by Dr. W. L. Abbott. Original number, 5236.

Diagnostic characters.—A medium sized member of the *Epimys rajah-surifer* group of rats, distinguished by its dark orange-buff and blackish coloration.

Color.—Type: Upper parts of head, neck, and body a mixture of orange-buff, rather darker than Ridgway's, and blackish, the latter color in excess along the back; sides of head, neck, and nearly all of legs nearly clear orange-buff, only sparingly mixed with blackish; under parts whitish to cream color, extending part way down inner side of legs; an orange-buff collar, 10 to 15 mm. wide, between throat and chest; feet whitish; ears blackish; tail dark above, cream color below.

Skull and teeth.—The skull and teeth of *Epimys saturatus* do not appear to differ from those of the related *Epimys rajah* and *E. carimatæ*.

Measurements.—See table, page 111.

Specimens examined.—Twenty-three, six skins with skulls and seventeen skulls with no skins, all from Pulo Panebangan.

Remarks.—*Epimys saturatus* is one of the darkest and richest colored members of the *E. rajah* group. Other species are as dark, such as the near-by *Epimys scrutus* from Pulo Serutu of the Karimata Islands, but the darker color is produced by an increase in the blackish elements, while in *E. saturatus* the lighter colors are deepened.

EPIMYS UBECUS, new species.

Type.—Skin and skull of adult male, Cat. No. 151931, collected on Pulo Sebuku, off southeast coast of Borneo, January 3, 1908, by Dr. W. L. Abbott. Original number, 5727.

Diagnostic characters.—A member of the *Epimys rajah* group, generally resembling *rajah*, but distinctly smaller.

Color.—Type: Upper parts of head, neck, and body a mixture of dark brownish and ochraceous buff, the darker color more prominent in the middle area of the back; sides of head, neck, and body, and outer sides of legs, ochraceous buff, nearly clear but slightly mixed with brownish; under parts and inner sides of legs whitish to cream color, the light color not interrupted at the throat by a darker collar; feet whitish; tail dark above, whitish beneath and at the extremity.

Skull and teeth.—These have the same general shape and proportions found in *Epimys rajah*, but are distinctly smaller throughout.

Measurements.—See table, page 111.

Specimens examined.—Three skins with skulls and one skull without skin, all from Pulo Sebuku.

Measurements of rats of the Epimys rajah group.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. | | Hind foot. | Condylar-basal length of skull. | Zygomatic width. | Maxillary toothrow (alveoli). |
|----------------------------|-----------------------|---------------|--------|-------------------------|----------------|-------|------------|---------------------------------|------------------|-------------------------------|
| | | | | | mm. | mm. | | | | |
| <i>E. rajah</i> | Base of Mount Palung. | 145566 | Female | Moderately worn | 202 | 198 | 42 | 41.3 | 19.6 | 6.9 |
| Do..... | Matan River..... | 145567 | do | do | 200 | 206 | 44 | 42.6 | 19.7 | 6.8 |
| Do..... | do..... | 145568 | do | Much worn | 198 | 178 | 40 | 39.9 | 18.8 | 6.5 |
| Do..... | Batu-Jurong..... | 153701 | do | Moderately worn | 176 | 176 | 41 | 38.5 | 18.1 | 6.7 |
| Do..... | do..... | 153702 | Male | do | 185 | 185 | 42 | 38.4 | 18.4 | 6.5 |
| Do..... | do..... | 153703 | do | Slightly worn | 183 | 183 | 41 | 38.5 | 18.4 | 6.3 |
| Do..... | do..... | 153704 | Female | Moderately worn | 175 | 185 | 41 | 38.0 | 18.8 | 6.2 |
| Do..... | Kendawangan River. | 153705 | do | Slightly worn | 167 | 180 | 45 | 37.4 | ..... | 6.4 |
| Do..... | do..... | 153706 | Male | do | 167 | 174 | 41 | 35.8 | 17.8 | 6.2 |
| Do..... | do..... | 153707 | do | Moderately worn | 178 | 194 | 42 | 40.5 | 18.7 | 6.5 |
| Do..... | Klumpang Bay. | 151932 | Female | do | 189 | 181 | 39 | 38.6 | 18.4 | 6.4 |
| Do..... | Pasir River..... | 154310 | Male | do | 184 | 170 | 39 | 40.4 | 19.5 | 6.4 |
| Do..... | Balik Papan Bay | 154311 | Female | do | 181 | 194 | 40 | ..... | ..... | ..... |
| Do..... | do..... | 154312 | Male | Moderately worn | 162 | 177 | 38 | 36.7 | ..... | 6.4 |
| Do..... | do..... | 154313 | do | do | 192 | 178 | 38 | 38.4 | 18.8 | 6.6 |
| Do..... | do..... | 154314 | do | do | 165 | 190 | 40 | 36.0 | 16.9 | 5.9 |
| Do..... | do..... | 154315 | Female | do | 208 | 198 | 39 | 40.5 | 20.7 | 7.0 |
| Do..... | Pamukang Bay. | 154316 | Male | do | 173 | 192 | 39 | 38.0 | 19.2 | 6.3 |
| Do..... | Balik Papan Bay. | 154317 | do | Slightly worn | 178 | 172 | 40 | 37.8 | ..... | 6.6 |
| Do..... | do..... | 154318 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Do..... | do..... | 154319 | ..... | Much worn | 198 | ..... | 37 | 42.0 | 13.6 | 7.1 |
| Do..... | do..... | 154320 | Female | do | 196 | 208 | 38 | 42.9 | 20.6 | 6.7 |
| Do..... | Pulo Lamukotan. | 145498 | Male | Unworn | 137 | 173 | 33 | 33.3 | 15.3 | 6.0 |
| Do..... | Pulo Datu..... | 145501 | do | Much worn | 224 | 212 | 44 | 44.8 | 21.2 | 6.8 |
| Do..... | do..... | 145502 | do | Moderately worn | 200 | 202 | 44 | 41.7 | 19.8 | 6.6 |
| Do..... | do..... | 145503 | Female | do | 180 | 178 | 40 | 39.9 | 19.0 | 6.5 |
| Do..... | do..... | 145504 | do | do | 194 | 181 | 40 | 39.7 | 18.9 | 6.7 |
| Do..... | do..... | 145505 | do | Much worn | 214 | 189 | 41 | ..... | ..... | 6.8 |
| Do..... | do..... | 145506 | Male | Moderately worn | 193 | ..... | 43 | 42.7 | ..... | ..... |
| Do..... | Pulo Bauwal. | 153685 | do | do | 198 | 188 | 41 | 40.5 | 19.4 | 6.8 |
| Do..... | do..... | 153686 | do | Slightly worn | 176 | 168 | 42 | 37.0 | 17.5 | 6.3 |
| Do..... | do..... | 153687 | Female | Moderately worn | 195 | 176 | 40 | 39.2 | 19.0 | 6.6 |
| Do..... | do..... | 153688 | do | Slightly worn | 172 | 128 | 44 | 37.3 | 17.5 | 6.4 |
| Do..... | do..... | 153689 | Male | do | 168 | 162 | 41 | 36.2 | 17.8 | 6.4 |
| Do..... | do..... | 153690 | Female | Much worn | 190 | 172 | 41 | 40.6 | ..... | 6.4 |
| Do..... | do..... | 153691 | do | Slightly worn | 182 | 166 | 42 | 37.0 | 17.5 | 6.3 |
| Do..... | do..... | 153692 | do | do | 164 | 157 | 41 | 36.6 | 17.6 | 6.2 |
| Do..... | do..... | 153693 | do | do | 168 | 165 | 40 | 36.2 | 17.3 | 6.6 |
| Do..... | do..... | 153694 | Male | do | 182 | 174 | 44 | 37.8 | 18.0 | 6.7 |
| Do..... | do..... | 153695 | Female | Moderately worn | 188 | 177 | 40 | 39.1 | 18.5 | 6.4 |
| Do..... | do..... | 153696 | do | do | 179 | 161 | 40 | ..... | 17.5 | 6.6 |
| Do..... | do..... | 153697 | do | Slightly worn | 170 | 165 | 41 | 36.6 | 17.5 | 6.6 |
| Do..... | do..... | 153698 | do | Much worn | 210 | 188 | 41 | 41.8 | 19.8 | 6.9 |
| Do..... | do..... | 153699 | Male | do | 209 | 188 | 42 | ..... | ..... | 6.4 |
| Do..... | do..... | 153700 | Female | Slightly worn | 171 | 162 | 40 | 36.8 | 17.6 | 6.7 |
| Do..... | do..... | 153708 | Male | do | 180 | 173 | 42 | 37.0 | 17.9 | 6.2 |
| <i>E. carinatus</i> | Pulo Pelapis. | 145465 | Female | Much worn | 215 | 167 | 41 | 42.8 | 20.9 | 6.7 |
| Do..... | do..... | 145466 | Male | do | 212 | 158 | 43 | ..... | ..... | 6.7 |
| Do..... | do..... | 145467 | do | do | 208 | 173 | 43 | 43.6 | ..... | 6.8 |
| Do..... | do..... | 145468 | Female | do | 207 | 155 | 41 | 2.0 | ..... | ..... |
| Do..... | do..... | 145469 | do | Moderately worn | 193 | ..... | 40 | 40.6 | 19.8 | 6.6 |
| Do..... | do..... | 145470 | Male | Much worn | 204 | 193 | 42 | 42.6 | 20.1 | 7.2 |
| <i>E. peribovius</i> | Pulo Laut..... | 151918 | do | Moderately worn | 196 | 177 | 42 | 40.8 | 19.8 | 6.6 |
| Do..... | do..... | 151919 | Female | do | 189 | 181 | 39 | 39.7 | 18.4 | 6.4 |
| Do..... | do..... | 151920 | do | do | 179 | ..... | 39 | 38.9 | ..... | 6.8 |
| Do..... | do..... | 151921 | Male | do | 198 | 182 | 40 | 42.2 | 20.0 | 6.7 |
| Do..... | do..... | 151922 | do | do | 187 | 171 | 40 | 41.4 | 20.1 | 6.8 |
| Do..... | do..... | 151923 | do | do | 197 | 177 | 39 | 41.2 | 19.7 | 6.8 |
| Do..... | do..... | 151924 | do | do | 196 | 183 | 41 | ..... | ..... | 6.9 |
| Do..... | do..... | 151925 | Male | do | 198 | 174 | 40 | 40.4 | 19.7 | 6.4 |

Measurements of rats of the *Epimys rajah* group—Continued.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. | | Condylo-basal length of skull. | Zygomatic width. | Maxillary tooththrow (alveoli). |
|---------------------------|------------------|---------------|--------|-------------------------|----------------|------------|--------------------------------|------------------|---------------------------------|
| | | | | | Tail. | Hind foot. | | | |
| <i>E. perflavus</i> ... | Pulo Laut..... | 151926 | Female | Moderately worn | 188 | 169 | 39 | 18.9 | 6.4 |
| Do..... | do..... | 151927 | ..... | do..... | 198 | 168 | 40 | 42.2 | 6.7 |
| Do..... | do..... | 151928 | Female | do..... | 183 | 177 | 38 | 39.9 | 19.5 |
| <i>E. ubecus</i> | Pulo Sebuku..... | 151929 | ..... | do..... | 172 | ..... | 36 | 34.8 | 17.4 |
| Do..... | do..... | 151930 | do | Slightly worn | 158 | 125 | 39 | 35.0 | 17.0 |
| Do..... | do..... | 151931 | Male | Moderately worn | 177 | 140 | 37 | 37.5 | 18.1 |
| Do..... | do..... | 151933 | do | Unworn | 136 | 115 | 33 | 31.3 | 16.0 |
| <i>E. saturatus</i> | Pulo Panebangan | 145521 | ..... | Moderately worn | 206 | 171 | 41 | 41.0 | 20.4 |
| Do..... | do..... | 145522 | Male | do..... | 209 | 171 | 41 | 41.3 | 20.2 |
| Do..... | do..... | 145523 | do | do..... | 197 | 186 | 41 | 41.1 | 20.6 |
| Do..... | do..... | 145524 | do | do..... | 200 | 163 | 41 | 39.9 | 20.0 |
| Do..... | do..... | 145525 | Female | Much worn | 198 | 178 | 39 | 40.4 | 20.5 |
| Do..... | do..... | 145526 | Male | Moderately worn | 190 | 165 | 41 | 39.2 | 19.8 |
| Do..... | do..... | 145527 | Female | do..... | 187 | 142 | 41 | 40.0 | 19.0 |
| Do..... | do..... | 145528 | Male | do..... | 204 | 181 | 41 | 41.1 | 20.3 |
| Do..... | do..... | 145529 | do | do..... | 194 | 157 | 41 | 39.7 | 20.4 |
| Do..... | do..... | 145530 | Female | do..... | 200 | 154 | 40 | 39.6 | 18.8 |
| Do..... | do..... | 145531 | do | Much worn | 195 | 165 | 39 | 40.8 | 6.6 |
| Do..... | do..... | 145532 | do | do..... | 200 | 168 | 39 | 41.6 | 21.0 |
| Do..... | do..... | 145533 | ..... | Moderately worn | 198 | 157 | 39 | 40.5 | 20.0 |
| Do..... | do..... | 145534 | Female | do..... | 194 | 156 | 40 | 39.3 | 19.8 |
| Do..... | do..... | 145535 | do | Much worn | 200 | 155 | 40 | 40.8 | 19.5 |
| Do..... | do..... | 145536 | Male | Moderately worn | 206 | 174 | 41 | 40.3 | 20.3 |
| Do..... | do..... | 145537 | ..... | Much worn | ..... | ..... | ..... | 42.7 | 6.2 |
| Do..... | do..... | 145538 | Male | Moderately worn | 189 | 181 | 40 | 40.7 | 19.3 |
| Do..... | do..... | 145539 | do | do..... | 201 | 171 | 40 | 40.2 | 6.5 |
| Do..... | do..... | 145540 | Female | do..... | 188 | 162 | 39 | 39.9 | 19.6 |
| Do..... | do..... | 145541 | do | do..... | 180 | 153 | 39 | ..... | 6.7 |
| Do..... | do..... | 145542 | do | do..... | 187 | 142 | 40 | 39.2 | 19.0 |
| Do..... | do..... | 145543 | do | do..... | ..... | ..... | ..... | 39.5 | 19.3 |

EPIMYS KINA (Bonhote.)

1903. *Mus kina* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 124, January, 1903.

Four adult specimens of *Epimys kina* were collected at Balik-Papan Bay, and one very young one along the Kendawangan River. They differ very slightly, if at all, from typical *E. cremoriventer* Miller.¹

(For measurements see table, p. 113.)

EPIMYS SPATULATUS, new species.

Type.—Skin and skull of adult male, Cat. No. 145499, collected on Pulo Lamukotan, off west coast of Borneo, May 10, 1907, by Dr. W. L. Abbott. Original number, 5214.

Diagnostic characters.—A member of the *Epimys cremoriventer* group² distinguished by its large size and the widened extremity of the nasals.

Color.—Type: Upper parts of head, neck, and body, a grizzly mixture of ochraceous buff and dark brownish, the two colors in about equal proportions; sides of head, neck, and body, and outer sides of

¹ Proc. Biol. Soc. Wash., vol. 13, p. 144, April 21, 1900.

² See Bonhote, Fasc. Malay., Zool., vol. 1, pp. 34, 36, October, 1903.

legs similar, but the ochraceous buff, lighter and duller and with very little admixture of other color, except the grayish bases of hairs showing through; entire under parts, including inner sides of legs, creamy white, feet dirty whitish, ears brownish with a few inconspicuous short hairs; tail light brownish above, but gradually lightening to dirty whitish for a narrow area beneath.

Pelage.—Pelage of three types of hairs: (1) soft, rather wavy normal hair, grayish at base, with a conspicuous subapical ochraceous ring and an inconspicuous dark brownish apex, these hairs often partaking of the nature of underfur, and with very little of the ochraceous coloring; (2) numerous flattened grooved spines, straw yellowish basally and centrally, dark brownish apically and marginally; (3) rather long slender bristles, generally blackish in color throughout, present only along middle line of back. On the light under parts the short hairs and spines are uniformly creamy white throughout. Middle portion of tail with eleven scales to the centimeter, each subtended by three brownish hairs, equaling a scale and a half in length. Whiskers very long, 65 mm., reaching as far back as shoulders.

Skull and teeth.—The skull of *Epimys spatulatus* has the same general shape as the skulls of other species of the *cremoriventer* group, but it is distinctly larger, the brain case absolutely and relatively longer, the rostrum larger and heavier, and the nasals relatively wider at the extremity. The teeth are relatively smaller than they are in other species.

Measurements.—External measurements of the type taken by collector: Head and body, 158 mm.; tail, 197; hind foot with claws, 31. Cranial measurements of the type: Condylar-basal length, 34.3; zygomatic breadth, 16.4; width of brain case above roots of zygomatics, 15.6; interorbital constriction, 5.7; length of nasals, 13.7; width of nasals at extremity, 4.8; maxillary tooth row, alveoli, 6.2.

Specimens examined.—One, the type.

Remarks.—*Epimys spatulatus* differs from *Epimys kina* Bonhote¹ mainly in its larger size.

¹ Ann. Mag. Nat. Hist., ser. 7, vol. 11, p. 124, January, 1903.

Measurements of cream-bellied rats.

| Name. | Locality. | Catalogue No. | Sex. | State of wear of teeth. | Head and body. ¹ | Tail. ¹ | Hind foot. ¹ | Condylar-basal length. | Zygomatic width. | Maxillary tooththrow (alveoli). |
|--------------------------|------------------|---------------|-----------|-------------------------|-----------------------------|--------------------|-------------------------|------------------------|------------------|---------------------------------|
| <i>E. kina</i> | Balik Papan Bay. | 154302 | Female.. | Moderately worn. | mm. 124 | mm. 178 | mm. 28 | mm. 29.8 | mm. 15.0 | mm. 6.2 |
| Do..... | do..... | 154303 | Male..... | do..... | 130 | 174 | 29 | 30.0 | 16.0 | 6.1 |
| Do..... | do..... | 154304 | ..... | do..... | 135 | 185 | ..... | 30.0 | 15.6 | 6.1 |
| Do..... | do..... | 154305 | Female.. | Much worn. | 140 | ..... | 29 | 32.0 | 15.9 | 6.4 |
| <i>E. spatulatus</i> ... | Pulo Lamuktan. | 145499 | Male..... | Moderately worn. | 158 | 197 | 31 | 34.3 | 16.4 | 6.2 |

TRICHYS LIPURA Günther.

1876. *Trichys lipura* GÜNTHER, Proc. Zool. Soc. London, 1876, p. 739, fig. 2, p. 740; fig. 2a; p. 741, pl. 71. Type-locality, Borneo, opposite island of Labuan. (See also p. 424 of foregoing reference.)

Two specimens of this species of brush-tailed porcupine were taken by Doctor Abbott, one in southwestern, one in southeastern Borneo.

Measurements.—Cat. No. 145571, adult male, Sungei Matan, and Cat. No. 151880, adult female, Saratok River, respectively, head and body, 420, 445 mm.; tail vertebrae, 200, 190; hind foot, 65, 64; greatest length of skull, 85.6, 79.8; zygomatic width, 45.8, 44.3; greatest length of nasals, 23.8, 23.7; maxillary tooththrow (alveoli). 14.8, 14.5.

ACANTHION LONGICAUDUM (Marsden).

1810. *Hystrix longicauda* MARSDEN, History of Sumatra, ed. 3, 1811, p. 118, name only, without description, and pl. 13 n. 1., with legend, "The Landak, *Hystrix longicauda*. Published by W. Marsden, 1810." Type-locality, Sumatra.

1907. *Acanthion crassispinis* LYON (not Günther), Proc. U. S. Nat. Mus., vol. 32, p. 581, June 29, 1907.

Three specimens of porcupine from southwestern Borneo may be referred to *Acanthion longicaudum*. It is not probable that the Bornean *Acanthion* is the same as the Sumatran one, but there is no satisfactory material from Sumatra in the U. S. National Museum to permit of comparisons, and no name so far as I know has been proposed for a Bornean *Acanthion*. In 1907 I applied Günther's name *crassispinis*³ to the Bornean *Acanthion*. Mr. Gerrit S. Miller, jr., has subsequently examined the type of that species in comparison with specimens of my *Thecurus sumatræ*⁴ and reports that the two are congeneric, but distinct species.

¹ Collector's measurements.

² Type.

³ Proc. Zool. Soc. London, 1876, p. 736.

⁴ Proc. U. S. Nat. Mus., vol. 32, p. 581, June 29, 1907.

The specimens collected by Doctor Abbott are as follows: (a) Cat. No. 153974, from the Kendawangan River, skull of a very young male, having but two cheek-teeth in each half of the jaw. This specimen has four upper incisors, a pair of slender rounded incisors lying in front of and resting on the anterior face of the usual incisors. They are scarcely large enough to be functional and remind one of the hinder pair of incisors found in the Lagomorphs. (b) Cat. No. 145572, from the Semandang River, skull, without skin. The permanent molars are in place, but the milk molars have not yet been shed. (c) Cat. No. 153737, skin and skull of an adult male from the Kendawangan River. Its principal measurements are: Head and body, from dried skin, 630 mm.; tail, from dried skin, 80; hind foot, from dried skin, 85; weight, 22 pounds (10 kgs.); greatest length of skull, 133; zygomatic width, 64; greatest length of nasals, 62.

Porcupines seemed the usual inhabitants of caves [southeast Borneo], but except the one *Trichys* none were caught.—W. L. A.

AILURIN PLANICEPS (Vigors and Horsfield).

1828. *Felis planiceps* VIGORS and HORSFIELD, Zool. Journ., vol. 3, p. 450, pl. 12.

Type-locality, Sumatra.

1855. [*Felis*] (*Ailurin*) [*planiceps*], GERVAIS, Hist. Nat. Mamm., vol. 2, p. 87.

Five specimens of this cat were secured in southwestern Borneo. For exact localities and measurements see table below. I have carefully compared this series with an adult female from the Siak River, Sumatra, and can find no characters by means of which the Bornean specimens may be distinguished from the one from Sumatra.

External and cranial measurements of Ailurin planiceps.

| Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail vertebra. ¹ | Hind foot with claws. ¹ | Weight. ¹ | Weight. | Condyllo-basal length. | Zygomatic breadth. | Postorbital constriction. | Width of brain case above roots of zygomata. | Maxillary toothrow (alveoli). |
|-----------------------------|---------------|-----------------|-----------------------------|-----------------------------|------------------------------------|----------------------|---------|------------------------|--------------------|---------------------------|--|-------------------------------|
| | | | mm. | mm. | mm. | lbs. | kilos. | mm. | mm. | mm. | mm. | mm. |
| Little Siak River, Sumatra. | 144119 | Female, adult. | 490 | 169 | 104 | ..... | ..... | 92.0 | 56.4 | 20.5 | 37.5 | 32.3 |
| Sempang River, Borneo. | 145591 |do..... | 464 | 148 | 99 | 4½ | 1.9 | 89.5 | 56.5 | 21.7 | 37.0 | 31.0 |
| Do..... | 145593 |do..... | 455 | 130 | 99 | 3¾ | 1.7 | 85.7 | 56.2 | 20.0 | 37.0 | 29.4 |
| Do..... | 145594 |do..... | ..... | 150 | 100 | 3½ | 1.5 | 89.7 | 56.3 | 20.5 | 36.7 | 32.0 |
| Do..... | 145592 | Male, adult.... | 505 | 135 | 107 | 4¾ | 2.2 | 97.0 | 63.5 | 21.2 | 39.0 | 34.0 |
| Kendawangan River, Borneo. | 153849 | Male(?), adult. | 446 | 149 | 102 | 4 | 1.8 | 90.0 | 57.0 | 21.2 | 37.5 | 33.0 |

¹ Collector's measurements.

FELIS BENGALENSIS, of authors.

1907. *Felis bengalensis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 559, December 24, 1907.

Two skins with skulls from the Kendawangan River, an adult female and a young female. They are brighter in color and apparently smaller in size than is the tiger cat from Sumatra. The young tiger cat from the Landak River recorded by me in 1907 is also brightly colored. An immature cat from Pahang, Malay Peninsula, of about the same age as the last is of the same dull color as that from Sumatra.

Measurements of the adult female, Cat. No. 153845: Head and body, 495 mm.; tail, 195; hind foot, 110; weight, 4 pounds (1.8 kilos); greatest length of skull, 84.7; condylo-basal length, 77.3; zygomatic breadth, 57.7; width of brain case above zygomata, 40.4; interorbital constriction, 14.6; maxillary tooththrow (alveoli), 26.0.

Stomach filled with rats.—W. L. A.

ARCTICTIS BINTURONG (Raffles).

1822. *Viverra? binturong* RAFFLES, Trans. Linn. Soc. London, vol. 13, p. 253. Type-locality, Sumatra.

Skin and skull of an immature female, Cat. No. 153840, from the Kendawangan River. The last permanent molars above are just level with alveoli. The skin is generally black, coarsely grizzled with buffy.

Measurements.—Head and body 700 mm.; tail, 688; hind foot, 121; weight, 13 pounds (5.9 kilos); condylo-basal length of skull, 123; zygomatic breadth, 64.3; width of brain case above roots of zygomata, 44.2; maxillary tooththrow (alveoli), 40.3.

VIVERRA TANGALUNGA (Gray).

1832. *Viverra tangalunga* GRAY, Proc. Zool. Soc. London, 1832, p. 63.

1906. *Viverra tangalunga*, MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 61, July 23, 1906, Karimata Island.

Eighteen specimens of *Viverra tangalunga* were collected by Doctor Abbott on Borneo, and one each on Pulos Panebangan, Bauwal, and Laut, and three on Karimata Island.

(For measurements and exact localities in Borneo see table, p. 116.)

Measurements of *Viverra tangalunga*.

| Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | | Hind foot. ¹ | Weight. ² | Condylar-basal length. | Zygomatic width. | Maxillary tooththrow (alveoli). |
|----------------------------|---------------|--------------------------|-----------------------------|-----|-------------------------|----------------------|------------------------|------------------|---------------------------------|
| | | | mm. | mm. | | | | | |
| Sempang River..... | 145338 | Male, adult..... | 675 | 350 | 107 | 3.7 | 117.6 | 58.0 | 46.8 |
| Do..... | 145339 | Female, adult..... | 685 | 325 | 104 | 4.0 | 114.3 | 54.8 | 43.1 |
| Foot of Gunung Palung..... | 145340 | Female, young adult..... | 663 | 330 | 103 | ..... | 113.7 | 54.3 | 44.0 |
| Kumbang River..... | 145341 | Female, very young..... | 515 | 240 | 94 | 1.8 | 98.9 | 44.6 | ..... |
| Kendawangan River..... | 153842 | Male, adult..... | 635 | 300 | 104 | 3.0 | 111.0 | 58.3 | 44.2 |
| Do..... | 153843 | Female, adult..... | 630 | 315 | 103 | 3.2 | 108.7 | 57.5 | 42.9 |
| Do..... | 153844 | Male, old..... | 620 | 313 | 105 | 3.2 | 112.5 | 57.7 | 44.7 |
| Klumpang Bay..... | 151868 | Female, young adult..... | 606 | 310 | 100 | 3.2 | 107.5 | 53.1 | 41.5 |
| Do..... | 151869 | Male, young adult..... | 600 | 335 | 103 | 2.7 | 110.2 | 54.5 | 42.8 |
| Do..... | 151870 | Female, young adult..... | 615 | 300 | 100 | 2.5 | 109.4 | 54.0 | 42.6 |
| Do..... | 151871 | Male, adult..... | 665 | 275 | 101 | 4.0 | 114.9 | 60.6 | 44.6 |
| Saratok River..... | 151872 | Female, adult..... | 640 | 300 | 103 | 3.6 | 110.6 | 56.3 | 43.5 |
| Do..... | 151873 | Male, old..... | 662 | 315 | 109 | 4.0 | 115.5 | 61.4 | 45.3 |
| Balik Papan Bay..... | 154354 | Male, adult..... | 620 | 315 | 95 | 3.2 | 113.0 | 58.4 | 46.2 |
| Do..... | 154355 | Male..... | 640 | 300 | 98 | 3.4 | 114.7 | 58.0 | 45.6 |
| Do..... | 154356 | do..... | 600 | 310 | 98 | 2.8 | ..... | ..... | ..... |
| Do..... | 154357 | Male, adult..... | 605 | 315 | 100 | 3.2 | 110.0 | 57.3 | 43.4 |
| Do..... | 154358 | do..... | 643 | 320 | 106 | 3.6 | 113.9 | 59.6 | 44.7 |
| Pulo Panebangan..... | 145337 | Female, old..... | 650 | 310 | 105 | 4.7 | 111.4 | 59.0 | 41.7 |
| Pulo Laut..... | 151867 | Female, adult..... | 610 | 310 | 103 | 2.8 | 111.8 | 53.5 | 43.6 |
| Pulo Bauwal..... | 153841 | do..... | 635 | 305 | 100 | 4.0 | 112.3 | 55.0 | 43.9 |

¹Collector's measurements. ²Collector's measurements in pounds and quarters computed to kilograms.

PARADOXURUS PHILIPPINENSIS (Jourdan).

1837. *Paradoxurus philippinensis* JOURDAN, Comptes Rendus, vol. 5, p. 523, 1837. Type-locality, Philippine Islands, Luzon and Mindanao.
 1885. *Paradoxurus philippinensis*, BLANFORD, Proc. Zool. Soc. London, 1885, p. 800.
 1907. *Paradoxurus philippinensis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 559, December 24, 1907. Kapuas River region.

Dr. W. L. Abbott has collected three additional specimens of *Paradoxurus* on Borneo since his first expedition in 1905, two from the Sempang River and one from Klumpang Bay. I have followed Blanford in calling them *P. philippinensis*. Jourdan's account is very meager and there are no really good specimens from the Philippines in the National Museum. Two skins collected by Dr. E. A. Mearns in the Philippine Islands, one of them young and the other without a skull, show no striking differences from the Bornean specimens.

(For measurements see table, p. 117.)

ARCTOGALIDIA STIGMATICA (Temminck).

1835. *Paradoxurus stigmaticus* TEMMINCK, Esquisses Zool. Côte de Guinée, 1st part, Mamm., p. 120. Type-locality, Doeson (or Dusan) River, southern Borneo.
 1907. *Arctogalidia stigmatica*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 559, December 24, 1907. Landak River, Borneo.

Two specimens from Klumpang Bay, southeastern Borneo. None were secured in the regions of the Kendawangan or Sempang rivers.

Measurements.—See table, page 117.

Measurements of viverrids.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail. ¹ | Hind foot. ¹ | Weight. ² | Condyllo-basal length. | Zygomatiac width. | Maxillary toothrow (alveoli). |
|-------------------------------------|--------------------|---------------|-----------------------------------|-----------------------------|--------------------|-------------------------|----------------------|------------------------|-------------------|-------------------------------|
| | | | | mm. | mm. | mm. | kilos. | mm. | mm. | mm. |
| <i>Arctogalidia stigmatica</i> . | Klumpang Bay.... | 151874 | Male, adult..... | 555 | 600 | 94 | 2.7 | 108.7 | 63.5 | 38.0 |
| Do..... | do..... | 151875 | Female, adult.... | 437 | 495 | 80 | 1.4 | 94.0 | 51.0 | 33.9 |
| <i>Paradoxurus philippinensis</i> . | Sempang River.... | 145342 |do..... | 515 | 420 | 86 | 2.3 | 92.6 | 54.5 | 32.4 |
| Do..... | do..... | 145343 | Male, adult..... | 516 | 400 | 80 | 2.3 | 99.2 | 60.3 | 35.8 |
| Do..... | Klumpang Bay.... | 151876 | Male, young..... | 420 | 370 | 73 | ..... | 84.0 | 48.0 | ..... |
| <i>Hemigalus hardwickii</i> . | Balik Papan Bay... | 154353 | Male, adult, nearly. ³ | 474 | 310 | 77 | 1.5 | 93.3 | 44.0 | 36.5 |
| <i>Herpestes brachyurus</i> . | Kendawangan River. | 153850 | Female, old..... | 395 | 218 | 85 | 1.3 | 81.2 | 51.0 | 31.2 |
| Do..... | do..... | 153851 |do..... | 445 | 250 | 90 | 1.4 | 88.8 | 51.0 | 32.5 |
| Do..... | Balik Papan Bay... | 154351 | Male, adult..... | 422 | 245 | 87 | 1.0 | 88.2 | 51.5 | 33.5 |
| Do..... | do..... | 154352 | Male, old..... | 445 | 230 | 90 | 1.5 | 88.6 | 53.9 | 33.5 |

HEMIGALUS HARDWICKII (Gray).

1830. *Viverra hardwickii* GRAY, Spic. Zool., vol. 2, p. 9.

One specimen; an adult male, from Balik Papan Bay. It is uniform in size and color with specimens from northern Borneo, as well as from Sumatra and the Malay Peninsula.

(For measurements see table above.)

HERPESTES SEMITORQUATUS (Gray).

1846. *Herpestes semitorquatus* GRAY, Ann. Mag. Nat. Hist., vol. 18, 1846, p. 211.

1907. *Herpestes semitorquatus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 559, December 24, 1907.

Skin and skull of a young male from Sanggau, Kapuas River; probably represents this species, but it is too young to determine positively.

HERPESTES BRACHYURUS (Gray).

1837. *Herpestes brachyurus* GRAY, Mag. Nat. Hist., vol. 1, p. 578. Type-locality, Indian Islands.

Four specimens—two from the Kendawangan River and two from Balik Papan Bay.

(For measurements see table above.)

CYNOGALE BARBATUS (Müller.)

1838-39. *Potamophilus barbatus* MÜLLER, Tijdschr. Natuurl. Gesch. Physiol., vol. 5, p. 142.

Six specimens of this interesting animal were secured by Doctor Abbott. Modern authors have uniformly referred the Bornean *Cynogale* to the species described by Gray⁴ under the name *bennettii*,

¹ Collector's measurements.

² Collector's measurements in pounds and quarters computed to kilograms.

³ m³ halfway up.

⁴ Ann. Mag. Nat. Hist., vol. 1, 1837, p. 579.

from Sumatra. A careful comparison of a fine old skull of a female from Aru Bay, Sumatra, with the present series from Borneo convinces me that the Bornean and Sumatran forms represent distinct species. The skull of *Cynogale barbatus* is slightly larger than that of *C. bennettii*, has more spreading zygomata, a more inflated brain-case and a less conspicuous post orbital constriction, the teeth are larger and heavier, the most noticeable difference being in the last upper molars. Müller's figure¹ of the skull shows that his specimen was of the same type as the present series of Bornean skulls. (For a comparison of measurements of the two forms, see table below.) Externally the two forms are essentially alike. The two Sumatran specimens, however, are rather lighter in color on the under parts than are the Bornean skins.

Three embryos the size of walnuts.—W. L. A.

Uterus contained two embryos nearly mature.—W. L. A.

Measurements of Cynogale bennettii and C. barbatus.

| Locality. | Catalogue No. | Sex and age. | Head and body. ² | Tail vertebrae. ² | Hind foot with claws. ² | Weight. ² | Weight. | Condylar-basal length. | Zygomatic width. | Breadth of brain-case above roots of zygomata. | Mastoid width. | Post orbital constriction. | Maxillary tooththrow (alveoli). |
|----------------------------|---------------|---------------------------|-----------------------------|------------------------------|------------------------------------|--------------------------------|---------|------------------------|------------------|--|----------------|----------------------------|---------------------------------|
| | | | mm. | mm. | mm. | lbs. | kilos. | mm. | mm. | mm. | mm. | mm. | mm. |
| Aru Bay, Sumatra. | 143621 | Female, old... | 617 | 180 | 106 | 7 ³ / ₈ | 3.5 | 121.0 | 61.0 | 35.8 | 43.0 | 10.2 | 48.7 |
| Siak River, Sumatra. | 144122 | Male, young ³ | 520 | 185 | 103 | 4 ³ / ₈ | 2.2 | 110.0 | 53.3 | 36.5 | 41.5 | 15.0 | 47.0 |
| Kendawangan River, Borneo. | 153848 | ...do. ⁴ | 440 | 150 | 90 | 2 ¹ / ₄ | 1.0 | 92.0 | 46.0 | 36.0 | 37.7 | 17.8 | ..... |
| Sempang River, Borneo. | 145587 | Female, young adult. | 650 | 140 | 111 | 10 | 4.5 | 122.4 | 61.2 | 37.3 | 46.5 | 13.2 | 49.3 |
| Do..... | 145588 | Female, adult | 648 | 200 | 110 | 12 | 5.4 | 123.5 | 66.0 | 38.8 | 45.5 | 14.2 | 50.3 |
| Do..... | 145589 | ...do..... | 600 | 205 | 105 | 12 ¹ / ₄ | 5.6 | 120.0 | 66.0 | 40.7 | 48.0 | 14.8 | 47.0 |
| Do..... | 145590 | Adult..... | ..... | ..... | ..... | ..... | ..... | 123.3 | 64.0 | 39.7 | ..... | 13.4 | 49.8 |
| Kendawangan River, Borneo. | 153847 | Female, young adult. | 595 | 120 | 102 | 7 | 3.2 | 114.0 | 60.0 | 37.5 | 45.0 | 13.0 | 47.5 |

LUTRA LOVII Günther.

1876. *Lutra loyii* GÜNTHER, Proc. Zool. Soc. London, p. 736. Type-locality, Borneo, opposite island of Labuan.

1907. *Lutra loyii*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 560, December 24, 1907.

Two specimens from the Kapuas River region collected in 1905.

¹ Verh. Nat. Gesch. Nederl. Bezitt., pl. 17, 1839-1844.

² Measurements by collector.

³ Last upper molars just appearing through alveolus.

⁴ Last milk molars and canines still in place.

AONYX CINEREA (Illiger).

1815. *Lutra cinerea* ILLIGER, Abh. Akad. Berlin, 1811, 1815, p. 99. Type-locality, near Batavia, Java.

A specimen of the clawless otter, a young adult female, Cat. No. 151879, was taken on Pulo Laut. The teeth are moderately large, about the size found in a specimen from the Kinabatangan River, northern Borneo.¹ The shape of the ascending ramus of the mandible closely resembles that of a specimen from Pulo Setoko, Rhio-Linga Archipelago.¹ The skull is smaller than skulls of other clawless otters in the collection, but it is not so old.

Measurements.—Head and body, 460 mm.; tail, 310; hind foot, 95; weight, 5½ pounds, equals 2.5 kilos; basal length of skull, 79.3; zygomatic width, 58.9; maxillary toothrow (alveoli), 29.6.

PUTORIUS NUDIPES Desmarest.

1822. *Mustela nudipes* DESMAREST, Mammalogie, p. 537, 1822. Type-locality, Java.

1842. *Putorius nudipes*, F. CUVIER, Hist. Nat. Mamm., Table method., p. 3, 1842.

One specimen was secured at Tjantung, southeastern Borneo. The general color of body, above and below, is tawny ochraceous. A narrow streak from occiput, over nape to between shoulders, and sides of neck, including front of shoulders, are a lighter and brighter tawny ochraceous; head, including ear, whitish or cream color; tail, between clay color and ochraceous, with the terminal third buffy.

Measurements.—Head and body, 366 mm.; tail, 222; hind foot, 58.

The single *Putorius* was shot as it was trying to enter a cave.—W. L. A.

MUSTELA HENRICII Westerman.

1848–1854. *Mustela (Martes) henricii* WESTERMAN, Bijdr. Dierk, vol. 1, p. 13, and unnumbered plate. Type-locality, Padang, Sumatra. (See Jentink, Mus. d'Hist. Nat. Pays-Bas, vol. 9, Cat. Osteol. Mamm. Leiden, 1887, p. 112.)

1901. *Mustela flavigula henricii*, BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 346, April, 1901.

Doctor Abbott collected two specimens of the yellow-throated marten in southwestern Borneo and one in southeastern Borneo. By a singular coincidence the three Bornean specimens are all females, and two from Sumatra are both males. There are no essential differences between the skins from the different islands. One of the Bornean specimens, however, Cat. No. 145579, from Gunong Palung, is generally darker than any of the others, and the anterior portions of the upper parts are practically as dark as are the posterior portions and tail. The other four are distinctly bicolor above. The skulls and teeth of the Sumatra martens, the males, are distinctly

¹ See Proc. U. S. Nat. Mus., vol. 36, pl. 39, June 1, 1909.

larger than those in the Bornean marten, the females. The difference in size is about the same as that usually found between the two sexes in the Mustelidæ.

(For measurements see table below.)

Measurements of specimens of Mustela henrici.

| Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail. ¹ | Hind foot. ¹ | Weight. ² | Condyllo-basal length. | Zygomatic width. | Maxillary toothrow (alveol). | Mandibular toothrow (alveol). |
|--------------------|----------------|--------------------|-----------------------------|--------------------|-------------------------|----------------------|------------------------|------------------|------------------------------|-------------------------------|
| | | | mm. | mm. | mm. | kilos. | mm. | mm. | mm. | mm. |
| Sumatra: | | | | | | | | | | |
| Makapan..... | 144123 | Male, adult..... | 445 | 370 | 99 | 1.4 | ..... | ..... | 26.3 | 32.8 |
| Kompei..... | 144124 |do..... | 458 | 340 | 100 | 1.8 | 87.3 | 52.4 | 28.2 | 33.3 |
| Borneo: | | | | | | | | | | |
| Sandakan..... | 39179 38592 | Female, adult..... | ..... | ..... | ..... | ..... | ..... | 44.8 | 24.5 | 30.3 |
| Sungei Matan..... | 145578 |do..... | 435 | 340 | 93 | 1.1 | 80.8 | 47.7 | 24.2 | 29.2 |
| Gunong Palung..... | 145579 |do..... | 442 | 365 | 94 | ..... | 80.5 | 45.1 | 24.8 | 29.6 |
| Pamukang Bay..... | 151877 |do..... | 425 | 305 | 90 | ..... | 81.2 | 46.9 | 24.3 | 31.1 |

¹ Collector's measurements.

² Collector's measurements in pounds and quarters computed to kilograms.

HELARCTOS EURYSPILUS Horsfield.

1826. *Helarctos euryspilus* HORSFIELD, Zool. Journ., vol. 2, pp. 221-234, pl. 7.

1907. *Helarctos euryspilus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 561; December 24, 1907.

Since 1905 Doctor Abbott secured seven additional specimens of the Bornean sun bear, six skulls obtained from natives in southwestern Borneo, and a skin and skull collected at Pamukang Bay. The present series of skulls shows that the differences between the Bornean and Sumatran sun bears are not as great as I was led to believe in 1907, but the differences pointed out then, hold in the main, as may be seen on reference to the table of measurements on page 121. There is no doubt as to the distinctness of the two forms. The Sumatran specimens have smaller collars and the light area of the nose is more conspicuous than in the single Bornean skin.

Bears seem to be pretty common wherever there is a plantation of cocoanuts. Some of the trees are said to be dead or dying as a result of their depredations. The bears climb up and eat the "heart" out of the palm. In a small grove of about ninety trees, near Tanjong Pamukang, the bears had destroyed about half the trees. It was full moon during my stay there, so the owners said it was no use to watch for bears, as they only came out on dark nights. The Dutch authorities took away all the guns about a year ago, so now the animals have it all their own way.—W. L. A.

Measurements of Bornean and Sumatran sun bears.

| Dimensions. | Cat. No. 142344, Landak River, old adult. | | | | | | | | |
|--|--|--|--|--|--|--|--|---|--|
| | Cat. No. 145580, young adult, Sempang River. | Cat. No. 153835, adult, Kendawangan River. | Cat. No. 153836, young adult, Kendawangan River. | Cat. No. 153837, adult, Kendawangan River. | Cat. No. 153838, old adult, Kendawangan River. | Cat. No. 153839, adult, Kendawangan River. | Cat. No. 151866, adult male, Pamukang Bay. | Cat. No. 123138, old adult, male, Kateman River, Sumatra. | Cat. No. 123139, adult female, Kateman River, Sumatra. |
| Basal length..... | mm.. 189 | 185 | ..... | ..... | 206 | ..... | 194 | 215 | 203 |
| Basilar length..... | mm.. 186 | 182 | ..... | ..... | 202 | ..... | 190 | 210 | 199 |
| Condylö-basal length..... | mm.. 205 | 203 | ..... | ..... | 220 | ..... | 210 | 234 | 220 |
| Palatal length..... | mm.. 102 | 108 | 100 | 93 | 94 | 109 | 102 | 110 | 117 |
| Greatest length..... | mm.. 222 | 220 | 216 | 205 | ..... | 243 | 222 | 235 | 256 |
| Zygomatic width..... | mm.. 176 | ..... | 164 | 165 | 164 | 182 | 173 | 171 | 208 |
| Mastoid width..... | mm.. 134 | 126 | 130 | 125 | 125 | 148 | 136 | 136 | 156 |
| Width of brain case above zygomata..... | mm.. 92 | 101 | 94 | 96 | 96 | 96 | 97 | 97 | 104 |
| Width at postorbital processes..... | mm.. 75 | 68 | 74 | 73 | 64 | 74 | 70 | 78 | 88 |
| Least interorbital width..... | mm.. 60 | 56 | 58 | 58 | 55 | 59 | 60 | 64 | 69 |
| Least width of palate between last upper molars..... | mm.. 36 | 37 | 38 | 32 | 38 | 36 | 40 | 38 | 41 |
| Posterior edge of last upper molar (alveolus) to palation..... | mm.. 28 | 29 | 28 | 23 | 24 | 27 | 26 | 26 | 36 |
| Posterior edge of last upper molar (alveolus) to tip of pterygoid..... | mm.. 60 | ..... | 60 | ..... | 52 | 70 | 63 | 61 | 66 |
| Alveolar length of last three upper cheek teeth combined..... | mm.. 45 | 43 | 40 | 43 | 44 | 44 | 45 | 45 | 44 |
| Antero-posterior diameter of upper canine at alveolus..... | mm.. 23 | 23 | 22 | 20 | 21 | 26 | 23 | 27 | 25 |
| Head and body ¹ | mm.. | ..... | ..... | ..... | ..... | ..... | ..... | 1,260 | 1,190 |
| Tail ¹ | mm.. | ..... | ..... | ..... | ..... | ..... | ..... | 90 | 40 |
| Weight ¹ | pounds..... | ..... | ..... | ..... | ..... | ..... | ..... | 124 | 138 |
| Weight..... | kilograms..... | ..... | ..... | ..... | ..... | ..... | ..... | 56 | 63 |
| Height at shoulders ¹ | mm.. | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 490 |

¹ Collector's measurements.

TUPAIA SPECIOSA (Wagner).

1840. *C[adobates] speciosa* WAGNER, Schreber's Säugethiere, Supplbd. 2, 1840, p. 43.

1907. *Tupaia speciosa*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 562, December 24, 1907.

Nine specimens of this tree-shrew have been taken by Doctor Abbott in Borneo, two in the Kapuas River region, three in south-western Borneo, and four in southeastern Borneo. (For exact localities, see table of measurements, p. 123.) The only adult specimen from the Kapuas region differs in its much larger size, cranially and externally, from Doctor Abbott's other specimens as well as from specimens from northern Borneo. In color and form, however, it resembles the others in all essential respects. It is no older than some of the smaller individuals. Without more material it does not seem advisable to recognize it as a distinct form.

(For measurements see table, p. 123.)

TUPAIA DORSALIS Schlegel.

1857. *Tupaia dorsalis* SCHLEGEL, Handl. beoef. Dierk., pt. 1, p. 59, pl. 3, fig. 31, 1857.

1907. *Tupaia dorsalis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 562, December 24, 1907.

One specimen from the Kapuas River, collected in 1905.

(For measurements see table, p. 123.)

TUPAIA SPLENDIDULA Gray.

1865. *Tupaia splendidula* GRAY, Proc. Zool. Soc. London, 1865, p. 322. Type-locality, Borneo, probably northern.

Three specimens, two from the Saratok River, Pamukang Bay, and one from the Kendawangan River.

Mr. Oldfield Thomas, of the British Museum, has kindly compared one of the specimens with Gray's type. He remarks:

Comparing 151884 with the type of *splendidula*, it is the best match to that troublesome species which I have yet seen, the color being identical (allowing for a slight bleaching from black to brown in the old specimen), and the hind feet practically the same length. The skull of *splendidula* is, however, certainly rather larger, as you say, but it is a very old specimen. There is no difference other than size that I can see. Condyllo-basal length of 151884, 42.5; of *splendidula*, 44.2.

The largest of the three specimens collected by Doctor Abbott was sent to Mr. Thomas, but the difference in size between the type of *splendidula* and the three specimens from southern Borneo is so slight and the material so limited that it can be attributed to individual variation only.

(For measurements see table, p. 123.)

TUPAIA LONGIPES (Thomas).

1893. *Tupaia ferruginea longipes* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 11, p. 343, May, 1893.

Five specimens, two from southwestern and one from southeastern Borneo. *Tupaia discolor* LYON,¹ from Banka, is very close to this form, and in the original description should have been compared with it. A specimen of the present series was sent to Mr. Oldfield Thomas. He remarks as follows:

With regard to *longipes* the differences you note are quite true as far as the type is concerned, but a later specimen from the same region has practically the same warm color on fore back, the same *hypochrysa*-like chest, and the same grayish tail. The skulls are identical, and the size the same.

(For measurements see table, p. 123.)

TUPAIA CARIMATÆ Miller.

1906. *Tupaia carimatæ* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 61, July 23, 1906.

In addition to the original series of *Tupaia carimatæ* collected in 1904, Doctor Abbott took one other specimen in 1908.

(For measurements see table, p. 123.)

TUPAIA INFLATA Lyon.

1906. *Tupaia inflata* LYON, Proc. U. S. Nat. Mus., vol. 31, p. 600, December 18, 1906.

A specimen of a small *Tupaia* taken on Karimata Island in 1908 does not differ essentially from *T. inflata* of Banka and Billiton

¹ Proc. U. S. Nat. Mus., vol. 31, p. 602, December 18, 1906.

Islands. It is a young adult female with a somewhat imperfect skull not suitable for comparison with skulls of the original series. The skin closely resembles the darker individuals of the Banka-Billiton specimens.

(For measurements see table below.)

TUPAIA GRACILIS Thomas.

1893. *Tupaia gracilis* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 12, p. 53, July, 1893.

One example of *Tupaia gracilis* was taken along the Kendawangan River.

(For measurements see table below.)

TUPAIA MINOR Günther.

1876. *Tupaia minor* GÜNTHER, Proc. Zool. Soc. London, 1876, p. 426.

Three small Tupaias are referable to *Tupaia minor*. Two are from the mainland of Borneo, Kendawangan River, and mouth of Sempang River, and third is from Pulo Laut. The latter is yellower underneath than are the mainland specimens, this perhaps due to staining. It is also somewhat darker above, especially the tail. The skull of the Pulo Laut specimen is too badly broken to compare with those of the mainland animals.

(For measurements see table below.)

Measurements of tree shrews.

| Name. | Locality. | Catalogue No. | Sex and age. | Head and body. ¹ | Tail vertebrae. ¹ | Hind foot, with claws. ¹ | Greatest length of skull. | Zygomatic breadth. | Maxillary toothrow, exclusive of incisors. |
|-----------------------------|------------------------|---------------|-----------------------|-----------------------------|------------------------------|-------------------------------------|---------------------------|--------------------|--|
| <i>Tupaia dorsalis</i> ... | Kapuas River..... | 142247 | Female, adult.... | mm. 175 | mm. 145 | mm. 43 | mm. 49.0 | mm. 22.4 | mm. 17.1 |
| <i>Tupaia speciosa</i> ... | Sungei Matan..... | 145573 | Male, adult..... | 207 | 188 | 52 | 57.0 | 25.1 | 20.4 |
| Do..... | do..... | 142247 | do..... | 229 | 196 | 55 | 64.4 | 29.4 | 23.2 |
| Do..... | do..... | 145574 | Female, adult.... | 220 | 180 | 50 | 59.2 | 25.7 | 20.5 |
| Do..... | Saratok River..... | 151885 | do..... | 210 | 180 | 49 | 57.7 | 26.0 | 20.0 |
| Do..... | Pasir River..... | 154339 | Male, adult..... | 209 | 175 | 50 | 57.6 | 26.2 | 19.6 |
| Do..... | Balik Papan Bay.... | 154340 | Female, adult.... | 210 | 180 | 51 | 58.2 | 27.0 | 19.9 |
| Do..... | Pamukang Bay..... | 154341 | Male, adult..... | 210 | 170 | 50 | 56.7 | 27.0 | 18.7 |
| <i>Tupaia splendida</i> ... | do..... | 157883 | do..... | 180 | 130 | 42 | 48.0 | 25.0 | 17.2 |
| Do..... | do..... | 151884 | do..... | 173 | 150 | 42 | ..... | 25.9 | 16.5 |
| Do..... | Kendawangan River... | 153856 | Female, adult.... | 188 | 157 | 44 | 46.4 | 24.0 | 16.4 |
| <i>Tupaia longipes</i> ... | Batu Jurong..... | 153852 | Male, adult..... | 205 | 195 | 53 | 51.0 | 25.9 | 19.1 |
| Do..... | do..... | 153853 | Male, young adult. | 192 | 205 | 53 | 48.3 | 25.0 | 18.2 |
| Do..... | Kendawangan River.... | 153854 | Female, nearly adult. | 190 | 180 | 53 | 50.6 | 25.3 | 19.4 |
| Do..... | do..... | 153855 | Male, adult..... | 213 | 190 | 53 | 51.5 | 25.3 | 19.0 |
| Do..... | Pangkajene River..... | 151882 | do..... | 213 | 185 | 50 | 53.0 | 24.8 | 20.3 |
| <i>Tupaia carinata</i> ... | Karimata Island..... | 153860 | do..... | 165 | 145 | 40 | ..... | 23.5 | 16.2 |
| <i>Tupaia inflata</i> ... | do..... | 153859 | Female, adult.... | 135 | 156 | 38 | ..... | 19.5 | 13.3 |
| <i>Tupaia gracilis</i> ... | Kendawangan River.... | 153858 | Male, adult..... | 143 | 174 | 42 | 39.0 | 20.6 | 13.2 |
| <i>Tupaia minor</i> ... | Mouth of Sempang River | 145575 | Female, adult.... | 130 | 156 | 34 | 33.5 | 19.2 | 12.2 |
| Do..... | Kendawangan River.... | 153857 | Male, adult..... | 132 | 148 | 34 | 34.6 | 19.4 | 12.0 |
| Do..... | Pulo Laut..... | 151881 | do..... | 130 | 145 | 34 | ..... | ..... | 12.0 |

¹ Collector's measurements.

GYMNURA ALBA Giebel.

1909. *Gymnura alba*, LYON, Proc. U. S. Nat. Mus., vol. 36, p. 453, May 27, 1909.

Six specimens from the Sempang River, southwestern Borneo.

(For a full account of and measurements of these specimens see paper referred to above.)

In one of them a nearly mature embryo in utero.—W. L. A.

GALEOPTERUS BORNEANUS, new species.

Type.—Skin and skull of adult female, Cat. No. 151888, U.S.N.M., collected at Tjantung, southeastern Borneo, January 30, 1908, by Dr. W. L. Abbott. Original number 5775.

Diagnostic characters.—A medium-sized member of the genus closely resembling the flying lemur from the Malay Peninsula¹ and the one from Bunguran of the Natuna Islands,² but skull slightly smaller than that of *G. peninsulæ*, and with distinctly shorter maxillary tooth row and smaller audital bullæ; skull and maxillary tooth row about the same general size as in *G. natunæ*, but braincase and interorbital region distinctly broader and nasals more pinched up into ridge.

Color.—Type: Upper surface of head, neck, body, tail, feet, and outer surfaces of limbs varying shades of gray, produced by irregular mixtures of dirty white and blackish, notably about the shoulders and hips the whitish color darkens to a buff yellow. The usual light spotting is found on the feet, and a rather conspicuous white spot is found on each side of the base of the tail. The outer border of the membrane above is dull chestnut. General color of the entire under parts except chin and throat, varying mixtures and shades of dull tawny ochraceous and clay color; chin similar to upper parts and throat, a gradual blending of the colors of the chin with those of the under parts.

Skull and teeth.—The skull is of medium size, about equal to that of *Galeopterus natunæ*, but the interorbital constriction is wider, the brain-case decidedly wider, the nasals more pinched up into a ridge, and the rostrum deeper; audital bullæ of about the same size, the palate, posterior nares, and interpterygoid space decidedly wider in the Bornean form. Compared with a skull from the Malay Peninsula, that of the Bornean animal is slightly smaller, with smaller bullæ, less inflated mastoids. The teeth have about the same size that they do in the Malay form, but the tooth row is shorter. The individual teeth appear slightly larger, but the tooth rows have about the same lengths in the Bornean and Natunan forms.

Measurements.—See table, page 126.

¹ *Galeopterus peninsulæ* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 303, September, 1908. Selangor-Pahang boundary, Malay Peninsula.

² *Galeopithecus natunæ* MILLER, Smiths. Misc. Coll., vol. 45, p. 50, November 6, 1903, Bunguran Island, North Natunas.

Specimens examined.—Two, the type and nearly adult male from the Sempang River.

Remarks.—I quite agree with Thomas¹ that there is a resemblance between the flying lemurs of Borneo, the Natunas, and the Malay Peninsula. It is not plausible to suppose that they represent a single species, nor does the rather limited material at hand show this to be the case. Even Thomas himself has recently named the Peninsular form. *Galeopterus borneanus* can not be considered a strikingly distinct species. It is certainly very distinct from *G. aoris* Miller. I can see very little wisdom in Thomas and Wroughton's combining the Aor, Rhio Archipelago, Natuna, and Bornean *Galeopterus* under the name *aoris*.² The only real way to settle the case is to get together good series, but meanwhile it seems best to recognize the described forms. Flying lemurs ought to be subject to as much geographic and insular variations as are other groups of mammals.

GALEOPTERUS LAUTENSIS, new species.

Type.—Skin and skull of adult female, Cat. No. 151886, U.S.N.M., collected on Pulo Laut off southeastern Borneo, December 23, 1907. Original number, 5679.

Diagnostic characters.—A medium-sized member of the genus closely related to the Bornean animal, but slightly larger, with a distinctly longer tooth row and with the mastoids considerably shrunken.

Color.—The color is essentially like that of the Bornean animal described above, but the white spotting occurs frequently in larger splotches, and there is more ochraceous in the color of the back.

Skull and teeth.—The skull and teeth of *Galeopterus lautensis* closely resemble those of the nearby Bornean animal. The skull is slightly larger, more angular, with a narrower brain-case, and less prominent mastoids. The tooth row is considerably longer.

Measurements.—See table, page 126.

Specimens examined.—Three; the type, a young one taken with her, and a male from the island of Sebu.

Remarks.—The male from the island of Sebu is only provisionally referred to *G. lautensis*. It has about the size and general appearance as if it might be the male of that species. Unfortunately there is no material with which to make a satisfactory comparison.

Regarding the type-specimen, Doctor Abbott writes:

This animal has a somewhat interesting history. It was seized by a small forest eagle (*Spizaetus limnaetus*) and the two fell to the ground and were seized by some Malays who observed the occurrence. The place was in a small clearing on the east side of Pulo Laut. There were some gigantic trees standing on the edge of the clearing. The "kubong" was on one of these trees when the hawk grabbed her. She was carrying a newborn young one. There was an old wound full of maggots upon one shoulder,

¹ Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 254, March, 1908.

² Journ. Fed. Malay States Museum, vol. 4, p. 111, 1909.

which had formed quite a large hole in the membrane and laid bare the muscles of the humerus. The disability caused by the wound and being hampered by the young one were the probable cause of its capture by the hawk. Both the hawk and the kubong were brought to me alive that same evening by the Malays who caught them. I have seen *Spizaëtus* try to catch *Ratufa*, but I never saw them succeed.

GALEOPTERUS ABBOTTI, new species.

Type.—Skin and skull of adult female, Cat. No. 145577, U.S.N.M., collected on Pulo Panebangan, off west coast of Borneo, May 16, 1907, by Dr. W. L. Abbott. Original number, 5231.

Diagnostic characters.—A small member of the genus, much smaller than the flying lemur from the adjacent island of Borneo, and even smaller than *G. gracilis* Miller¹ from Sirhassen, Natuna Islands.

Color.—The color of *Galeopterus abbotti* is essentially like that of *G. borneanus* described above.

Skull and teeth.—The chief peculiarity of the skull of *G. abbotti* is its small size. In addition to that it is a rather flat skull, with moderately pinched-up nasals and rather shriveled and shrunken mastoids. The teeth show no peculiarities, but are proportionately as small as the skull.

Measurements.—See table below.

Specimens examined.—Two, the type and a young male preserved in alcohol.

Remarks.—*Galeopterus abbotti* has the smallest skull of any female flying lemur in the National Museum. It is nearly but not quite as small as the skull of the type, a male of *G. pumilus* Miller² from the Adang Islands. The skin of single specimen of *G. abbotti* shows well-developed mammæ, so that there can be no question as to the sex of it.

Measurements of adult flying lemurs.

| Name. | Locality. | Catalogue No. | Sex. | Head and body. ³ | Tail. ³ | Hind foot. ³ | Condyllo-basal length of skull. | Zygomatic width. | Width of braincase. | Upper tooththrow. |
|-----------------------------------|------------------|---------------|-----------|-----------------------------|--------------------|-------------------------|---------------------------------|------------------|---------------------|-------------------|
| <i>Galeopterus borneanus</i> ... | Tjantung..... | 4151888 | Female | mm. 415 | mm. 248 | mm. 78 | mm. 70.0 | mm. 46.5 | mm. 27.0 | mm. 35.0 |
| <i>Galeopterus lautensis</i> | Pulo Laut..... | 4151886 | ...do.... | 450 | 299 | 86 | 74.0 | 50.0 | 24.5 | 37.7 |
| Do..... | Pulo Sebuku..... | 151887 | Male.... | 350 | 180 | 65 | 61.5 | 41.3 | 23.0 | 32.0 |
| <i>Galeopterus abbotti</i> | Pulo Panebangan. | 4145577 | Female. | 345 | 210 | 62 | 60.0 | 40.5 | 22.4 | 29.4 |

¹ Smiths. Misc. Coll., vol. 45, p. 49, November 6, 1903.

² Idem, p. 46, November 6, 1903.

³ Collector's measurements.

⁴ Type.

CYNOPTERUS BRACHYOTIS BRACHYOTIS (Müller).¹

1839. *Pachysoma brachyotis* MÜLLER, Tijdschr. Natuur. Gesch. Physiol., vol. 5, p. 146.
 1907. *Cynopterus brachyotis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 562, December 24, 1907.

Twenty-five specimens from the Kapuas River, thirteen from the Sempang River, sixteen from the Kendawangan River, and one from Batu Jurong.

(For measurements see table, p. 128.)

CYNOPTERUS BRACHYOTIS INSULARUM Andersen.

1910. *Cynopterus brachyotis insularum* ANDERSEN, Ann. Mag. Nat. Hist., ser. 8, vol. 6, p. 624, December, 1910. Type-locality, Kangean Island.

Two specimens from Pulo Mata Siri.

(For measurements see table, p. 128.)

PTEROPUS VAMPYRUS Linnæus.

1758. *Vespertilio vampyrus* LINNÆUS, Syst. Nat., 10th ed., p. 31.

Three specimens from the Kendawangan River and fifteen from Klumpang Bay, all skins and skulls; three skeletons and seven preserved in alcohol from Klumpang Bay.

(For measurements see table, p. 128.)

An immense roost of many thousands of these bats was among the mangroves near the head of Klumpang Bay. The roost was on a small tidal creek a couple of hundred yards from the shore of the bay. The mangroves were all small, not more than 18 to 25 feet high. There were probably at least 15,000 to 20,000 individuals. I fired four shots into different trees and we picked up about thirty-five bats which were wounded and clung to the branches. Those killed outright mostly fell into the water and were lost, either sinking like stones or being swept away by the strong tidal current. Most of the females had young ones with them.—W. L. A.

PTEROPUS SPECIOSUS Andersen.

1908. *Pteropus speciosus* ANDERSEN, Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 364, October, 1908. Type-locality, Malanipa Island, off Zamboanga, Philippine Islands.

Five skins and skulls, and three specimens preserved in alcohol from Pulo Solombo Besar, and one skin and skull from Pulo Mata Siri.

Skins and skulls compared with type and paratype of species and found indistinguishable. The color of the fur varies in the species of the *hypomelaus* group within wider limits than generally in *Pteropus*.—Knud Andersen.

¹ The author is indebted to Dr. Knud Andersen for the identifications of many of the fruit bats and leaf-nosed bats.

Measurements of fruit bats.

| Name. | Catalogue No. | Locality. | Sex. | Head and body. | | Forearm. | Tibia. | Foot. | Ear from crown. | Condylo-basal length. | Maxillary toothrow including canine. |
|--|---------------|---------------------|---------|----------------|-------|----------|--------|-------|-----------------|-----------------------|--------------------------------------|
| | | | | mm. | mm. | | | | | | |
| <i>Pteropus speciosus</i> .. | 151893 | Pulo Solombo Besar | Female | 182 | 119 | 58 | 41.0 | 54.0 | 21.4 | | |
| Do..... | 151894 | do..... | do..... | 182 | 116 | 56 | 42.0 | 54.0 | 21.5 | | |
| Do..... | 151896 | do..... | Male | 195 | 119 | 54 | 43.0 | 57.0 | 22.0 | | |
| Do..... | 151897 | do..... | Female | 205 | 121 | 57 | 40.0 | 56.0 | 21.3 | | |
| Do..... | 151898 | Pulo Mata Siri..... | do..... | 205 | 125 | 55 | 40.0 | 58.0 | 22.1 | | |
| <i>Pteropus vampyrus</i> . | 153861 | Kendawangan River | Male | 298 | 184 | 90 | 60.0 | 76.0 | 28.5 | | |
| Do..... | 153862 | do..... | do..... | 296 | 185 | 85 | 58.0 | 74.0 | 28.0 | | |
| Do..... | 153863 | do..... | Female | 288 | 187 | 87 | 59.0 | 75.0 | 28.4 | | |
| Do..... | 151901 | Klumpang Bay..... | Male | 292 | 185 | 83 | 57.0 | 75.0 | 29.5 | | |
| Do..... | 151902 | do..... | do..... | 276 | 175 | 85 | 56.0 | 71.0 | 28.4 | | |
| Do..... | 151915 | do..... | do..... | 292 | 179 | 84 | 64.0 | 75.0 | 29.3 | | |
| Do..... | 151903 | do..... | Female | 260 | 190 | 86 | 57.0 | 72.0 | 30.1 | | |
| Do..... | 151903 | do..... | do..... | 280 | 178 | 89 | 62.0 | 71.0 | 27.5 | | |
| Do..... | 151910 | do..... | do..... | 280 | 184 | 88 | 60.0 | 75.0 | 28.8 | | |
| <i>Cynopterus brachyotis</i> | 145626 | Sempang River..... | Male | 71 | 10 | 63 | 23 | 13.2 | 14 | 26.5 | 9.4 |
| Do..... | 145627 | do..... | Female | 80 | 9 | 61 | 26 | 13.1 | 13 | 26.7 | 8.9 |
| Do..... | 145628 | do..... | do..... | 73 | 9 | 61 | 25 | 13.2 | 15 | 26.2 | 9.3 |
| Do..... | 153865 | Kendawangan River | Male | 100 | 9 | 62 | 25 | 14.0 | 14 | 27.7 | 9.3 |
| Do..... | 153887 | do..... | Female | 73 | 9 | 64 | 25 | 15.0 | 14 | 26.0 | 8.8 |
| Do..... | 153889 | do..... | Male | 21 | 9 | 60 | 22 | 12.2 | 11 | 25.0 | 8.8 |
| Do..... | 153892 | do..... | Female | 65 | 9 | 61 | 23 | 13.4 | 14 | 25.0 | 8.2 |
| Do..... | 153894 | do..... | do..... | 75 | 10 | 62 | 25 | 13.5 | 13 | 27.0 | 9.4 |
| Do..... | 153896 | do..... | do..... | 79 | 10 | 62 | 25 | 14.5 | 14 | 26.6 | 9.3 |
| Do..... | 153882 | Batu Jurong..... | Male | ..... | ..... | ..... | ..... | ..... | ..... | 26.0 | 9.2 |
| Do..... | 151892 | Pamukang Bay..... | Female | ..... | ..... | ..... | ..... | ..... | ..... | 26.1 | 8.7 |
| <i>Cynopterus brachyotis insularum</i> . | 151891 | Pulo Mata Siri..... | Male | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 10.0 |
| Do..... | 151987 | do..... | Female | 82 | 13 | 67 | 27 | 15.2 | 16 | 29.2 | 10.0 |

¹ Paratype.

MEGADERMA SPASMA CARIMATÆ (Miller).

1906. *Megaderma carimatæ* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 63, July 23, 1906.

1907. *Megaderma carimatæ*, ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 133, February, 1907.

Thirty-one specimens from Karimata Island. *Megaderma spasma carimatæ* is evidently closely related to the Bornean form of *M. spasma*, differing mainly by its rather longer ear and shorter tibia.

MEGADERMA SPASMA TRIFOLIUM (Geoffroy).

1907. *Megaderma spasma trifolium* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 132, February, 1907.

Eleven specimens from a small islet northeast of Pulo Bauwal, five from Batu Jurong, and five from Pulo Lamukotan.

(For measurement see table, p. 136.)

These bats were roosting in some small caves on the seashore, just above high-water mark.

HIPPOSIDEROS LARVATUS (Horsfield).

1878. *Phyllorhina larvata*, DOBSON, Cat. Chiropt. Brit. Mus., p. 137.

1906. *Hipposideros larvatus*, MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 64, July 23,

1906. Karimata Island specimens.

Twenty-seven specimens from the Pangkallahan River, one from the upper Pasir River, four from Pulo Panebangan, six from Pulo Serutu, Karimata Islands, all preserved in alcohol.

(For measurements see table, p. 130.)

HIPPOSIDEROS DYACORUM Thomas.

1902. *Hipposideros dyacorum* THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 9, p. 271, April, 1902.

Seven specimens preserved in alcohol from Sungei Matan.

(For measurements see table, p. 130.)

Hanging under a rock on Bukit Sepunchok.—W. L. A.

HIPPOSIDEROS GALERITUS Cantor.

1878. *Phyllorhina galerita*, DOBSON, Cat. Chiropt. Brit. Mus., p. 141.

Twenty-two specimens from Panebangan Island, fourteen from the Pangkallahan River, and eleven from the upper Pasir River, all preserved in alcohol.

(For measurements see table, p. 130.)

Taken in a large cave near Lowatsi (the Pasir River specimens).—W. L. A.

HIPPOSIDEROS INSOLENS, new species.

Type.—Adult male preserved in alcohol, skull removed, Cat. No. 154389, U.S.N.M., collected near Lowatsi on the upper Pasir River, southeastern Borneo, December 31, 1908, by Dr. W. L. Abbott. Original number, 6274.

Diagnostic characters.—Related to *Hipposideros galeritus*, but forearm, tail, and tibia distinctly longer, though skulls are of the same size.

Color.—Type: Specimen taken out of alcohol and temporarily dried. On back general color mummy brown. When the fur is blown open, the terminal third or half of the hairs is seen to be mummy brown, the basal portions Prout's to wood brown; the extreme narrow base of the hairs is buffy. Underparts, terminal portions of hairs, isabella color, extreme basal portion buffy, and intermediate portion dark wood brown. Membranes and naked portions of ears, the usual blackish brown color seen in bats.

Nose-leaf.—Vertical posterior portion divided by three vertical ridges into four cells, frontal sac in male only, opening by a transverse slit, two secondary cutaneous leaflets, external to and on each side of horseshoe.

Ears.—Short and broad, tip reaching to anterior border of horseshoe when laid forward, furred almost to the tip on outer side, and anterior and posterior margins well furred inside. Height above crown, 11mm.; from meatus, 13; width, 13.

Wings, membranes, etc.—Wings from the tarsus, interfemoral membrane well developed. Forearm, 52 mm.; thumb, 7; first finger, 42; second finger, 72; third finger, 58; fourth finger, 58; tibia, 21; foot, 8; calcar, 9; tail, 38.

Skull and teeth.—The skull and teeth of *Hipposideros insolens* show no difference from those of *H. galeritus*, not even in size, in spite of the fact that *H. insolens* is a much larger bodied animal. The principal measurements of the type skull are: Greatest length, 17.7 mm.; zygomatic width, 9; mastoid width, 9; interorbital constriction, 2.7; maxillary tooth-row, including canine, 5.8.

Specimens examined.—The type and two other specimen, females, all in alcohol, from the same locality.

Remarks.—*Hipposideros insolens* is readily distinguished from *H. galeritus* by its distinctly larger body size. (See table of measurements below.) The skulls of the two forms, however, are curiously enough indistinguishable. This is undoubtedly another instance of the not unusual occurrence among bats of two closely related species differing only or mainly in size.

Measurements of *Hipposideros*.

| Name. | Catalogue No. | Locality. | Sex. | Head and body. | | | | | | | Ear from crown. | Condyl-basal length. | Maxillary toothrow, including canine (atveol.). |
|----------------------------------|---------------|---------------------|---------|----------------|-----|------|------|------|-----|------|-----------------|----------------------|---|
| | | | | mm. | mm. | mm. | mm. | mm. | mm. | mm. | | | |
| <i>Hipposideros larvatus</i> . | 152067 | Pangkallahan River. | Male... | 67 | 32 | 65.0 | 25.0 | 12.5 | 15 | 23.0 | 9.0 | | |
| Do..... | 152068 | do..... | Female | 59 | 37 | 62.0 | 25.0 | 12.5 | 18 | 21.5 | 8.5 | | |
| Do..... | 152079 | do..... | Male... | 58 | 34 | 62.0 | 24.0 | 13.0 | 18 | 22.2 | 8.9 | | |
| Do..... | 152080 | do..... | do..... | 62 | 32 | 63.0 | 24.0 | 12.5 | 18 | 22.3 | 8.7 | | |
| Do..... | 152089 | do..... | Female | 64 | 37 | 64.0 | 23.0 | 12.0 | 17 | 22.2 | 8.6 | | |
| Do..... | 154387 | Upper Pasir River. | Male... | 64 | 32 | 64.0 | 24.0 | 12.0 | 18 | 22.4 | 9.0 | | |
| Do..... | 145608 | Pulo Panebangan. | do..... | 67 | 32 | 62.0 | 25.0 | 13.0 | 16 | 21.2 | 8.3 | | |
| Do..... | 145670 | do..... | Female | 61 | 34 | 62.0 | 24.0 | 12.5 | 19 | 21.4 | 8.7 | | |
| Do..... | 145671 | do..... | do..... | 55 | 28 | 61.0 | 22.0 | 12.0 | 18 | 20.0 | 8.0 | | |
| <i>Hipposideros dya-corum</i> . | 145692 | Matan River | do..... | 39 | 21 | 42.5 | 17.0 | 8.5 | 12 | 15.2 | 5.7 | | |
| Do..... | 145694 | do..... | do..... | 42 | 21 | 42.0 | 17.3 | 8.0 | 13 | 15.0 | 5.5 | | |
| <i>Hipposideros gal-eritus</i> . | 152057 | Pangkallahan River. | Male... | 40 | 23 | 42.5 | 17.4 | 8.0 | 11 | 14.9 | 5.7 | | |
| Do..... | 152058 | do..... | Female | 41 | 21 | 42.0 | 15.0 | 8.3 | 12 | 14.2 | 5.6 | | |
| Do..... | 152060 | do..... | Male... | 44 | 22 | 44.0 | 17.2 | 8.0 | 11 | 15.4 | 5.7 | | |
| Do..... | 154391 | Upper Pasir River. | Female | 42 | 22 | 45.0 | 17.2 | 8.0 | 12 | 15.7 | 5.9 | | |
| Do..... | 154392 | do..... | Male... | 44 | 21 | 45.0 | 18.0 | 8.5 | 12 | 15.7 | 6.0 | | |
| Do..... | 154393 | do..... | Female | 45 | 24 | 47.0 | 18.0 | 8.0 | 12 | 14.8 | 6.0 | | |
| Do..... | 154394 | do..... | Male... | 45 | 23 | 44.0 | 18.0 | 7.5 | 12 | 15.1 | 5.9 | | |
| Do..... | 145615 | Pulo Panebangan. | do..... | 42 | 24 | 46.0 | 18.4 | 8.5 | 12 | 15.6 | 5.8 | | |
| Do..... | 145688 | do..... | Female | 44 | 22 | 47.0 | 18.0 | 9.0 | 12 | 15.0 | 5.8 | | |
| Do..... | 145683 | do..... | do..... | 44 | 23 | 47.0 | 18.0 | 8.5 | 13 | 15.9 | 6.1 | | |
| Do..... | 145689 | do..... | Male... | 40 | 25 | 47.0 | 18.5 | 8.0 | 13 | 15.5 | 5.7 | | |
| <i>Hipposideros inso-lens</i> . | 154388 | Upper Pasir River. | Female | 49 | 38 | 52.0 | 22.0 | 8.2 | 12 | 15.5 | 6.0 | | |
| Do..... | 154389 | do..... | Male... | 44 | 38 | 52.0 | 21.0 | 8.0 | 11 | 15.0 | 5.8 | | |
| Do..... | 154390 | do..... | Female | 49 | 36 | 51.0 | 22.0 | 8.7 | 12 | 15.7 | 5.8 | | |

¹ Type.

RHINOLOPHUS TRIFOLIATUS Temminck.

1905. *Rhinolophus trifolius*, ANDERSEN, Ann. Mag. Nat. Hist., ser. 7, vol. 16, p. 249, August, 1905.

1907. *Rhinolophus trifolius*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 563, December 24, 1907.

One specimen from along the Kapuas River in 1905, and four others on later expeditions, three from the Kendawangen River and one from the Sampanahan, all preserved in alcohol.

(For measurements see table, p. 132.)

Hanging beneath a palm leaf in dense hill jungle (Sampanahan River specimen).—W. L. A.

RHINOLOPHUS AFFINIS Horsfield.

1824. *Rhinolophus affinis* HORSFIELD, Zool. Research, Java.

Fourteen specimens from the Pangkallahan River, and five from the upper Pasir River, all preserved in alcohol.

(For measurements see table, p. 132.)

Taken in a large cave near Lowatsi (of the Pasir specimens).—W. L. A.

RHINOLOPHUS BORNEENSIS Peters.

1861. *Rhinolophus borneensis*, PETERS, Monatsber. Akad. Berlin, 1861, p. 709.

Five specimens in alcohol from Pulo Panebangan.

(For measurements see table, p. 132.)

RHINOLOPHUS BORNEENSIS SPADIX (Miller).

1906. *Rhinolophus borneensis spadix*, MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 64, July 23, 1906.

Three specimens from Pulo Serutu and two from Karimata, collected in 1904.

NYCTERIS¹ JAVANICUS (Geoffroy).

1813. *Nycteris javanicus* GEOFFROY, Ann. Mus. Paris, vol. 20, p. 20.

One specimen preserved in alcohol, from the Upper Pasir River.

(For measurements see table, p. 136.)

In a small cave in limestone rock.—W. L. A.

¹See Miller, Proc. Biol. Soc. Wash., vol. 22, p. 90, April 17, 1909. I have used the name *Nycteris* instead of *Petalia*, as by recommendation of the International Code *Nycteris* is a different term from *Nycteris*.

Measurements of *Rhinolophus*.

| Name. | Catalogue No. | Locality. | Sex. | Head and body. | | | | | | | Ear from crown. | Condylar-basal length. | Maxillary toothrow, including canine (alveoli). |
|----------------------------------|---------------|---------------------|------------|----------------|-----|-----|------|------|-----|-------|-----------------|------------------------|---|
| | | | | mm. | mm. | mm. | mm. | mm. | mm. | mm. | | | |
| <i>Rhinolophus trifoliatus</i> . | 153960 | Kendawangan River. | Male.... | 54 | 34 | 49 | 24.0 | 12.0 | 21 | 20.5 | 8.3 | | |
| Do..... | 153961 |do..... | Female.. | 53 | 32 | 51 | 26.0 | 13.0 | 22 | ..... | 8.4 | | |
| Do..... | 153962 |do..... |do... | 55 | 34 | 52 | 27.0 | 14.0 | 23 | 21.4 | 8.3 | | |
| Do..... | 152090 | Sampanahan River. |do... | 57 | 31 | 53 | 28.0 | 14.5 | 22 | 21.7 | 8.8 | | |
| <i>Rhinolophus affinis</i> . | 152045 | Pangkallahan River. | Male.... | 50 | 20 | 47 | 22.0 | 11.0 | 15 | 19.0 | 8.0 | | |
| Do..... | 152047 |do..... | Female.. | 50 | 20 | 49 | 23.0 | 11.5 | 17 | 19.5 | 8.4 | | |
| Do..... | 154402 | Upper Pasir River. | Male.... | 47 | 21 | 48 | 22.0 | 11.0 | 17 | 19.7 | 8.5 | | |
| Do..... | 154404 |do..... |do... | 47 | 22 | 49 | 23.0 | 12.5 | 17 | 19.7 | 8.3 | | |
| Do..... | 154406 |do..... | Female.. | 47 | 20 | 49 | 23.0 | 12.0 | 18 | 20.4 | 8.3 | | |
| <i>Rhinolophus borneensis</i> . | 145611 | Pulo Panebangan. | Male.... | 44 | 22 | 42 | 18.5 | 9.5 | 15 | 17.0 | 7.2 | | |
| Do..... | 145612 |do..... | Female.. | 44 | 21 | 43 | 19.0 | 8.6 | 15 | 16.9 | 7.2 | | |
| Do..... | 145699 |do..... |do... | 43 | 21 | 43 | 18.3 | 9.0 | 16 | 17.0 | 7.1 | | |

EMBALLONURA MONTICOLA Temminck.

1838. *Emballonura monticola* TEMMINCK, Tijdschr. Natuur. Gesch. Physiol. Leiden, vol. 5, p. 25. Type-locality, Java.

Seven specimens from the Matan River, ten from the Saratok River, Klumpang Bay.

(For measurements see table, p. 133.)

Brought by a Malay boy who said he got them under an overhanging rock. * * *
Brought by a Malay boy who said he got them in a cave. W. L. A.

EMBALLONURA ANAMBENSIS Miller.

1900. *Emballonura anambensis* MILLER, Proc. Wash. Acad. Sci., vol. 2, p. 236, August 20, 1900. Type-locality, Anamba Islands.

1906. *Emballonura anambensis* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 63, July 23, 1906.

In addition to the twenty-six bats of this species collected on Karinata Island in 1904 Doctor Abbott secured nineteen others in 1908. Five specimens from Pulo Panebangan may be referred to the same species.

(For measurements of the Panebangan specimens, see table, p. 133.)

EMBALLONURA PUSILLA, new species.

Type.—Adult female, preserved in alcohol, and skull removed, Cat. No. 153940, collected at Mankol, Kendawangan River, southwestern Borneo, September 29, 1908, by Dr. W. L. Abbott. Original number, 6223.

Diagnostic characters.—Like the Bornean form of *Emballonura monticola*, but with a distinctly smaller skull.

Color.—Type: Dried out of alcohol temporarily, hair of upper parts between seal and mummy brown, becoming much lighter at base, like a pale sepia; under parts similar to a rather dark Broccoli brown, with the hairs of the throat and chin inclining toward russet; ears, membranes, etc., blackish.

Skull and teeth.—Essentially like those of the Bornean *Emballonura monticola*, but distinctly smaller and weaker; space between the canine and the large premolar distinctly less in the smaller bat.

Measurements.—Type: Head and body, 36 mm.; tail, 9; forearm, 44; thumb, 6; first finger, 35; second finger, 60; third finger, 44; fourth finger, 43; tibia, 17; foot, 8; ear from crown, 9; greatest length of skull, 13.3; zygomatic width, 8.3; greatest width of brain case, 6.5; interorbital constriction, 2.8; greatest superior width of rostrum, 5.3; maxillary toothrow, including canine, 5.; mandibular toothrow, including canine, 5.2. Also see table below.

Specimens examined.—Four, two from the Kendawangan River and two from the Pangkallahan River.

Hanging beneath a rock in the forest.—W. L. A.

Measurements of Emballonura.

| Name. | Catalogue No. | Locality. | Sex. | Head and body. | | Forearm. | Tibia. | Foot. | Ear from crown. | Condyllo-basal length. | Maxillary toothrow, including canine. |
|-------------------------------|---------------------|----------------------|---------|----------------|-----|----------|--------|-------|-----------------|------------------------|---------------------------------------|
| | | | | mm. | mm. | | | | | | |
| <i>Emballonura monticola</i> | 145658 | Matan River..... | Female | 43 | 11 | 48 | 18 | 8.5 | 11 | 13.8 | mm. 5.9 |
| Do..... | 145659 | do..... | do..... | 46 | 11 | 48 | 19 | 8.6 | 12 | 14.4 | 6.1 |
| Do..... | 145660 | do..... | do..... | 43 | 13 | 47 | 17 | 8.0 | 10 | 14.0 | 5.8 |
| Do..... | 145664 | do..... | Male | 43 | 13 | 48 | 19 | 8.2 | 11 | 14.3 | 6.0 |
| Do..... | 152099 | Saratok River..... | Female | 47 | 11 | 47 | 19 | 8.4 | 11 | 14.2 | 6.0 |
| Do..... | 152100 | do..... | do..... | 42 | 12 | 46 | 19 | 7.6 | 12 | 13.8 | 5.7 |
| Do..... | 152102 | do..... | do..... | 44 | 13 | 47 | 18 | 8.2 | 10 | 14.3 | 6.0 |
| <i>Emballonura anambensis</i> | 145665 | Pulo Panebangan..... | do..... | 42 | 11 | ..... | 17 | 8.0 | 11 | 13.7 | 5.6 |
| Do..... | 145666 | do..... | do..... | 43 | 11 | 47 | 18 | 8.6 | 11 | 13.4 | 5.7 |
| Do..... | 145669 | do..... | do..... | 44 | 13 | 45 | 17 | 8.4 | 11 | 13.5 | 5.7 |
| <i>Emballonura pusilla</i> | 153939 | Kendawangan River. | do..... | 41 | 12 | 45 | 17 | 8.0 | 10 | 12.5 | 5.2 |
| Do..... | 153940 ¹ | do..... | do..... | 36 | 9 | 44 | 17 | 8.0 | 9 | 12.4 | 5.0 |
| Do..... | 152091 | Pangkallahan River. | do..... | 40 | 13 | 42 | 17 | 8.5 | 9 | 12.5 | 5.0 |

¹ Type.

MYOTIS CARIMATÆ Miller.

1906. *Myotis carimatæ* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 62, July 23, 1906.

Two specimens collected on Karimata in 1904 and three from the Kendawangan River in 1908. The mainland specimens do not appear to be different from the island form.

(For measurements see table, p. 136.)

MYOTIS MURICOLA (Gray).

1841. *Vespertilio muricola* HODGSON, Journ. Asiatic Soc. Bengal, vol. 10, p. 908 (*Nomen nudum*).
1846. *Vespertilio muricola* GRAY, Cat. Spec. Draw. Mamm. Birds Nepal and Thibet, presented by B. H. Hodgson to British Museum, p. 4.
1907. *Myotis muricola*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 563, December 24, 1907.

Thirty-seven specimens from Mankol, Kendawangan River, nine from the Sempang River, and forty-one from Pulo Laut, all preserved in alcohol.

(For measurements see table, p. 136.)

Caught roosting in plantain leaves.

Roosting in curled-up young banana leaves.

Roosting in the folds of the mainsail, out near the end of the main boom.—W. L. A.

GLISCHROPUS TYLOPUS (Dobson).

1875. *Vesperugo (Glischropus) tylopus* DOBSON, Proc. Zool. Soc. London, p. 473.
1907. *Glischropus tylopus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 563, December 24, 1907.

Fifty-six specimens from the Kapuas River region, collected in 1905.

KERIVOULA HARDWICKII (Horsfield).

1825. *Vespertilio hardwickii* HORSFIELD, Zool. Researches in Java.
1907. *Kerivoula hardwickii*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 563, December 24, 1907.

One specimen from the Kapuas River in 1905.

KERIVOULA BOMBIFRONS, new species.

Type.—Preserved in alcohol, skull removed, adult male, Cat. No. 145616, U.S.N.M., collected along the Matan River, western Borneo, August 15, 1907, by Dr. W. L. Abbott. Original number 5497.

Diagnostic characters.—A small member of the genus, light in color, with large ears, apparently rather closely related to *Kerivoula pellucida* Waterhouse from the Philippines, but middle incisors not unusually slender, and membranes and legs more hairy.

Color.—Type; temporarily dried from alcohol: Upper parts, a light wood brown with a slight tint of cinnamon; under parts, a light ecru drab, but rather dull; wing membranes, brownish something between Prout's and hair brown; bases of hairs lighter in color than tips; uropatagium similar in color to fur of upper parts.

Membranes, etc.—Uropatagium moderately well furred, hairs at free edge not longer or more numerous than elsewhere; legs and dorsum of foot quite well furred; forearm, and carpus and bases of fingers with rather scant, short hairs; edge (width of 4 mm.) of membrane from foot to fifth digit, hairy to about same extent as uropatagium, membrane between elbow and foot moderately haired.

Ears.—Large, extending about 3 mm. beyond end of muzzle when laid forward; inner margin uniformly convex; outer margin with a very obtuse angle about opposite tip of tragus; tragus, long (8.5 mm.) slender (1.7 mm. wide at base), tapering gradually to a point, at lower outer angle, a small obtuse lobe, projecting about 0.5 mm.

Skull.—Brain-case rather narrowed from side to side but considerably enlarged and swollen from above downward, anteriorly; interorbital region narrow (3 mm.); a small concave depression at base of rostrum, in front of interorbital constriction; as the skull rests on its natural base the facial portion is much tilted upward; or with the skull resting on the maxillary tooth-row, the cranial portion is much tilted upward; in comparison with *K. hardwickii* and *K. picta*, the portion of the palate posterior to the tooth-row is very narrow (about 1.5 mm. as to 2.0 mm.)

Teeth.—Very similar to those in the Kapuas River specimen of *Kerivoula hardwickii*, except that m^1 is more compressed antero-posteriorly, pm^3 has a slightly greater crown surface and less vertical depth as compared with the other upper premolars; the lower premolars in *K. bombifrons* are relatively slightly larger and with greater antero-posterior diameter than they are in *K. hardwickii*, especially the middle premolars.

Measurements.—Head and body, 39 mm.; tail, 40; forearm, 30; second digit, 30; third finger, 60; fourth finger, 47; fifth finger, 41; tibia, 14; foot, 9; ear from crown, 12; ear, tip to tip (without stretching), 25; greatest breadth of ear, 11; condylo-basal length of skull, 13; maxillary tooth-row, including canine, 5.6; mandibular tooth-row, front of canine to back of last molar, 6.2; zygomatic width, 7.8; width of brain-case, 6.8.

Specimens examined.—One, the type.

Remarks.—The only other species of *Kerivoula* hitherto recorded from Borneo are *hardwickii*,¹ *pusilla*,² and *papillosa*.³ From *K. hardwickii*, *K. bombifrons* differs conspicuously in its narrower skull, anteriorly inflated brain-case, narrower interorbital constriction, and by its lighter color; from *K. pusilla*, by its generally larger size and distinctly larger ears; and from *K. papillosa* by its much smaller size, relatively larger ears, and relatively larger incisors.

Shot while hanging from a leaf in dense forest.—W. L. A.

¹ See page 134.

² Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 14, p. 461, December, 1894.

³ Hose, Mammals of Borneo, p. 40, 1893.

Measurements of bats.

| Name. | Catalogue No. | Locality. | Sex. | Head and body. | | | | | | | |
|-------------------------------------|---------------|--|--------|----------------|-------|----------|--------|-------|-----------------|---------------------------------|---------------------------------------|
| | | | | Head and body. | Tail. | Forearm. | Tibia. | Foot. | Ear from crown. | Condylar-basal length of skull. | Maxillary toothrow, including canine. |
| <i>Nycteris javanica</i> . | 154386 | Upper Pasir River. | Female | 63 | 58 | 47.0 | 27.0 | 11.0 | 25 | 19.0 | 7.8 |
| <i>Megaderma spasma trifolium</i> . | 153877 | Batu Jurong | Male | 70 | 0 | 61.0 | 35.0 | 19.0 | 28 | 19.7 | 9.2 |
| Do. | 153878 | do. | do. | 65 | 0 | 57.0 | 34.0 | 17.0 | 26 | 20.5 | 10.0 |
| Do. | 153880 | do. | do. | 63 | 0 | 56.0 | 35.0 | 17.0 | 29 | 20.8 | 9.4 |
| Do. | 153881 | do. | Female | 71 | 0 | 60.0 | 35.0 | 18.0 | 28 | | |
| Do. | 153866 | Pulo Bauwal, small islet northeast of. | Male | 77 | 0 | 55.0 | 30.0 | 17.0 | | 20.5 | 9.0 |
| Do. | 153869 | do. | Female | 61 | 0 | 56.0 | 31.0 | 17.0 | 28 | 19.5 | 8.9 |
| Do. | 153870 | do. | do. | 70 | 0 | 58.0 | 35.0 | 16.0 | 31 | 20.5 | 9.5 |
| Do. | 153872 | do. | Male | 64 | 0 | 56.0 | 34.0 | 17.0 | 30 | 20.0 | 9.4 |
| Do. | 145576 | Pulo Lamukotan. | Female | | 0 | 60.0 | 35.0 | 18.0 | | 20.5 | 8.9 |
| Do. | 145653 | do. | do. | 60 | 0 | 59.0 | 34.0 | 18.0 | 30 | 20.2 | 9.1 |
| Do. | 145654 | do. | Male | 63 | 0 | 59.0 | 34.0 | 19.0 | 31 | 20.3 | 9.3 |
| Do. | 145657 | do. | Female | 65 | 0 | 60.0 | 33.0 | 18.0 | 31 | 20.0 | 9.3 |
| <i>Kerivoula bombifrons</i> | 145616 | Matan River | Male | 39 | 40 | 30.0 | 14.0 | 9.0 | 12 | 13.0 | 5.6 |
| <i>Myotis carimata</i> . | 153936 | Kendawangan River. | do. | 44 | 35 | 38.0 | 18.0 | 11.0 | 11 | 14.0 | 5.7 |
| Do. | 153937 | do. | do. | 47 | 36 | 38.0 | 18.0 | 11.0 | 12 | 14.8 | 5.7 |
| Do. | 153938 | do. | Female | 45 | 33 | 38.5 | 18.0 | 11.0 | 11 | 14.5 | 5.9 |
| <i>Myotis muricola</i> . | 145617 | Sempang River. | Male | 39 | 34 | 33.4 | 14.5 | 7.2 | 10 | 13.2 | 5.1 |
| Do. | 145619 | do. | Female | 38 | 30 | 32.4 | 14.5 | 7.2 | 10 | 12.5 | 5.1 |
| Do. | 145623 | do. | Male | 37 | 30 | 33.0 | 14.0 | 7.6 | 10 | 12.9 | 5.3 |
| Do. | 153899 | Kendawangan River. | Female | 40 | 35 | 33.5 | 14.5 | 7.2 | 11 | 13.0 | 5.5 |
| Do. | 153902 | do. | Male | 37 | 32 | 32.9 | 15.0 | 7.0 | 10 | 13.0 | 5.0 |
| Do. | 153903 | do. | Female | 40 | 36 | 32.8 | 14.8 | 7.5 | 11 | 13.0 | 5.2 |
| Do. | 153904 | do. | do. | 38 | 35 | 33.6 | 15.6 | 7.5 | 11 | 13.1 | 5.3 |
| Do. | 153934 | do. | do. | 37 | 36 | 35.0 | 15.9 | 7.3 | 11 | 12.8 | 5.4 |
| Do. | 152010 | Pulo Laut. | Male | 38 | 36 | 33.0 | 15.5 | 7.8 | 11 | 12.9 | 5.4 |
| Do. | 152019 | do. | do. | 39 | 32 | 34.0 | 16.0 | 7.0 | 10 | 13.0 | 5.1 |
| Do. | 152032 | do. | do. | 39 | 32 | 34.0 | 15.6 | 7.3 | 12 | 12.7 | 5.4 |
| Do. | 152004 | do. | Female | 38 | 37 | 35.0 | 16.4 | 7.8 | 11 | 13.1 | 5.3 |
| Do. | 152027 | do. | do. | 38 | 35 | 34.0 | 15.5 | 7.6 | 11 | 13.3 | 5.4 |
| Do. | 152034 | do. | do. | 37 | 37 | 35.0 | 16.0 | 7.4 | 10 | 12.5 | 5.2 |

1 Type.

TARSIVS BORNEANUS Elliot.

1907. *Tarsius tarsier*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 565, December 24, 1907.1910. *Tarsius borneanus* ELLIOT, Bull. Amer. Mus. Nat. Hist., vol. 28, p. 153, May 27, 1910.

Four specimens collected by Doctor Abbott in western Borneo in 1905.

NYCTICEBUS BORNEANUS Lyon.

1906. *Nycticebus borneanus* LYON, Proc. U. S. Nat. Mus., vol. 31, p. 535, November 9, 1906.1907. *Nycticebus borneanus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 565, December 24, 1907.

Nine specimens from western Borneo, collected by Doctor Abbott in 1905.

PITHECUS NEMESTRINUS (Linnaeus).

1766. [*Simia*] *nemestrina* LINNÆUS, Syst. Nat., vol. 1, 12th ed., p. 35. Type-locality, Sumatra.1907. *Macaca nemestrina*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 565, December 24, 1907. (Landak and Sakaïam rivers specimens.)

Three specimens, a skin and skull from Sukadana, an odd weathered skull from the Kendawangan River, and a skin and skull from Pamukang Bay. The two skins have hairs that are distinctly annulated, and the skulls are of the narrow type, quite unlike the skin and skull of the type of *P. broca* Miller¹ from northern Borneo.

(For measurements see table, p. 138.)

PITHECUS MANDIBULARIS Elliot.

1907. *Macaca fascicularis*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 565, December 24, 1907.

1910. *Pithecus mandibularis* ELLIOT, Proc. U. S. Nat. Mus., vol. 38, p. 347, August 6, 1910.

Only one specimen of the usually common Malay long-tailed macaque was obtained by Doctor Abbott in Borneo, on the Sungei Sama, near Pontianak, in 1905.

(For measurements see table, p. 138.)

PITHECUS CARIMATÆ Elliot.

1906. *Macaca fascicularis* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 65, July 23, 1906.

1910. *Pithecus carimatæ* ELLIOT, Proc. U. S. Nat. Mus., vol. 38, p. 346, August 6, 1910.

Two skins and skulls from Telok Pai, Karimata Island, collected by Doctor Abbott in 1904.

(For measurements see table, p. 138.)

PITHECUS CUPIDUS Elliot.

1910. *Pithecus cupidus* ELLIOT, Proc. U. S. Nat. Mus., vol. 38, p. 348, August 6, 1910.

Skin and skull and an odd weathered skull from Pulo Mata Siri.

(For measurements see table, p. 138.)

PITHECUS BAWEANUS Elliot.

1910. *Pithecus baweanus* ELLIOT, Proc. U. S. Nat. Mus., vol. 38, p. 347, August 6, 1910.

Two skins and skulls from Bawean Island.

(For measurements see table, p. 138).

¹ Proc. U. S. Nat. Mus., vol. 29, p. 558, Feb. 3, 1906.

Measurements of *Pithecus*.

| Name. | Locality. | Catalogue No. | Sex. | Age. | Head and body. ¹ | | Hind foot. ¹ | Weight. ² | Basal length of skull. | | Zygomatic width. | Front of c ¹ to back of m ³ . |
|--------------------------|------------------------------|---------------------|-----------|------------|-----------------------------|-------|-------------------------|----------------------|------------------------|-------|------------------|---|
| | | | | | mm. | mm. | | | mm. | mm. |  |  | mm. |
| <i>P. nemestrinus</i> . | Sukadana..... | 145330 | Male.... | Adult..... | 615 | 220 | 190 | 10.9 | ..... | ..... | ..... | ..... |
| Do..... | Ken dawangan River. | 153804 | ..do..... | ..do..... | (4) | ..... | ..... | ..... | ..... | ..... | ..... | 47.0 |
| Do..... | Pamukang Bay. | 154367 | ..do..... | ..do..... | 590 | 240 | 195 | 10.9 | 115 | 101 | ..... | 48.0 |
| <i>P. mandibularis</i> . | Near Pontianak, Sungei Sama. | ³ 142225 | ..do..... | ..do..... | 445 | 570 | 140 | 5.0 | ..... | 77 | ..... | 37.0 |
| <i>P. cupidus</i> .. | Pulo Mata Siri. | ³ 151831 | ..do..... | ..do..... | 435 | 540 | 127 | 4.8 | 85 | 81 | ..... | 36.4 |
| Do..... | do..... | 154368 | ..do..... | ..do..... | (4) | ..... | ..... | ..... | 87 | 83 | ..... | 38.0 |
| <i>P. baweanus</i> | Bawean Island. | ³ 151829 | ..do..... | ..do..... | 472 | 580 | 141 | 6.2 | 91 | 89 | ..... | 42.5 |
| Do..... | do..... | 151830 | Female.. | ..do..... | 438 | 535 | 122 | 3.9 | 74 | 74 | ..... | 34.5 |
| <i>P. carimatæ</i> . | Karimata Island | ³ 125101 | Male.... | ..do..... | 460 | 655 | 144 | 5.4 | 81 | 78 | ..... | 37.4 |
| Do..... | do..... | 125102 | ..do..... | ..do..... | 460 | 630 | 145 | 5.2 | ..... | ..... | ..... | ..... |

PYGATHRIX RUBICUNDA RUBICUNDA (Müller).

1838-39. *Semuopithecus rubicundus* MÜLLER, Tijdschr. Natuur. Gesch. Physiol., vol. 5, p. 137.

1839-1844. *Semuopithecus rubicundus*, MÜLLER and SCHLEGEL, Verh. Nat. Gesch. Nederl. Bezitt, pp. 61 and 69, pl. 9, figs. 1, 2, 3, and 4; pl. 11, fig. 1. Type-locality, southeastern Borneo.

Doctor Abbott secured three specimens of *Pygathrix rubicunda rubicunda* from Balik Papan Bay and three from the Seratok River. These six specimens are practically topotypes of the species, the original specimens having been collected at Mount Sakumbang and Tana Lawut. (The latter place does not appear on any of the available maps. Mount Sakumbang is shown on the map on page 57.) They are of a generally darker red color than any of the other Bornean specimens of this species in the National Museum, and the hands and feet have a more distinct tendency to be suffused with blackish.

There seem to be three distinct forms of this species on Borneo, *P. rubicunda rubicunda* from southeastern Borneo, *P. rubicunda ignita*⁵ from the northern parts of the island, a new form described below as *P. rubicunda rubida* from western Borneo, south of the Kapuas River. A fourth subspecies, *P. rubicunda carimatæ*, from Karimata Island is evidently derived from the Bornean fauna.

The differential characters of the four forms are set fourth in the table below.

(For measurements, see table, p. 141.)

¹ Collector's measurements.

² Collector's measurements computed to kilograms.

³ Type.

⁴ Weathered skull.

⁵ Dollman, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 204, September, 1909.

PYGATHRIX RUBICUNDA RUBIDA, new subspecies.

Type.—Skin and skull of adult female, Cat. No. 153790, U.S.N.M., collected at Batu Jurong, southwestern Borneo, June 17, 1908, by Dr. W. L. Abbott. Original number, 5979.

Diagnostic characters.—Closely related to *Pygathrix rubicunda rubicunda*, differing in having a somewhat lighter color, no conspicuous suffusion of blackish color on the hands and feet, less prominent outer edge of the mastoid, and a distinct space between that edge and the edge of the posterior root of the zygoma.

Color.—Type: General color similar to Ridgway's hazel, but rather brighter, the hairs generally darker at the ends and lighter at bases, so that on the back where the hairs are longest, the general color is dark hazel; a considerable number of blackish hairs on the dorsal surface of the fingers and toes.

Skull and teeth.—The skull and teeth of *Pygathrix rubicunda rubida* are in general as they are in *P. r. rubicunda*; the outer edge of the mastoid, however, is more inconspicuous than it is in the typical form and is usually separated from the outer edge of the posterior root of the zygoma by a more or less well-defined groove or distinct space.

Measurements.—See table, page 141.

Specimens examined.—Twelve, from various localities in southwestern Borneo. (See table of measurements for exact localities.)

PYGATHRIX RUBICUNDA CARIMATÆ Miller.

1906. *Presbytis carimatæ* MILLER, Proc. U.S. Nat. Mus., vol. 31, p. 65, July 23, 1906.

In addition to the original series of seven specimens collected in 1904, two additional specimens were collected on Karimata Island at Telok Edar by Dr. W. L. Abbott in 1908.

(For external and cranial measurements see table, p. 141.)

Diagnostic characters of the forms of Pygathrix rubicunda.

| <i>P. rubicunda carimatæ.</i> | <i>P. rubicunda rubida.</i> | <i>P. rubicunda rubicunda.</i> | <i>P. rubicunda ignita.</i> |
|---|---|---|---|
| Lighter colored, without well-marked blackish suffusion on hands and feet. | Lighter colored, without well-marked blackish suffusion on hands and feet. | Darker colored, with blackish suffusion on hands and feet. | Lighter colored, without blackish suffusion on hands and feet. |
| Post-glenoid process long and heavy. | Post-glenoid process not conspicuously developed. | Post-glenoid process not conspicuously developed. | Post-glenoid process not conspicuously developed. |
| Fossa between pterygoids relatively shallow. | Fossa between pterygoids relatively shallow. | Fossa between pterygoids intermediate in character. | Fossa between pterygoids relatively deep. |
| Outer edge of mastoid relatively less conspicuous. | Outer edge of mastoid relatively less conspicuous. | Outer edge of mastoid rather conspicuous. | Less conspicuous. |
| Outer edge of posterior zygomatic root as a rule not separated from outer mastoid edge by a distinct space or groove, but the two edges soon confluent. | Outer edge of posterior zygomatic root separated from outer mastoid edge by a more or less well-defined groove or distinct space. | Outer edge of posterior zygomatic root as a rule not separated from outer mastoid edge by a distinct space or groove, but the two edges soon confluent. | Outer edge of posterior zygomatic root as a rule not separated from outer mastoid edge by a distinct space or groove, but the two edges soon confluent. |
| Angle of jaw and condyle large and heavy. | Angle of jaw and condyle not so large and heavy. | Angle of jaw and condyle not so large and heavy. | Angle of jaw and condyle not so large and heavy. |

PYGATHRIX FRONTATA (Müller).

1838-39. *Semnopithecus frontatus* MÜLLER, Tijdschr. Natuur. Gesch. Physiol., vol. 5, p. 136.

1839-44. *Semnopithecus frontatus* MÜLLER and SCHLEGEL, Verh. Nat. Gesh. Nederl. Bezitt., pp. 62 and 78, pl. 8, figs. 1-4.

Ten specimens of this rare monkey were collected by Doctor Abbott in southeastern Borneo, eight at Klumpang Bay, and two at Balik Papan Bay.

(For measurements see table, p. 141.)

Generally common.—W. L. A.

PYGATHRIX CRISTATA (Raffles).

1822. *Simia cristata* RAFFLES, Trans. Linn. Soc. London, vol. 13, p. 244. Type-locality, Sumatra.

1907. *Presbytis cristata*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 568, December 27, 1907. Kapuas River specimens.

In addition to two specimens of *Presbytis cristata* taken by Doctor Abbott in the Kapuas River region, an adult female and her young were taken at the Pasir River, southeastern Borneo.

(For measurements of the specimens see table, p. 141.)

In point of coloration the young specimen bears no resemblance whatever to its parent. The hairs are everywhere ochraceous in color, with the exception of a fringe of long blackish hairs over the forehead. A good illustration of the young may be seen in Verhandeligen over de Natuurlijke Geschiedenis der Nederlandsche overzeesche Bezittingen, plate 12, fig. 1.

PYGATHRIX CHRYSOMELAS (Müller).

1838-39. *Semnopithecus chrysomelas* MÜLLER, Tijdschr. Natuurl. Gesch. Physiol. vol. 5, p. 138. Type-locality, Pontianak, western Borneo.

1907. *Presbytis chrysomelas*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 567, December 27, 1907.

Nine specimens from Pontianak, and the lower Landak and Kapuas rivers. None were collected by Doctor Abbott in southwestern or southeastern Borneo.

Measurements of *Pygathrix*.

| Name. | Locality. | Catalogue No. | Sex. | Age. | Head and body. ¹ | | Hind foot. ¹ | Weight. ² | Basal length of skull. | Front of canine to back of m ³ | Zygomatic width. |
|---------------------------------|--------------------|---------------|-------------|------------------|-----------------------------|-------|-------------------------|----------------------|------------------------|---|------------------|
| | | | | | mm. | mm. | | | | | |
| <i>P. frontata</i> .. | Klumpang Bay. | 151819 | Male... | Not quite adult. | 405 | 660 | 158 | 3.6 | 56.7 | 26.9 | 66.6 |
| Do..... | do..... | 151820 | Female..... | ..... | 480 | 710 | 170 | 5.7 | ..... | ..... | ..... |
| Do..... | do..... | 151821 | do..... | do..... | 405 | 695 | 172 | 4.0 | ..... | ..... | ..... |
| Do..... | do..... | 151822 | do..... | Old..... | 505 | 735 | 178 | 6.5 | 64.8 | 29.5 | 75.0 |
| Do..... | do..... | 151823 | do..... | do..... | 500 | 660 | 175 | 5.9 | 61.6 | 28.0 | 69.8 |
| Do..... | do..... | 151824 | do..... | do..... | 495 | 700 | 170 | 5.4 | ..... | ..... | ..... |
| Do..... | do..... | 154363 | do..... | Adult..... | 480 | 710 | 173 | 6.4 | 63.3 | 28.7 | 72.3 |
| Do..... | Sampanahan River. | 151825 | Male..... | do..... | 480 | 640 | 168 | 5.6 | 64.7 | 29.3 | 73.3 |
| Do..... | Balik Papan Bay. | 154361 | Female..... | Young adult | 445 | 745 | 175 | 5.0 | 62.3 | 28.9 | 67.0 |
| Do..... | do..... | 154362 | do..... | do..... | 490 | 710 | 163 | 6.4 | 62.5 | 29.8 | 68.5 |
| <i>P. cristata</i> .. | Pasir River..... | 154359 | do..... | Adult..... | 515 | 635 | 140 | 5.2 | 59.3 | 28.0 | 68.5 |
| Do..... | do..... | 154360 | Male..... | Very young | 200 | 280 | 70 | ..... | ..... | ..... | ..... |
| <i>P. rubicunda rubida</i> . | Sukadana..... | 145331 | do..... | Not quite adult. | 475 | 665 | 165 | 4.4 | 56.0 | 26.0 | 63.4 |
| Do..... | do..... | 145332 | Female..... | Old..... | 525 | 750 | 175 | 6.0 | 61.2 | 28.3 | 67.5 |
| Do..... | do..... | 145333 | do..... | do..... | 510 | 690 | 165 | 6.9 | ..... | ..... | ..... |
| Do..... | do..... | 145334 | Male..... | Adult..... | 540 | 695 | 177 | 7.4 | 65.2 | 28.9 | 72.3 |
| Do..... | Semandang River. | 145335 | do..... | do..... | 500 | 700 | 170 | 6.4 | 59.4 | 27.0 | 70.2 |
| Do..... | Sempang River. | 145336 | do..... | do..... | 500 | 705 | 188 | 6.9 | 63.7 | 28.5 | 69.6 |
| Do..... | Batu Jurong..... | 153789 | do..... | do..... | 530 | 710 | 182 | 6.7 | 60.6 | 27.3 | 70.7 |
| Do..... | do..... | 153790 | Female..... | do..... | 495 | 690 | 170 | 7.8 | 59.2 | 28.2 | 68.7 |
| Do..... | do..... | 153791 | do..... | do..... | 500 | 670 | 165 | 7.3 | 59.4 | 26.4 | 67.9 |
| Do..... | do..... | 153792 | Male..... | do..... | 505 | 675 | 178 | 6.7 | 61.4 | 27.6 | 72.2 |
| Do..... | Kendawangan River. | 153793 | Female..... | do..... | 480 | 690 | 175 | 5.2 | 57.8 | 27.4 | 67.0 |
| Do..... | do..... | 153803 | Male..... | do..... | ..... | ..... | ..... | ..... | 59.6 | 25.7 | 68.9 |
| <i>P. rubicunda rubicunda</i> . | Balik Papan Bay. | 154364 | do..... | do..... | 485 | 660 | 175 | 6.4 | 61.9 | 28.9 | 69.6 |
| Do..... | do..... | 154365 | do..... | do..... | 500 | 690 | 171 | 6.4 | 60.0 | 27.3 | 69.2 |
| Do..... | do..... | 154366 | do..... | do..... | 510 | 670 | 179 | 6.9 | 60.3 | 27.4 | 70.9 |
| Do..... | Saratok River..... | 151826 | do..... | do..... | 520 | 695 | 180 | ..... | 62.2 | 26.6 | 71.6 |
| Do..... | do..... | 151827 | do..... | do..... | 507 | 710 | 173 | ..... | ..... | ..... | ..... |
| Do..... | do..... | 151828 | Female..... | do..... | 470 | 710 | 170 | 4.6 | ..... | ..... | ..... |
| <i>P. rubicunda carinata</i> . | Karimata Island. | 153794 | Male..... | do..... | 505 | 700 | 175 | 6.9 | 64.4 | 29.5 | 71.5 |
| Do..... | do..... | 153795 | Female..... | do..... | 510 | 710 | 172 | 7.7 | 63.9 | 29.6 | 72.0 |

¹ Collector's measurements.² Collector's measurements in pounds and quarters computed in kilograms.³ Type.

NASALIS LARVATUS (Wurmb).

1907. *Nasalis larvatus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 569, December 24, 1907.

Ten specimens from the Kapuas River region, four from southwestern and five from southeastern Borneo.

(For exact localities and measurements see table, p. 142.)

In southeastern Borneo *Nasalis larvatus* was common in the swampy lowlands at the edges (scarcely banks) of rivers and creeks. They understand the art of "sitting tight." I have often gone within a few feet of them in the Nipa Palms without noticing them.—W. L. A.

Measurements of proboscis monkeys.

| Locality | Catalogue No. | Sex. | Age. | Head and body. ¹ | Hind foot. ¹ | Tail. ¹ | Weight. ² | Basal length of skull. | Zygomatic width. | Front of canine to back of m. ³ |
|------------------------|---------------|---------------------|---------------|-----------------------------|-------------------------|--------------------|----------------------|------------------------|--------------------|--|
| Sempang River..... | 145323 | Male.... | Young adult.. | <i>mm.</i> 710 | <i>mm.</i> 230 | <i>mm.</i> 670 | <i>kgs.</i> 22.0 | <i>mm.</i> 93.7 | <i>mm.</i> 91.8 | <i>mm.</i> 40.6 |
| Do..... | 145324 | do..... | Adult..... | 715 | 230 | 665 | 19.0 | 93.8 | 93.9 | 39.3 |
| Do..... | 145325 | Female ³ | Old..... | 560 | 182 | 550 | 9.5 | 72.9 | 73.3 | 33.9 |
| Kendawangen River..... | 153802 | Male..... | Young adult.. | ..... | ..... | ..... | ..... | 94.5 | 91.7 | 44.0 |
| Pangkalahan River..... | 151816 | Female.. | Adult..... | 600 | 180 | 520 | ..... | 71.3 | 72.3 | 31.7 |
| Do..... | 151817 | do..... | do..... | 565 | 188 | 605 | 8.6 | 60.9 | 72.3 | 33.6 |
| Pamukang Bay..... | 151818 | Male..... | do..... | 680 | 215 | 660 | ..... | 95.9 | 90.4 | 39.7 |
| Balik Papan Bay..... | 154374 | do..... | Young adult.. | 690 | 228 | ..... | 19.0 | 93.9 | 93.9 | 41.8 |
| Do..... | 154375 | Female.. | do..... | 560 | 181 | 590 | 9.0 | 71.0 | 73.5 | 36.2 |

¹ Collector's measurements.² Collector's measurements in pounds changed to kilograms.³ Fetus in uterus.

HYLOBATES LEUCISCUS (Schreber).

1907. *Hylobates leuciscus*, LYON, Proc. U. S. Nat. Mus., vol. 33, p. 570, December 24, 1907.

Seven specimens from the Landak and Kapuas rivers, collected in 1905.

HYLOBATES MÜLLERI Martin.

1841. *Hylobates mülleri* MARTIN, Nat. Hist. Mamm. Anim., p. 444. Type-locality, "meridional parts of [Borneo]."

Twenty-three specimens of *Hylobates mülleri* were collected by Doctor Abbott in southwestern and southeastern Borneo. They are strikingly different in coloration from *Hylobates leuciscus* of the Kapuas River region. All of them have the crowns of the head and the hands and feet distinctly darker in color than the rest of the animal. I have been unable to find any tangible differences between the skulls of the two species, although they show many and marked individual variations. These gibbons from southern Borneo are separable into two geographic races, *H. mülleri mülleri*, from southeastern Borneo, and a new form described below. The type-locality of Martin's *H. mülleri* is simply southern Borneo. As the gibbons collected by Doctor Abbott in southeastern Borneo agree with Martin's description, especially as to the light-colored superciliary stripe not being continued down on to the face as light whiskers. The type-locality of *H. mülleri* may be restricted to southeastern Borneo.

Generally common.—W. L. A.

HYLOBATES MÜLLERI ALBIBARBIS, new subspecies.

Type.—Skin and skull of adult male, Cat. No. 145327, U.S.N.M. collected along the Matan River, a tributary to the Sempang, August 16, 1907, by Dr. W. L. Abbott. Original number, 5501.

Diagnostic characters.—A geographic race of *Hylobates mülleri* distinguished from the typical form by lighter crown patch, light-colored chin and side whiskers, and the lower back very much lighter in color than rest of upper parts.

Color.—Type: Narrow rim of hairs encircling face blackish, followed by a narrow, dirty white forehead band, widening and the individual hairs lengthening to form well-marked side whiskers and a whitish patch on throat; crown patch dark-drab color; anterior portion of back and sides, including adjacent portions of arms, a sort of drab gray; posterior portion of back and sides, pale cream buff; underparts, a blackish brown, continuous with the seal-brown color of the inner side of the arms and legs; dorsal surfaces of hands and feet blackish or blackish brown; outside of forearms and legs a sort of light clay or light isabella color. The colors everywhere are subdued and there are no abrupt changes from one color to the next. The main distinguishing color character between the gibbons of southeastern and southwestern Borneo are shown in the table below.

| Gibbons from southwestern Borneo, <i>Hylobates mülleri albibarbis</i> . | Gibbons from southeastern Borneo, <i>Hylobates mülleri mülleri</i> . |
|---|--|
| Crown patch dark brown. Lower half of back, generally light buffy in color, and arms inclining toward same color. Side and chin whiskers buffy in six out of nine specimens, brownish in the other three. Underparts, including inner side of legs and arms, blackish brown, less widely diffused. | Crown patch blackish. Lower half of back, generally wood brown in color, and arms inclining toward same color. Side and chin whiskers brownish, not conspicuously different in color from rest of animal. Underparts, including inner side of legs and arms, blackish, widely diffused. |

Skull and teeth.—I have been unable to find any characters by which to distinguish the skulls or teeth of the gibbons of one part of Borneo from those of another part of the island.

Measurements.—For external and cranial measurements of the type and series see table, page 144.

Specimens examined.—Ten, from various localities in southwestern Borneo. (For exact localities see table of measurements, p. 144.)

Remarks.—The gibbons of Borneo, as shown by Doctor Abbott's specimens, are all closely related, as is indicated in part by the lack of distinguishing characters in the skulls. *Hylobates leuciscus*, while very different in coloration from *H. mülleri*, is evidently not distantly removed. It possesses a light-colored forehead band and shows a darkening of the fingers and toes, but none of the specimens show an indication of the dark crown patch. It is not improbable that somewhere in Borneo the two forms intergrade. Doctor Abbott failed to indicate from which side of the Kapuas River his specimens were taken, but they probably came from the north bank, so that the Kapuas serves as a barrier between the two forms, as it does in the case of the *prevostii* group of squirrels. Intergradation should be looked for in the interior of the island near the sources of the Kapuas.

Measurements of gibbons.

| Name. | Locality. | Catalogue No. | Sex. | Age. | Head and body. ¹ | Hind foot. ¹ | Weight. ² | Basal length of skull. | Zygomatic width. | Front of canine to back of m_3 . ³ |
|---------------------------|----------------------|---------------|--------|--------------|-----------------------------|-------------------------|----------------------|------------------------|------------------|---|
| | | | | | mm. | mm. | kilos. | mm. | mm. | mm. |
| <i>H. m. albrbarbis</i> . | Matan River | 3145327 | Male | Old | 462 | 141 | 5.8 | 75.3 | 71.5 | 32.3 |
| Do. | do. | 145329 | do. | Nearly adult | 460 | 150 | 5.4 | 72.3 | 64.0 | 32.6 |
| Do. | do. | 145328 | Female | Adult | 497 | 149 | 6.1 | 79.6 | 68.2 | 37.8 |
| Do. | Sukadana | 145326 | do. | do. | 465 | 148 | 5.9 | 68.8 | 66.3 | 31.4 |
| Do. | Batu Jurong | 153796 | Male | do. | 468 | 137 | 4.9 | 72.7 | 65.5 | 30.0 |
| Do. | do. | 153798 | do. | Old | 470 | 145 | 6.0 | 74.2 | 66.2 | 30.4 |
| Do. | do. | 153797 | Female | Young adult | 465 | 145 | 6.8 | 70.3 | 69.2 | 31.9 |
| Do. | do. | 153799 | do. | Adult | 480 | 147 | 6.5 | 72.3 | 66.9 | 31.6 |
| Do. | Kendawan gan River. | 153800 | Male | do. | 475 | 146 | 6.5 | 76.0 | 74.0 | 34.2 |
| Do. | do. | 153801 | Female | Old | 480 | 148 | 6.2 | 75.3 | 73.2 | 31.3 |
| <i>H. m. mülleri</i> . | Klumpang Bay | 151832 | Male | Adult | 470 | 138 | 5.0 | 70.9 | 68.0 | 31.5 |
| Do. | do. | 151834 | do. | Old | 510 | 158 | 6.8 | 80.7 | 71.9 | 33.8 |
| Do. | do. | 151835 | do. | do. | 460 | 138 | 5.0 | 72.3 | 64.6 | 32.2 |
| Do. | do. | 151833 | Female | Adult | 470 | 144 | 5.8 | 72.8 | 68.9 | 32.0 |
| Do. | do. | 151836 | do. | do. | 465 | 135 | 4.6 | 72.0 | 66.7 | 32.9 |
| Do. | Pangkallah an River. | 151837 | Male | do. | 485 | 143 | 5.2 | 75.0 | 70.5 | 35.0 |
| Do. | do. | 151838 | Female | Young adult | 470 | 140 | 5.9 | 70.8 | 66.9 | 31.2 |
| Do. | do. | 151839 | do. | do. | 388 | 130 | 3.3 | 63.0 | 68.7 | 29.0 |
| Do. | Pasir River | 154369 | do. | do. | 435 | 135 | 4.2 | 65.1 | 63.7 | 28.2 |
| Do. | Balik Papan Bay. | 154370 | Male | Adult | 440 | 135 | 5.2 | 68.0 | 70.4 | 29.4 |
| Do. | do. | 154371 | Female | do. | 470 | 140 | 5.4 | 74.5 | 66.2 | 31.3 |
| Do. | do. | 154372 | do. | Old | 450 | 143 | 5.4 | 72.0 | 68.5 | 33.2 |
| Do. | do. | 154373 | do. | do. | 460 | 135 | 5.6 | 69.0 | 63.0 | 32.6 |

PONGO PYGMÆUS PYGMÆUS (Linnæus).

1763. *Simia pygmæus* LINNÆUS, *Amœnitates Academicæ*, vol. 6, p. 68.

1901. *Pongo pygmæus pygmæus*, ROTHSCILD, *Proc. Zool. Soc. London*, 1904, vol. 2, p. 438.

1906. *Pongo pygmæus pygmæus*, LYON, *Proc. U. S. Nat. Mus.*, vol. 33, p. 571, December 24, 1907 (26 specimens from the Landak region).

Orangs are represented by forty-eight specimens from southwestern Borneo in Doctor Abbott's recent collections, sixteen as skins and skulls and the remainder as skulls obtained from the natives. (For a list of specimens with the exact localities see table, p. 145. Immature or imperfect specimens among the skulls obtained from natives are not included in the table). No orangs were obtained in southeastern Borneo, Doctor Abbott remarking, "There are no orang-utans. They do not occur south of the Mahakam (also Mehakam, Mehakkam, or Koetei, Kutei, Koti) River,⁵ but are said to be common to the northward of it."

I have been unable to discover any differences between orangs from the Landak River region and those from southwestern Borneo. In fact, it is with great difficulty that I have been able to find any

¹ Collector's measurements.

² Collector's weight in pounds, computed to kilograms.

³ Type.

⁴ This specimen has a tooth posterior to m_3 on both right and left sides, and posterior to m_3 on left side. The supernumerary teeth are well developed and functional, each about half the size of the tooth in front.

⁵ This river is not shown on the map, p. 57, but lies about as far north of Balik Papan Bay as the Pasir River is south.

tangible differences between the oranges of northern Sumatra¹ and those from western Borneo. This difficulty is no doubt due in part to the bulkiness of the specimens and the resulting inability to get a view of both series as a whole, as can so readily be done with small mammals in a tray. The Bornean oranges, however, appear to be slightly larger externally and cranially; to be lacking nails on the great toes almost entirely; to have a less conspicuous beard; and to possess less hair about the head and neck generally.

Illustrations of the head of a freshly killed male, and the entire body, and of the head of a freshly killed female are shown on plates 5, 6, and 7.

Measurements of oranges.

| Sex and age. | Locality. | Catalogue No. | Crown of head to sole of foot. ² | Head and body. ² | Hind foot. ² | Weight. ³ | Basilar length of skull. | Zygomatic width. | Mastoid width. | Upper toothrow, including canine (alveol.). | With nails on great toes. | Without nails on great toes. | |
|--|--------------------|---------------|---|-----------------------------|-------------------------|----------------------|--------------------------|------------------|----------------|---|---------------------------|------------------------------|-------|
| | | | <i>mm.</i> | <i>mm.</i> | <i>mm.</i> | <i>kilos</i> | <i>mm.</i> | <i>mm.</i> | <i>mm.</i> | <i>mm.</i> | | | |
| Male, adult | Semandang River | 145301 | 1,410 | 957 | 355 | 200 | 168 | 173 | 147 | 70 | ..... | + |  |
| Male, young, <i>m</i> ³ not visible. | Sempang River | 145303 | 1,055 | 680 | 267 | 66 | 124 | 126 | 122 | 453 | ..... | + |  |
| Male, adult | do | 145304 | (⁵) | (⁵) | (⁵) | 180 | 180 | 174 | 142 | 70 | ..... | + |  |
| Male, adult, rather old | Matan River | 145305 | 1,400 | 968 | 335 | 175 | 183 | 173 | 156 | 71 | ..... | + |  |
| Male, young, <i>m</i> ³ not through alveolus. | do | 145307 | 1,150 | 735 | 290 | 75 | 141 | 132 | 122 | 68 | ..... | + |  |
| Male, adult | do | 145310 | ..... | ..... | ..... | ..... | 181 | 175 | 154 | 70 | ..... | + |  |
| Male, adult, rather old | Semandang River | 145313 | ..... | ..... | ..... | ..... | ..... | 183 | 147 | 74 | ..... | ..... |  |
| Male, adult | do | 145314 | ..... | ..... | ..... | ..... | ..... | 178 | ..... | 71 | ..... | ..... |  |
| Do | Sempang River | 145316 | ..... | ..... | ..... | ..... | ..... | 179 | 161 | 75 | ..... | ..... |  |
| Male, adult, rather old | do | 145317 | ..... | ..... | ..... | ..... | ..... | 182 | 176 | 145 | ..... | ..... |  |
| Male, adult | do | 145318 | ..... | ..... | ..... | ..... | ..... | 178 | 172 | 76 | ..... | ..... |  |
| Male, adult, rather young. | Kendawangan River. | 153806 | | | | | | 165 | 155 | 111 | 74 | | |
| Do | do | 153807 | | | | | | | 165 | 118 | 77 | | |
| Male, adult | do | 153816 | ..... | ..... | ..... | ..... | ..... | 174 | 168 | 666 | ..... | ..... |  |
| Do | do | 153823 | 1,390 | 970 | 335 | 200 | 168 | 167 | 154 | 70 | ..... | + |  |
| Male, adult, rather young. | Mambuluh River | 153827 | ..... | ..... | ..... | ..... | ..... | 160 | 157 | 69 | ..... | ..... |  |
| Female, adult | Sempang River | 145300 | ..... | 745 | 285 | 72 | 129 | 128 | 118 | 56 | ..... | + |  |
| Do | Semandang River | 145302 | ..... | 820 | 290 | 100 | 144 | 139 | 124 | 60 | ..... | + |  |
| Do | Matan River | 145306 | | 1,160 | 770 | 295 | 82 | 141 | 113 | 121 | 63 | | + |
| Do | Sempang River | 145308 | | 1,200 | 805 | 310 | 872 | 151 | 141 | 124 | 65 | | + |
| Do | do | 145309 | | | | | | 134 | 129 | 122 | 64 | | + |
| Do | Semandang River | 145315 | ..... | ..... | ..... | ..... | ..... | 134 | 122 | 62 | ..... | ..... |  |
| Do | Sempang River | 145320 | | | | | | 130 | 129 | 121 | 62 | | |
| Do | do | 145321 | | | | | | | 133 | 129 | 61 | | |
| Do | Batu Jurong | 153805 | 1,160 | 785 | 262 | 788 | 129 | 127 | 116 | 62 | ..... | + |  |
| Do | Kendawangan River. | 153809 | ..... | ..... | ..... | ..... | ..... | ..... | 133 | 62 | ..... | ..... |  |
| Do | do | 153818 | | | | | | 130 | 139 | 122 | 63 | | |
| Female, adult, rather old. | do | 153820 | ..... | ..... | ..... | ..... | ..... | 141 | ..... | 65 | ..... | ..... |  |
| Female, young, <i>m</i> ³ not through alveolus. | do | 153821 | ..... | 740 | 270 | 776 | 117 | 121 | 120 | 49 | ..... | + |  |
| Female, adult | do | 153822 | 1,065 | 755 | 250 | 860 | 125 | 123 | 112 | 59 | ..... | + |  |
| Female, young, <i>m</i> ³ level with alveolus. | do | 153824 | 1,200 | 770 | 280 | 81 | 126 | 123 | 122 | 64 | ..... | + |  |
| Female, adult | Mambuluh River | 153828 | | | | | | 137 | 131 | 118 | 65 | | |

¹Lyon Proc. U. S. Nat. Mus., vol. 34, p. 676, September 14, 1908.

²Collector's measurements.

³Collector's measurements in pounds and quarters computed to kilograms.

⁴*m*³ not included.

⁵"In rigor mortis, impossible to measure."

⁶"Teeth unusually small."

⁷"Fat."

⁸"Gutted."

EXPLANATION OF PLATES.

PLATE 1.

(About one-third natural size.)

- FIGS. 1 and 3. Skull of type of *Muntiacus rubidus*, Cat. No. 151863, U.S.N.M., Pamukang Bay, southeastern Borneo, p. 73.
 2 and 4. Skull of *Muntiacus pleiharicus*, Cat. No. 154384, U.S.N.M., Pamukang Bay, southeastern Borneo, p. 71.

PLATE 2.

(About one-third natural size.)

- FIG. 1. Skull of *Muntiacus pleiharicus*, Cat. No. 154384, U.S.N.M., Pamukang Bay, southeastern Borneo, p. 71.
 2. Skull of type of *Muntiacus rubidus*, Cat. No. 151863, U.S.N.M., Pamukang Bay, southeastern Borneo, p. 73.

PLATE 3.

(About one-fourth natural size.)

Antlers of Bornean muntjacs collected by Dr. W. L. Abbott in southwestern Borneo.

- FIG. 1. Cat. No. 153772, U.S.N.M., Kendawangan River.
 2. Cat. No. 153762, U.S.N.M., Kendawangan River.
 3. Cat. No. 153756, U.S.N.M., Kendawangan River.
 4. Cat. No. 153763, U.S.N.M., Kendawangan River.
 5. Cat. No. 145364, U.S.N.M., Sempang River.
 6. Cat. No. 153766, U.S.N.M., Kendawangan River.
 7. Cat. No. 153764, U.S.N.M., Kendawangan River.

PLATE 4.

Squirrels of the *Sciurus prevostii* group collected by Dr. W. L. Abbott on the Bornean mainland (slightly more than one-fourth natural size; reproduced directly from the specimens), pp. 79 to 81.

- FIG. 1. *Sciurus borneoensis palustris*, adult male, Cat. No. 142331, U.S.N.M., Kapuas River, north bank near mouth, western Borneo, September 23, 1905.
 2. *Sciurus borneoensis borneoensis*, adult male, Cat. No. 142308, U.S.N.M., Kapuas River, north bank, at Sanggau, western Borneo, August 25, 1905.
 3. *Sciurus sanggaus*, adult female, Cat. No. 142328, U.S.N.M., Kapuas River, south bank, September 20, 1905.
 4. *Sciurus atricapillus*, adult female, Cat. No. 154292, U.S.N.M., Balik Papan Bay, southeastern Borneo, February 19, 1909.

PLATE 5.

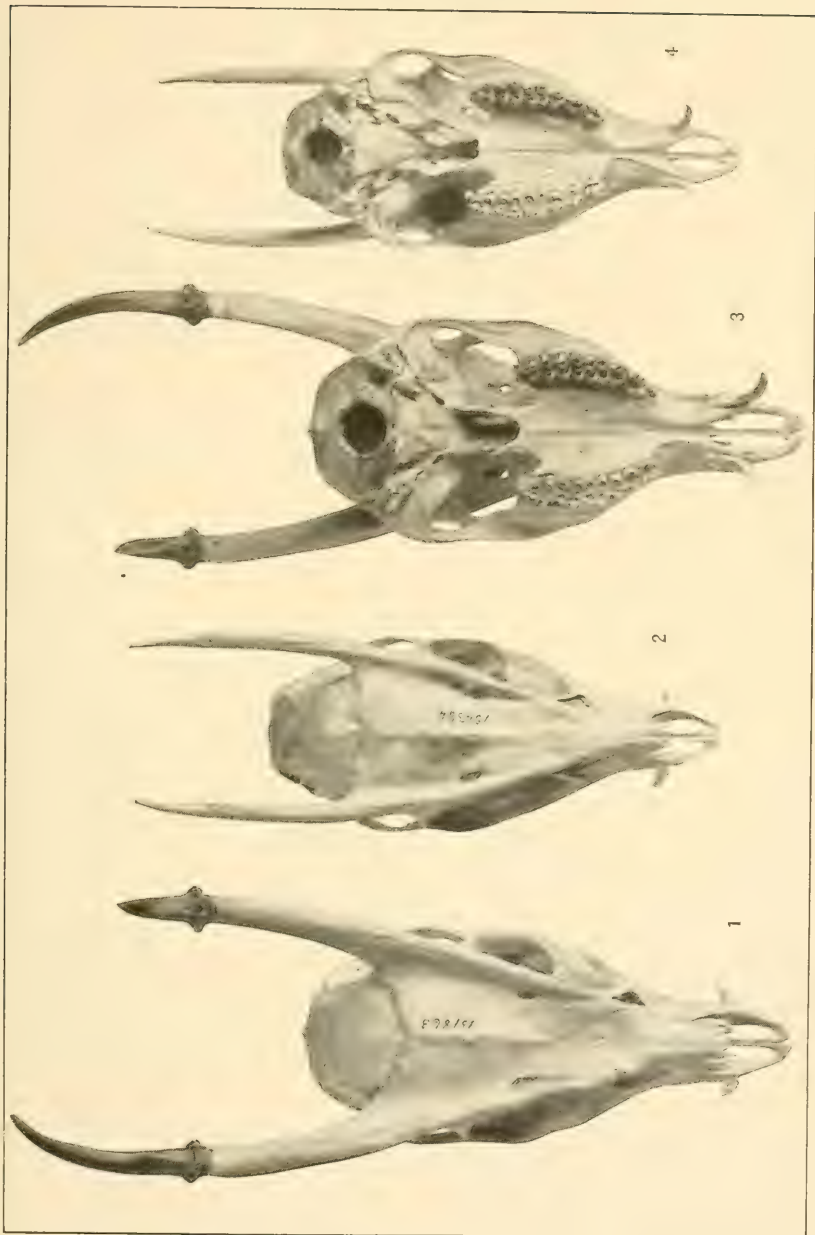
Head of a freshly killed adult male Bornean orang utan, photographed by Dr. W. L. Abbott, p. 144.

PLATE 6.

Freshly killed adult male Bornean orang utan, photographed by Dr. W. L. Abbott, p. 144.

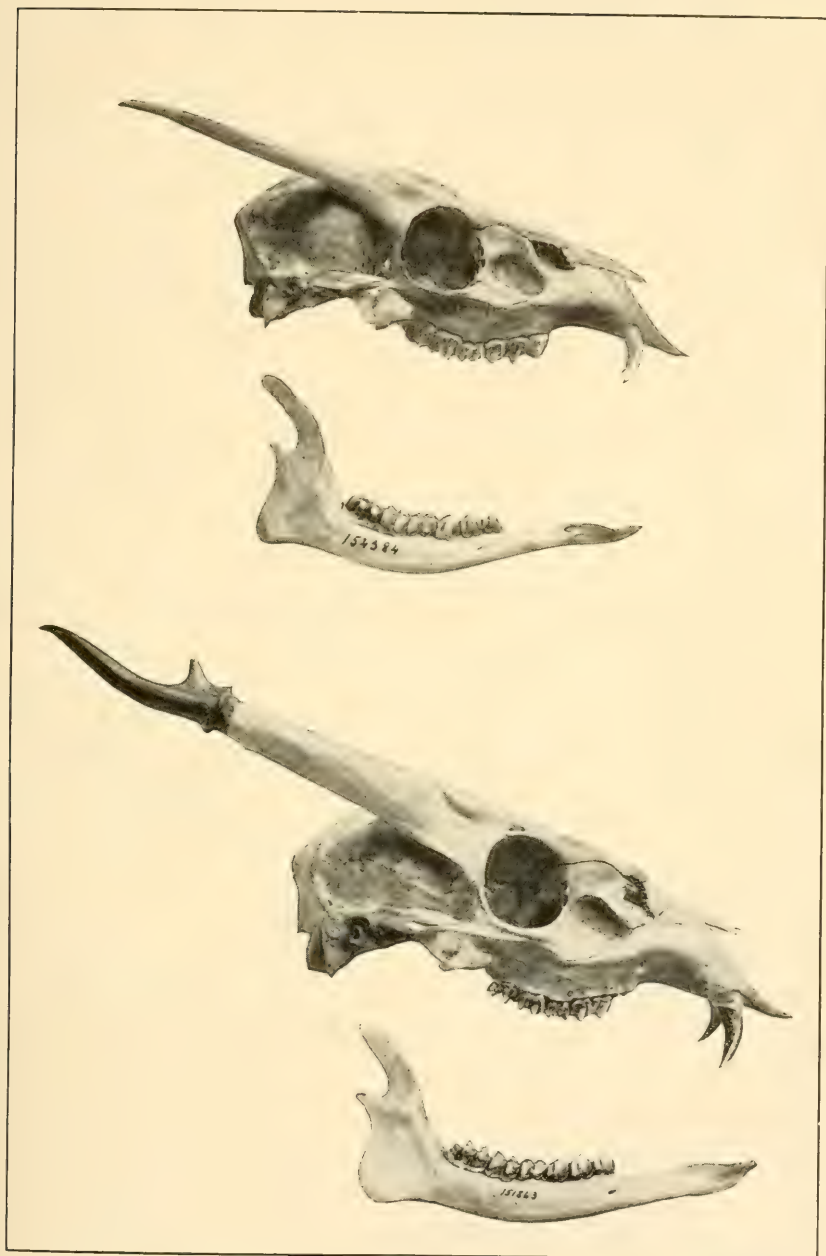
PLATE 7.

Head of a freshly killed adult female Bornean orang utan, photographed by Dr. W. L. Abbott, p. 144.



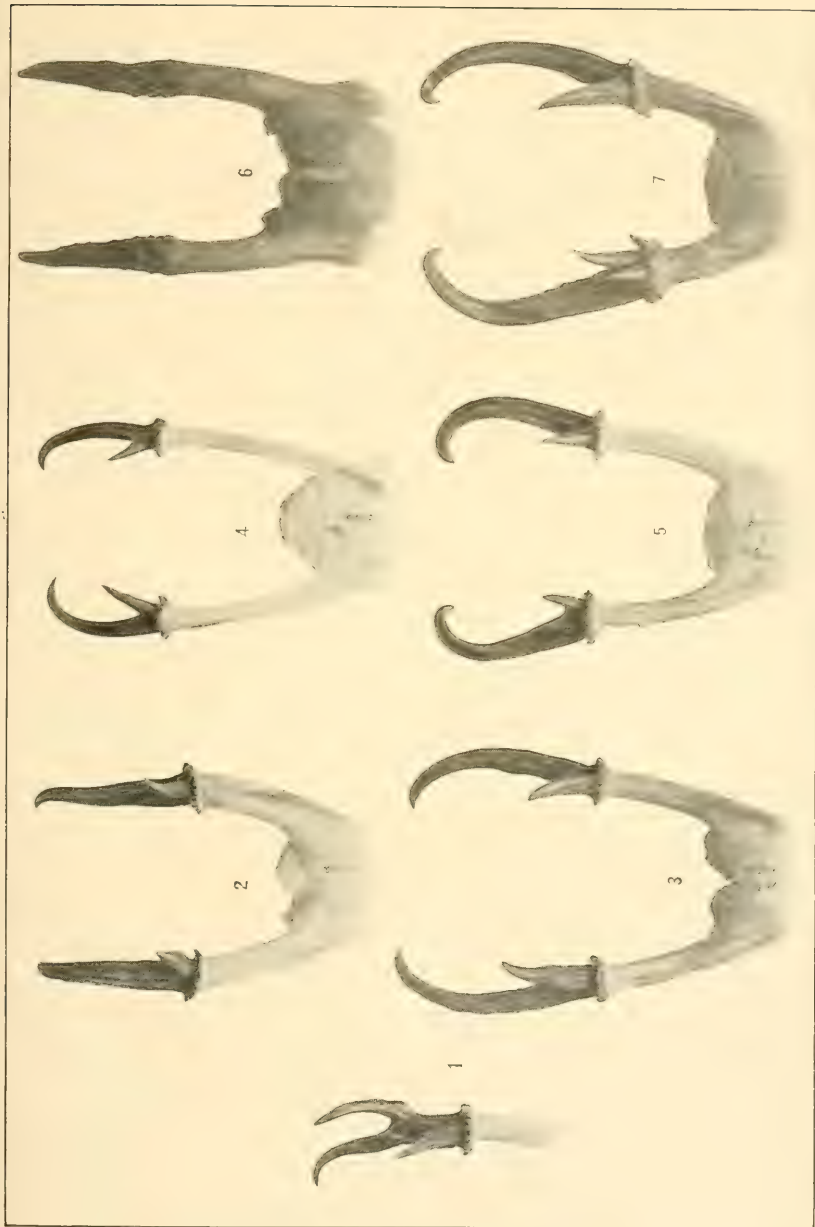
SKULLS OF BORNEAN MUNTJACS.

FOR EXPLANATION OF PLATE SEE PAGE 146.



SKULLS OF BORNEAN MUNTJACS.

FOR EXPLANATION OF PLATE SEE PAGE 146.



ANTLERS OF BORNEAN MUNTJACS.

FOR EXPLANATION OF PLATE SEE PAGE 146.



SQUIRRELS OF THE SCIURUS PREVOSTII GROUP



MALE BORNEAN ORANG UTAN.

FOR EXPLANATION OF PLATE SEE PAGE 146.



ADULT MALE BORNEAN ORANG UTAN.

FOR EXPLANATION OF PLATE SEE PAGE 146.



FEMALE BORNEAN ORANG UTAN.

FOR EXPLANATION OF PLATE SEE PAGE 146.

NOTES ON THE DISTRIBUTION OF MILLIPEDS IN SOUTHERN TEXAS, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES FROM TEXAS, ARIZONA, MEXICO, AND COSTA RICA.

By O. F. COOK,
Of the U. S. Department of Agriculture.

DISTRIBUTION OF MILLIPEDS IN SOUTH TEXAS.

The millipeds and other primitive types of humus-inhabiting arthropoda constitute a living summary of the biological conditions and history of the soil. The environmental limitations of the millipeds render this group of animals especially interesting from the standpoint of geographical distribution. It is impossible for these creatures to exist or to extend their distribution over areas where there are no accumulations of humus or other vegetable débris that can retain a permanent supply of moisture. As these animals are unable to fly, or even to run with rapidity, and can not endure exposure to extremes of light, heat, or drought, they afford unusually direct evidence regarding the earlier extension of forests or other conditions that would determine their geographical distribution.

Attention has been called in a previous publication to the persistence of tropical types of humus-inhabiting organisms in certain localities in south Texas, as an evidence of permanent moisture in the soil. The existence of such oases of permanently moist humus in regions where desert conditions otherwise appear so nearly universal has been taken to indicate a much greater extension of forest growth in south Texas in former times. Without assuming a previous extension of forest conditions it is difficult to imagine how animals that require permanently moist humus could have reached the isolated localities where they now exist.¹

Reference was made in a previous paper to a spot a little to the northeast of the town of Falfurrias, Texas, as one of these oases where the existence of permanent moisture had made possible the survival of

¹Change of Vegetation on the South Texas Prairies. Circular No. 14, Bureau of Plant Industry, U. S. Department of Agriculture, 1908.

several very small and delicate humus-inhabiting creatures, such as *Scolopendrella*, *Pauropus*, *Japyx*, and *Campodea*. The finding of a relatively large tropical milliped (*Eurelus*, new genus, order Anocheta) in the same locality, may be taken to indicate that permanent moisture has not been confined to the lower layers of the soil, but has existed practically on the surface. Though these larger millipeds are undoubtedly able to endure much more exposure to dry air than the smaller and more delicate types mentioned above, they can hardly be expected to survive any such complete exposure as would follow the destruction of all the forest growth. The more minute animals are able to crawl into small cracks and interstices, and thus take advantage of any moisture that exists, even at considerable depths. The evidence of continuous humidity is strengthened by the finding of relatively large species of millipeds that remain nearer to the surface.

These facts indicate that some of the present forest growth in the vicinity of Falfurrias is not of recent origin, but may represent a remnant of earlier and more continuous forests. There is a rather densely wooded area to the northeast of Falfurrias, consisting of a slight depression where the water collects after rains and stands in small pools long enough apparently to prevent the growth of grasses, and thus to give protection against the prairie fires that might otherwise have destroyed the woody growth and obliterated the last traces of the millipeds and other humus-inhabiting types of animal life.

The existence of any form of arthropod life in the soils of south Texas is in striking contrast with the black-land prairies farther north, those that form the so-called "hog wallows." The soil of the black-land prairies is remarkably devoid of life of any sort; even the agricultural ants are unable to occupy the typical black-land prairie. The soil cracks during drought to the depth of several feet, and then dissolves into a very adhesive, pasty mud when the rain comes. Delicate animals would find no protection in drought, and the more hardy would be drowned or smothered in their burrows in times of floods. One group of large heavily armored millipeds of the order Diplocheta is able to live in deserts of west Texas and Arizona by virtue of their habit of burrowing, taking advantage also of the deep excavations of the burrowing rodents that are so abundant in the deserts.

The preservation of even a remnant of permanent forest in such a place as Falfurrias under present climatic conditions might not strike the observer as being at all probable, were it not for the concrete evidence afforded by the existence of these animals. Local opinion declares that this district has become distinctly drier in the last twenty years. Surface wells and pools that were formerly relied upon to furnish permanent supplies of water for stock have completely dried out, in the last decade, over a considerable section. This has

been ascribed, of course, to a deficiency of rainfall, though there are no records to establish the fact, and other factors may be responsible.

The extension of grazing and the limitations of forest fires has allowed woody vegetation to spread in recent years over large tracts of land that were formerly covered with heavy growths of grass. It is known that little water, relatively speaking, enters the naked surfaces of the soil when the land is occupied by the usual sparse growth of mesquite, prickly pear, and other desert vegetation. The formerly more heavy and general growth of grass may have afforded more favorable conditions for holding water on the surface and allowing it to soak gradually into the soil. With ordinary gentle rains the effect of grass is, of course, to keep the soil dry, but with the very heavy rains that come occasionally in south Texas, nearly level grass-covered areas might be expected to hold the water longer than denuded surfaces, and give it a better opportunity to penetrate to the lower layers of the soil.

The recent open growth of mesquite probably represents the most unfavorable condition for the retention of water in the soil. With sufficiently old and abundant forest growth to accumulate fallen timber and other débris, obstacles to drainage would be formed and the earth would be shaded from the sun. Conditions would again become more favorable to the retention of permanent moisture, and many areas would eventually change from naked deserts into humid forests or swamps. Tendencies in this direction begin to appear in the region of Brownsville. The finding of another new genus of tropical millipeds near Brownsville serves as an additional indication that present tendencies are only a return toward a former condition of much more abundant forest growth in south Texas.

The rapidity with which these prairies are now being covered with woody vegetation is a further indication that the previous treeless condition did not represent the natural state of the country, but might be ascribed to the same agencies that have exterminated forests in many parts of Mexico and Central America. Lands that have been cleared by the natives for agricultural purposes eventually become occupied by perennial grasses that put an end to agriculture, as practiced by primitive Indian methods. The burning of accumulations of dead grass kills young trees and thus hinders or prevents the extension of forests. Large areas that are naturally well adapted to forests have been gradually denuded into artificial deserts or grassy fire-swept tracts, now quite unoccupied by human inhabitants, and more or less completely devoid of millipeds and other humus-inhabiting types of arthropoda.

On the other hand, many areas now covered with heavy growth do not represent truly virgin or primeval forests. The absence or scarce representation of the humus-inhabiting animals shows that many

EURELUS, new genus.

Type.—*Eurelus soleatus*, a new species from south Texas.

Diagnosis.—More nearly related to *Onychelus* than to any other recognized genus. Differs in the much greater size and more fusiform shape of the body, in having the anterior legs of the males armed with large coxal processes, but without enlarged claws, and in the very different structure of the copulatory legs.

Description.—Body rather large and robust, about nine times as long as broad, subfusiform in outline, gradually narrowed in front and more abruptly behind, especially the last five segments.

Antennæ moderately robust, not clavate; second joint longest; joints 3-5 subequal; joint 6 somewhat shorter and narrower than joint 5. Antennæ not inserted under the first segment, but accommodated by a large lateral depression of the head and the mandibular stipe. In comparison with *Onychelus* the antennæ appear more slender, and the sixth joint does not appear to be reduced in that genus. Olfactory cones four in both genera.

Eyes of over 40 closely clustered, flattened ocelli, arranged in seven or eight rows.

First segment rather strongly emarginate on each side behind the antennæ and the somewhat prominent posterior corner of the mandibular stipe. Lateral angle acute, with a prominent, thickened anterior margin. The groove that bounds the margin remains very distinct as far up as the middle of the eye and then suddenly disappears. Second segment not produced below the somewhat projecting angle of the first segment.

Segments of middle of body with only a slight and rather indistinct constriction between the midbelt and the hindbelt. Forebelt with very fine and somewhat broken striations extending slightly beyond the very indistinct anterior suture. Midbelt and hindbelt marked on the surface with the same minute punctations, but somewhat more numerous on the midbelt. Posterior suture usually indicated by a fine superficial striation. Median suture indicated by a very fine and indistinct striation, not grooved on the hindbelt as in *Onychelus*. Ventral striations beginning well below the pores, especially on posterior segments; extending farther up on the midbelt than on the hindbelt, but more irregular and passing below into a fine reticulation; all these ventral markings much more distinct than in *Onychelus*.

Repugnatorial pores inconspicuous, located above the middle of the segments, though hardly as far above as in *Onychelus*; on or in contact with posterior suture, usually below the lateral suture, but in contact with it or nearly so, the suture being sometimes slightly sinuate above the pore. The pores of the sixth segment are distinctly lower

down than those of the seventh and subsequent segments and are distinctly separated from the lateral suture. The aperture of the pore is not surrounded by a raised rim, and the lateral suture is not marked by a distinct groove behind the pore as in *Onychelus*. In *Onychelus* the pore is set in a distinct depression and there often appears to be a rim or a minute papilla in the depression.

Supplementary margin shorter than in *Onychelus* and the surface apparently plain, instead of longitudinally grooved or fluted. With sufficient magnification very fine longitudinal striations appear, and a fringe of minute needle-like teeth.

Pleural sutures indistinct, indicated only by a slight interruption or greater irregularity of the reticular striations.

Sterna subquadrate, but distinctly broader in front; surface with distinct close striations, not reaching the ventral sutures. The striations are much more distinct and more numerous than in *Onychelus*, and the sutures are not so nearly parallel as in that genus. Spiracles set in distinct excavations.

Last segment very short, with a short broadly rounded apex, slightly exceeded by the anal valves.

Anal valves strongly and evenly convex, not thickened nor prominent along the margins which meet in a broad groove. Surface rather coarsely wrinkled, instead of smooth and shining, as in *Onychelus*. Preanal scale very broadly and evenly rounded, as in *Onychelus*, the surface rugose like the valves.

Males with claws of anterior legs not specially enlarged as in *Onychelus*, except the first three pairs. The next four pairs have the claws reduced, smaller than those of the segments behind the gonopods.

Coxæ of third pair of legs of male produced into very long flattened appendages with a sharp double curve near the middle, ending in heavily chitinized shoe-shaped process.

Coxæ of fourth, fifth, and sixth pairs of legs of male produced into much shorter, flattened, thin-edged processes, bent backward and covered by the long process of the third legs.

Coxæ of sixth pair of legs of male with broad, thick subquadrate straight processes which project behind the ends of the long processes of the third legs.

Coleopods with ventral plate produced in the middle into a very broadly triangular-quadrate process with a very short, broadly angular apex greatly exceeded by the abruptly produced median corners of the strongly transverse anterior lobes, which completely conceal the posterior lobes, as well as the gonopods, both of which are distinctly exposed from in front in *Onychelus*.

Gonopods ending in a short, expanded, concave, somewhat hand-shaped process, not in a recurved bidentate spine as in *Onychelus*.

Coalesced pleuræ of seventh segment of male crossed by a relatively slight, straight ridge, not carried up into a fold-like, arcuate crest, as in *Onychelus*.

The narrowing of the first segment at the sides in *Eurelus* and *Onychelus* does not result from a change in the anterior margin, which is much the same as in *Arctobolus*. The principal difference lies in the much straighter posterior margin of *Eurelus* which does not curve back from the lateral angle of the segment, as in *Arctobolus*, but passes directly upward.

EURELUS SOLEATUS, new species.

Type.—Cat. No. 801, U. S. National Museum. Collected at Falfurrias, Starr County, Texas, August, 1906, by O. F. Cook.

Length of male about 65 mm., width nearly 8 mm. Number of segments 48.

Color in life, dull olive brown with somewhat grayish posterior margins, not at all reddish or yellowish, as in *Arctobolus*. On being placed in alcohol the dark bands appear darker and the light bands lighter, and the contrast accordingly much greater, as though black and pale yellow.

With age the alcoholic specimens become very dark, blackish-green, with the margins of the segments paler, and appearing yellowish or brownish if the specimens begin to dry out. The first segment and the dorsal part of the last segment appear distinctly paler than the others, both in the fluid and out.

Clypeal foveolæ five on each side, sometimes only four; surface of clypeus and vertex with rather remote, irregularly scattered wrinkles, otherwise smooth and shining.

Eyes rounded-polygonal, 43 or 44 ocelli, arranged in nearly vertical, somewhat curved rows, counted as follows, beginning at the back: 6, 7, 8, 7, 6, 6, 4. In the other eye of the same specimen the arrangement of the ocelli seemed to be 5, 6, 7, 7, 7, 6, 4, 1. In an eye of *Onychelus obustus* the ocelli were counted in rows of 5, 5, 6, 6, 5, 3.

First segment with three or four short irregular striations above the lateral angle, not present in *Onychelus obustus*. The angle is more pointed than in *Onychelus*, and the anterior thickened margin is broader and more prominent and also more distinctly sinuate because of the deeper emargination.

Second segment with a distinct raised flange along the anterior ventral margin, but not nearly so prominent as in *Onychelus*.

Surface of segments with a rather dull luster, minutely punctate over all the exposed surface, but somewhat more on the midbelt than on the hindbelt, which becomes slightly more prominent on the sides and below, and may then have the surface roughened by indistinct granules or by irregular shallow, seal-like depressions, above the regular ventral striations.

Last segment punctate like the others except along the margins, where it tends to become rugulose like the anal valves. The very much shortened and narrowed segments at the end of the body are also more minutely and indistinctly punctate.

The anal valves are both punctate and rugose, the prominent wrinkles being marked very often with distinct punctations.

The same number of the segments, 48, was counted in four normal individuals. A fifth specimen had only 47 segments and one of these, the ninth, was distinctly shorter than its neighbors and was fused with the tenth for a short distance; near the middle of the back.

The repugnatorial secretion appeared unusually abundant and was exuded very promptly, as soon as the animals were caught. Numerous specimens were found crawling about on damp ground in a field of sorghum a short distance to the northeast of the village of Falfurrias, Starr County, Texas. The species is evidently rare, or at least not generally distributed, even in the immediate vicinity, for no more specimens have been found in many subsequent visits that have been made to the same neighborhood.

Single individuals of *Eurelus* have been found in two other localities in south Texas, one collected near San Antonio by Mr. W. P. Carr and another at Moore, Frio County, about 40 miles southwest of San Antonio, by Mr. F. L. Lewton.

A NEW GENUS FROM MEXICO, RELATED TO EURELUS.

The U. S. National Museum contains four specimens of a small milliped labeled as *Spiroboldus nietanus*, Guanajuato, Mexico, probably identified by Bollman.

These specimens are of interest as very near relatives of *Eurelus*. Though hardly to be reckoned as members of the same genus, the agreement is more complete than with any other type thus far known. The form of the copulatory apparatus is much the same and the third legs of the male are provided with coxal processes. The following diagnosis and description refer mostly to the features in which this Mexican type appears to diverge from *Eurelus*.

CENTRELUS, new genus.

Type.—*Centrelus falcatus*, a new species from Guanajuato, Mexico.

Diagnosis.—Closely related to *Eurelus*. Differs in having the body smaller, more slender and more cylindrical, the sterna narrower, and the ventral striations very few and subtended by large curved spines, especially on the posterior half of the body.

Description.—Body rather small and slender, ten or twelve times as long as broad, cylindrical, slightly wider in front, narrowed rather gradually behind.

First segment with the thickened anterior edge slightly emarginate near the somewhat rounded lateral angle, and limited by a deep, slightly sinuate groove. Posterior edge not emarginate, marked with three or four short strictions like those of the other segments.

Segments of middle of body with no distinct constriction. Forebelt with very fine, indistinct striations not extending beyond the anterior suture except below. Midbelt and hindbelt nearly smooth, the hindbelt not thickened nor convex. Posterior and median sutures indicated by very fine superficial striations, especially the median. Ventral striations very few and remote, not ascending more than half way to the pores, even on posterior segments. The surface is very prominent below each of the first four or five striations and the angle of the prominence is produced into a sharp upcurved spine, especially on the segments behind the middle of the body. The spined striations are interrupted at the posterior suture instead of passing over to join a reticular ornamentation of the midbelt as in *Eurelus*. Only the pleuræ have the fine close longitudinal striations of the usual sort.

Repugnatorial pores very minute, set in distinct depressions above the middle of the segments, distinctly behind the posterior suture, and unusually close to the margin of the segment. Lateral suture usually indicated by a very fine groove behind the pore; seldom indicated on midbelt but very distinct on forebelt and interrupting the concentric striations.

Supplementary margin short, minutely pectinate along the edge.

Pleural suture very distinct along the forebelt and midbelt, not indicated on the hindbelt; surface of pleuræ with very obscure, transverse striæ and reticulations in front, longitudinally striate behind.

Sterna quadrate, scarcely broader than long, but the sutures distinctly excurved near the anterior corners; rather closely covered with obscure striations. Spiracles situated in front of a small depression.

Last segment very short, the broadly rounded apex distinctly exceeded by the very convex anal valves.

Males with claws of the anterior legs distinctly reduced, but the first two pairs with strong claws.

Coxæ of third pair of legs of male with large strongly chitinized processes abruptly geniculate near the base and then prolonged into a recurved falcate armature.

Coxæ of legs 4, 5, and 6 with large flattened obliquely truncate processes, the outer corner slightly produced and the inner provided with a small narrow, abruptly incurved branch. The same legs have the second and especially the third joints swollen into conical prominences on the lower side.

Coxæ of seventh pair of legs with a simple triangular-conic process, longer and thicker than those of the preceding legs.

Coleopods with ventral plate very large, subquadrate, occupying more than half of the anterior surface, but rather poorly chitinized; margin nearly transverse, slightly angled in the middle, but not produced. Anterior lobes broadly and deeply emarginate, the mesial corners produced, much as in *Eurelus*, but broader and distinctly curved outward. Posterior lobes also somewhat broader and stronger than in *Eurelus*.

Gonopods very small and deeply retracted.

Coalesced pleuræ of the seventh segment of male forming a very deep sinus behind and with the anterior face carried up into a narrow transverse ridge much more prominent than in *Eurelus*.

CENTRELUS FALCATUS, new species.

Type.—Cat. No. 800, U. S. National Museum, Guanajuato, Mexico.

Length of male about 38 mm., width about 3 mm.; female about 42 mm. by 4.5 mm.

Color in alcohol dull olive or grayish green, the segments with a pale posterior margin behind an equally short black band. Antennæ and legs of the same color as the segments, but the head and last segment somewhat paler.

Clypeal foveolæ 4 on each side, at nearly equal distances; outer pair located on the lower margin of the clypeus. Surface of clypeus and vertex smooth, except for slight depressions and a few fine irregular striations.

Eyes somewhat oval or trapezoidal, of over 40 ocelli counted in eight nearly vertical rows from the back toward the antennæ, 4, 5, 6, 6, 6, 5, 3, or in 7 obliquely transverse rows from above downward 3, 5, 7, 8, 7, 6, 5.

First segment with the anterior emargination not so broad and deep as in *Eurelus soleatus*, the marginal ridge broader and the lateral angle more rounded, not projecting below the second segment as in *Eurelus*.

Second segment with the anterior margin decurved, much as in *Eurelus*.

Surface of segments nearly smooth, shining with a dull luster, very finely and indistinctly punctate and longitudinally striate above; lateral and ventral striations very short, confined to the hindbelt; surface convex below each striation. Segments behind the middle of the body have the striations remote, only three or four on each side, and produced into distinct sharp spines, curving obliquely upward. Several of the posterior segments have the spines reduced.

Last segment smooth, the apex very broadly triangular-rounded, distinctly exceeded by the strongly convex smooth anal valves. Preanal scale very broadly rounded.

Four specimens were examined, a male being selected as type. All four were in a broken condition, so that the proportions of the body and the numbers of segments could not be stated with certainty, though the matching of the pieces allowed the same number of segments to be counted in all four cases.

This species is evidently very distinct from *Spirobolus nictanus* Saussure, which Pocock has recently transferred to his genus *Cyclothryphorus*.

Genus ONYCHELUS Cook.

Onychelus Cook, Myriapoda of Northwestern America, Harriman Expedition, p. 67.

The type of this genus, *O. obustus*, was from the Colorado desert of California. Specimens now in the National Museum seem to represent three additional species of *Onychelus* from the deserts of Arizona. When the original description was drawn *Onychelus* appeared to have no close relatives in the North American fauna. Several points of difference between *Onychelus* and its undiscovered relatives were not anticipated in the original description. Several additional peculiarities of *Onychelus* have been noted in comparing it with *Eurelus*, as the description of that genus will show.

ONYCHELUS HOSPES, new species.

Type.—Cat. No. 803, U. S. National Museum, collected at Tucson, Arizona, December 23, 1896, by H. G. Hubbard, in the nest of a rat (*Neotoma albigula*).

Diagnosis.—Distinct from *Onychelus obustus* in the smaller size of the body and in the position of the transverse constriction of the segments.

Description.—Body about 25 mm. long by 2.5 mm. in diameter, probably composed of 41 or 42 segments. All the specimens are broken and may not be fully mature.

Color nearly black, with pale posterior margins.

Clypeal foveolæ four on each side.

Eyes composed of about 33 ocelli arranged in an oval cluster of seven rows: 3, 6, 6, 6, 5, 4, 3.

First segment with two or three very short rudimentary striations above the lateral angle. The segment is somewhat less strongly emarginate in front and with a somewhat broader and less prominent raised margin. The posterior margin is not so straight as in *O. obustus*, but is distinctly curved forward above the angle.

Segments very minutely punctate-striate, much more distinctly than in *O. obustus*. The striae of the forebelt and ventral surfaces are slight and indistinct, much as in *O. obustus*. The transverse constriction is in the midbelt of the segment, instead of following the posterior suture as in *O. obustus*. This brings the repugnatorial pores

behind the constriction instead of in front as in *O. obustus*. The hindbelt is also somewhat shorter than in *O. obustus*, so that the repugnatorial pores are brought closer to the posterior margin of the segment. The lateral suture is indicated by a fine groove behind the pore, but not so pronounced as in *O. obustus*.

Last segment somewhat less produced than in *O. obustus* but the apex distinctly angular, instead of being completely rounded off as in *O. obustus*. Penultimate segment very short, the margin scarcely exposed.

Anal valves somewhat more convex and prominent than in *O. obustus*, and with a less distinct row of fine hairs along the margin. Preanal scale thinner and somewhat angular like the apex of the segment.

Five specimens, three evidently immature and the others possibly so. The only complete specimen is a male with 38 segments, but only about 12 mm. long.

ONYCHELUS DENTATUS, new species.

Type.—Cat. No. 804, U. S. National Museum, collected at Fort Huachuca, Arizona, by T. E. Wilcox. Accession No. 26403.

Diagnosis.—Similar in size and shape to *Onychelus obustus*, but having the lateral angles of the first segment acute and striate, the transverse constriction very shallow and indistinct, the pores closer to the posterior margin, and the lateral suture not marked by a distinct groove.

Description.—Body about 40 mm. long with a diameter of 4.5 mm., composed of 48 segments.

Color of alcoholic specimen very deep olive green, nearly black; legs and antennæ also dark, with a bluish tinge.

Clypeal foveolæ five on each side, the outer pair close to the margin and smaller than the others. Surface of clypeus with a few irregular impressed lines; otherwise evenly convex but scarcely shining.

Eyes composed of nearly 40 ocelli, arranged in seven rows, counted as follows: 4, 6, 6, 7, 7, 4, 2, and 5, 6, 7, 7, 6, 5, 3.

First segment with the lateral corner acute, more produced than in *O. obustus* or *O. hospes*, the anterior raised margin more pronounced and the posterior margin striate or grooved near the angle like the sides of the other segments. The raised margin is carried farther back around the corner than in *O. obustus* and even projects very slightly, so that the posterior margin appears slightly emarginate just above the corner.

Segments very minutely and indistinctly punctate-coriaceous on the surface, the punctations more distinct than in *O. obustus*, but less distinct and less numerous than in *O. hospes*. The transverse constriction is very slight, but follows the posterior suture, so that the pores are in the line of the constriction. The lateral suture is

not indicated by a groove behind the pore as in *O. obustus*. The suture crosses the midbelt in an oblique direction, being turned or bent downward to meet the pore, which appears to be set exactly at the junction of the sutures. The ventral striations are much more pronounced than in *O. obustus*, with the ridges running out into distinct teeth along the posterior margin.

Last segment more produced and more angular at apex than in *O. obustus*, and the surface rugulose-punctate, more distinctly than the preceding segments.

Anal valves somewhat more prominent than in *O. obustus*, distinctly exceeding the apex of the last segment. Surface distinctly rugulose-punctate, especially on the sides; margin fringed with a row of short hairs.

Preanal scale broadly rounded, but not thickened as in *O. obustus*.

The more angular first segment and the indistinct transverse constrictions are similar to those of the related Texan genus *Eurechus*.

ONYCHELUS SUTURATUS, new species.

Type.—Cat. No. 805, U. S. National Museum, collected at Fort Huachuca, Arizona, by T. E. Wilcox. Accession No. 27626.

Diagnosis.—Similar in size and general appearance to *O. dentatus*, but with the sculpture of the ventral surfaces coarser and more pronounced and all the sutures marked by superficial grooves.

Description.—Body about 43 mm. long, 4.6 mm. in transverse diameter, and 4.2 mm. in vertical diameter, the segments being appreciably depressed.

Color, very dark green, nearly black.

Clypeal foveolæ four on each side, the inner pair very small and crowded into the median suture, the next two pairs large and also crowded toward the middle. Outer pair very small, near the margin, remote from the others.

Eyes composed of over 40 ocelli arranged in seven rows, 6, 7, 8, 7, 7, 5, 3, to form nearly circular clusters.

First segment much as in *O. dentatus*, but the lateral angles somewhat more produced and the anterior raised margin distinctly narrower. Posterior margin distinctly striate on the sides and also distinctly notched just above the corner.

Segments nearly as smooth as in *O. obustus*, very finely and irregularly punctate-coriaceous, but somewhat less than in *O. dentatus*. Transverse constriction very slight, appearing to follow the suture on the sides, passing a little in front of the suture above. All the sutures, anterior and posterior, median, lateral, pleural and ventral, are marked by distinct superficial grooves. The reticulate sculpture of the ventral surfaces is coarser and more pronounced than in *O. dentatus*, although the longitudinal striations are rather less

accentuated. The anterior transverse and pleural sutures are especially well marked and completely interrupt the patterns of the superficial network. The pleuræ are distinctly wider in front, the forebelt being narrowed and shortened below.

Last segment of much the same shape as in *O. dentatus*; surface of the segment and the valves less rugulose and more distinctly punctate.

Morphological interest warrants the description of the peculiarities of this animal, though more abundant material must determine whether they have taxonomic importance or not.

Genus CYCLOTHYRAPHORUS Pocock.

Cyclothyraptor Pocock, *Biologia Centr.-Amer.*, 1908, p. 83.

The Mexican genus *Cyclothyraptor*, established by Pocock on *C. salvini* from the Mexican State of Guerrero, may belong to the same general group as *Onychelus* and *Eurelus*. The anal valves have the same peculiarity of meeting in a reentering angle or groove, and the anterior corners of the first segment are cut away so as to expose the sides of the mandibulatory stipes. Nevertheless, if the characteristics of the type species are taken into account, the genus *Cyclothyraptor* appears to be quite distinct from the more northern types.

The body of *C. salvini* is described as slender, less than 3 mm. wide and over 12 times as long. The antennæ are crassate, with the second and third joints about equal in length. The first segment is "without trace of a sulcus" to define an anterior margin. Second segment "projecting below the level of the first." The coxæ of the third pair of legs of males are without processes, and the ventral plate of the gonopods is not produced, fully exposing the oblong anterior lobes.

The form of the body, the absence of processes from the third pair of legs of the males, and the form of the coleopods seem to ally *Cyclothyraptor* with *Onychelus* rather than with *Eurelus*.

ANELUS, new genus.

Type.—*Anelus reduncus*, a new species from south Texas.

Diagnosis.—Remotely related to *Onychelus* and *Eurelus*, but readily distinguished by having the first segment very broad, with two nearly square lateral corners, the body segments with densely reticulate forebelt and coarsely punctate hindbelt, the last segment with a produced triangular apex, the anterior male legs without coxal processes, and the ventral plate of the copulatory legs rudimentary.

Description.—Body rather small and robust, nine or ten times as long as broad, cylindrical, slightly thicker in front, rather abruptly tapered behind, coiling into a close spiral.

Antennæ short, subclavate, joint 2 distinctly the longest, joint 1 next, joints 3-5 subequal, slightly exceeded by 6, about half as long as joint 2. Antennæ accommodated by a lateral depression of the head and mandibulary stipe and partly covered by the wide anterior corner of the first segment. Olfactory cones 4.

Eyes of less than 20 rather prominent ocelli arranged in five rows.

First segment very broad, not emarginate below the eyes and with broad anterior and posterior lateral angles, the latter more rounded, the former somewhat produced and with a very broad raised margin. Second segment not produced below the first, but crossed by an obliquely longitudinal crest parallel with the lower edge of the first segment.

Segments of middle of body with no distinct constriction, the hindbelt scarcely more convex than the midbelt. Anterior suture usually distinct, the posterior often perceptible as a fine superficial striation; median suture often marked by a distinct groove of the hindbelt. Forebelt and covered parts of midbelt with very fine indistinct irregular striations along the anterior margin, passing into a more distinct, very fine reticulation. Exposed parts of midbelt beset with deep, coarse punctations, irregular in size and arrangement. Hindbelt nearly smooth, with a few minute punctations and fine longitudinal striæ. The more distinct lateral and ventral striations are confined to the hindbelt. They begin well below the pores on anterior segments, but on posterior segments come up nearly to the pores.

Repugnatorial pores, with slightly raised margins set in distinct depressions, slightly below the middle of the segment, on or in front of the posterior suture. Lateral suture not indicated on the midbelt, but marked by a distinct straight groove crossing the hindbelt and sloping slightly upward from the pore, instead of downward like the other lateral striations.

Supplementary margin short, with fine longitudinal striations; minutely pectinate with extremely fine-pointed teeth, visible with a quarter-inch objective.

Sterna quadrate, less than twice as broad as long; the lateral margins parallel, the anterior distinctly convex; surface with fine transverse striations, somewhat irregular and broken. Pleural sutures indistinct, indicated by interruption of the surface reticulation of the midbelt.

Legs of anterior segments of males not crassate, the claws not enlarged. Basal joints rather prominent below, but not distinctly produced.

Posterior segments somewhat abruptly narrowed and shortened, especially the two penultimate. Last segment with a thickened,

triangular apex projecting for about half its length beyond the closed anal valves.

Anal valves moderately convex, not thickened nor prominent, the edges meeting in a slight groove. Surface nearly smooth. Preanal scale short, broadly rounded.

Coleopods with ventral plate rudimentary, not produced in the middle, exposing the whole of the long, subquadrate anterior lobes, which are closely approximate along the median line.

Gonopods rather straight, the projecting apex consisting of two parts, the mesial a simple oblong transverse blade, the lateral shorter and ending in two incurved prongs that partially embrace the middle of the mesial blade.

Sixth and seventh segments of males not notably enlarged nor prominent below; coalesced pleuræ of seventh segment crossed by a broad flattened elevation, not projecting as a crest, the median suture distinct.

The very broadly rounded lateral margins of the first segment and the projecting apex of the last segment would at once distinguish this genus from all members of the order Anocheta previously known in the United States without taking the other peculiar characters into account. The affinity with *Eurelus* and *Onychelus* is certainly very slight, but there is still less with the more northern genera *Arctobolus* and *Tylobolus*.

The absence of scobinæ and of a median process from the ventral plate of the coleopods distinguish *Anelus* from the Mexican and Central American forms that have the last segment produced. The broadly rounded first segment might be supposed to ally this genus with *Rhinoericus* as well as the produced last segment, but it does not appear that there is any real affinity with the scobinate forms.

ANELUS REDUNCUS, new species.

Type.—Cat. No. 798, U. S. National Museum, collected near Brownsville, Texas, January, 1905, by O. F. Cook.

Length of male about 30 mm., width about 3 mm. Number of segments, 44. The largest female specimens are nearly 4 mm. in diameter.

Color in life slate gray, the dark background modified by pale bluish punctations not large enough to be distinguished by the naked eye. Alcoholic specimens change to a moderately dark grayish brown, but distinctly banded. The midbelt still appears gray and the anterior part of the hindbelt dark brown. Posterior part of hindbelt and exposed parts of forebelt light brown.

Clypeal foveolæ three on each side, the two upper close together, the lower much more widely separated; surface of clypeus and vertex smooth and shining.

Eyes rounded, of 17 ocelli, arranged in five rows—3, 4, 4, 4, 2.

First segment with surface smooth, not punctate nor striate like the others. Lateral margin nearly straight or slightly emarginate in the middle, the strongly thickened raised margin broadened and slightly produced to a broadly angled corner.

Surface of segments divided into three bands, the forebelt reticulate, the midbelt coarsely punctate and the hindbelt smooth, except for a few minute punctations along the midbelt, and a few fine longitudinal wrinkles or grooves. Reticulations limited to forebelt on the dorsal surface, but covering about half of midbelt lower down.

Penultimate segments distinctly narrowed and shortened, and the punctations less pronounced.

Last segment nearly smooth with a distinctly triangular produced apex, slightly decurved. Anal valves and preanal scale also smooth.

Several specimens were collected in a small forest of the Texan palmetto (*Inodes texana*) not far from the north bank of the Rio Grande, a few miles east of Brownsville. They showed no tendency to congregate in rotten wood, as *Arctobolus* usually does, but were scattered about in the humus layer, an inch or two below the surface. No other millipeds were found in the same place.

It is possible, of course, that the Brownsville locality represents the most northern distribution of a species otherwise limited to Mexico, but this is not to be taken for granted. The Texas palmetto appears to have ranged formerly as far north as Jackson County

ANELUS RICHARDSONI (Pocock).

Spirobolellus richardsoni Pocock, *Biologia Centr.-Amer.*, 1908, p. 87.

A Mexican milliped from Tampico, larger than *A. reduncus*, but having the last segment shorter and the outer ramus of the gonopod with the terminal prongs very unequal. The females attain, according to Pocock, a length of 56 mm. and a diameter of about 5.5 mm. The projecting apex of the last segment of *A. richardsoni* is "a rather wide and flat, apically rounded, caudal process which surpasses the summit of the valves," while the corresponding part of the Texan animal is rather acutely triangular, about as long as wide. The anterior portion of the surface of the segments is not described as reticulate, but "only very finely striolate," and there is said to be a distinct transverse sulcus or constriction of the segments, which is not true of *A. reduncus*. Pocock recognizes the improbability of any close alliance between the Mexican species and the genus *Spirobolellus*, the type of which came from Sumatra. The sexual characters of the original East Indian species of *Spirobolellus* have not been described.

GLOSSELUS, new genus.

Type.—*Glosselus musarum*, a new species from Costa Rica.

Diagnosis.—Apparently related to *Anelus*, but with the first segment strongly emarginate behind the antennæ, the last segment scarcely

produced, the anal valves with prominent margins, the coxæ of the fifth pair of legs of males armed with processes, the ventral plate of the coleopods large, and the anterior lobes widely separated.

Description.—Body rather small and slender, over ten times as long as broad, cylindrical, slightly thicker in front, the sixth and seventh segments of the male distinctly wider.

Antennæ rather short, subclavate, joint 6 the longest, slightly exceeding joint 2; joints 3–5 subequal, distinctly shorter than joint 6. Antennæ accommodated by a large lateral depression of the head and mandibular stipe, but the cardo with a prominent raised rim fitting against the emargination of the first segment, so that the antennæ are excluded. Olfactory cones four.

Eyes of more than 40 flattened ocelli arranged in six or seven vertical curved rows.

First segment much longer in the middle than in *Anelus*, much shorter on the sides; distinctly broader than the second segment, distinctly narrowed by a broad emargination below the level of the eyes, but with rounded lateral angles, both the emargination and the angle bordered by a very distinct, rather narrow ridge. Second segment slightly exposed below the first when viewed from the side, but without a crest as in *Anelus*.

Segments of middle of body with a slight constriction a little in front of the posterior suture, the hindbelt and midbelt about equally convex. Sutures not indicated by superficial striations, but becoming distinct as white lines as the animals dry out, except the median. Forebelt nearly smooth, the striations extremely fine and indistinct. Midbelt rather sparsely covered with short curved striæ deepening to a row of distinct punctations in the constriction.

Hindbelt above smooth and shining, the lateral and ventral striations rather few and weak, and confined to the hindbelt, but the constriction with more numerous short striations below, replacing of the dorsal punctures.

Repugnatorial pores nearly on the middle line of side, inserted in a distinct circular depression slightly separated from the posterior suture that bends slightly away from the pore. Lateral suture sometimes indicated by a slight groove behind the pore.

Supplementary margin rather thick and firm, the edge irregularly crose-dentate with short, broad, square or rounded teeth, not regularly pectinate with fine teeth as in *Anelus*.

Pleural sutures very faintly indicated on the smooth surface, but often marked by a whiter line, especially along the forebelt and midbelt.

Sterna quadrate, a little broader than long, the surface covered with close regular transverse striations.

Posterior segments but little shorter than the others, gradually narrowed and somewhat compressed; constriction and punctations slight.

Last segment abruptly narrowed and distinctly angled at the apex, equaling the anal valves or very slightly produced.

Anal valves strongly convex, with rather thin, distinctly compressed slightly prominent margins, bordered by shallow grooves.

Preanal scale small, the posterior margin nearly transverse.

Males with anterior legs rather strongly crassate, all of the joints but the last swollen on the under side into rounded prominences. Claws not enlarged.

Coxæ of third and fourth pairs of legs of male produced into very small papilliform processes, turned obliquely forward.

Coxæ of fifth pair of male legs with processes four or five times as long as the others and thick in proportion, about twice as long as broad, subcylindric, slightly tapering, with the ends abruptly hooked forward.

Coxæ of sixth and seventh pairs without processes, merely rounded like the other joints.

Coleopods with ventral plate forming a large, oblong-ligulate median process nearly twice as long as broad, emarginate at apex. Anterior lobes widely separated, stout columnar, the outer margins nearly straight, the rounded apex slightly incurbed. Posterior lobes small, with simple incurved apices only slightly exceeding the corners of the ventral plate.

Gonopods not exposed; doubtless retracted into the unusually thick bulbous bases of the coleopods.

Sixth and seventh segments of males notably broader, the seventh inflated and prominent below; coalesced pleuræ of seventh segment with a very broad transversely striate anterior slope, the median suture obsolete. The dorsal part of the seventh segment very short, that of the sixth segment unusually long.

The affinity of this genus with *Anclus* is certainly not close, and may prove to be very remote, but the external similarities are at least interesting. The transverse row of punctations renders the segments much alike, and the apex of the last segment shows a slight projection, giving at least an external appearance more similar to *Anclus* than any other Mexican or Central American type available for comparison. Both genera may prove to be relatives of *Trigoniulus*, and may assist in determining whether that cosmopolitan genus is of American or Old World origin.

GLOSSELUS MUSARUM, new species.

Type.—Cat. No. 799, U. S. National Museum, collected in a banana plantation at La Colombiana, Costa Rica, April, 1903, by O. F. Cook.

Length of male about 33 mm., width 2.8 mm.; female about 35 mm. by 3.2 mm. Number of segments 47 in a male, 49 in a female. Males have the sixth and seventh segments broader than the others; females distinctly constricted behind the head.

Color in alcohol very dark brown, nearly black; legs and antennæ slightly paler and more reddish.

Clypeal foveolæ two on each side, one near the median sulcus, and one widely removed, near the inferior margin. Vertex with sulcus distinct, and with a band of fine vertical wrinkles under the margin of the first segment; surface elsewhere smooth and shining.

Eyes rounded triangular, of about 42 ocelli arranged in 7 vertical curved rows, counted from behind toward the antennæ, 9, 9, 8, 7, 5, 3, 1, and 8, 9, 8, 7, 6, 3, 1.

First segment with the surface smooth, the emarginations very broad and shallow and the raised margin narrow but very distinct from the rounded lateral corner to behind the middle of the eye.

Surface of segments smooth on the forebelt, sparingly punctate on the midbelt, distinctly punctate along the shallow constriction, smooth or very finely striolate longitudinally on the hind belt. Lateral striations numerous below the pores, but not strongly developed. Surface nowhere distinctly reticulate as in *Anelus*. Posterior segments smoother than the others, the transverse constrictions and punctations becoming obsolete.

Last segment, anal valves and preanal scale with surfaces smooth and shining.

Nineteen specimens, mostly adults, were collected about banana stumps; some of the male specimens are smaller than the others, but do not appear to differ in any other respect except that the sixth and seventh segments are only very slightly enlarged. They seem to have as many segments as the others, and all the segments are provided with legs except the last two, as in the adults. The copulatory apparatus appears to be partially developed.

GLOSSELUS NARESII (Pocock).

Spirobolus naresii Pocock, Ann. and Mag. Nat. Hist., ser. 6, vol. 11, p. 252, pl. 16, fig. 4.

The copulatory apparatus of *G. musarum* shows such a marked resemblance to that of *Spirobolus naresii* Pocock that the existence of generic differences between the two species seem very improbable. The ventral plate, as well as the anterior and posterior lobes, are of the same general form, the most notable difference being that the ventral plate of *naresii* is shown with a somewhat triangular rounded apex, instead of emarginate.

The color seems to be quite distinct, that of *naresii* being described as slate-gray, with the posterior borders of the segments ochraceous and the legs and antennæ flavous. The segments are also described as marked "with a transverse row of ring-shaped or crescentic impressions just in front of the sulcus." The drawings of the anterior and posterior parts of the body also indicate an essential agreement in the characters of the first and last segments, so that a reference to the same genus seems justified, in spite of the fact that the locality given for *naresii* is "Mahé Island, Seychelles."

DESCRIPTIONS OF A NEW GENUS AND SPECIES OF ISOPOD
CRUSTACEAN OF THE FAMILY IDOTHEIDÆ FROM THE
MOUTH OF THE RIO DE LA PLATA, ARGENTINA, SOUTH
AMERICA.

By HARRIET RICHARDSON,

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In 1888, the U. S. Bureau of Fisheries steamer *Albatross*, while dredging off the coast of South America, obtained a specimen representing a new genus and species of Idotheidæ, the descriptions of which follow.

CHIRISCUS, new genus.

Body ovate. Head large, laterally expanded; lateral margins not cleft. First pair of antennæ with a peduncle of three articles, the second inserted at the outer lateral margin of the basal article; flagellum composed of a single long article and a minute terminal one. Second antennæ concealed by first pair; peduncle composed of five articles and geniculate at the articulation of the second and third articles; flagellum multi-articulate. Maxillipeds with a palp composed of three articles. Segments of thorax, except the first, furnished with distinct epimera. Seventh segment abruptly narrower than the sixth and not wider than the abdominal segments. Abdomen composed of three segments, two short ones anterior to a long terminal segment. First pair of legs strongly prehensile, with propodus large and dilated. Four following pairs and seventh pair similar, with terminal joints furnished with long hairs; these legs have no dactylus. Sixth pair of legs much longer than the others, with the carpus and propodus elongate.

This genus is similar to both *Macrochiridotca* Ohlin¹ and to *Chætilia* Dana.² It differs from both, however, in not having the second and third pairs of legs prehensile, and in having no dactylus

¹Isopoda from Tierra del Fuego and Patagonia. Svenska Expeditionen till Magellansländerna, vol. 2, No. 11, 1901, pp. 286-291.

²U. S. Expl. Exp., vol. 14, 1853, pp. 711-713, pl. 46, fig. 11a-f.

to the last six pairs of legs, with the exception of the sixth pair. It also differs from both genera in having only three segments to the abdomen. It differs further from *Macrochiridotea* in not having the sides of the head cleft and in having the second article of the peduncle of the first antennæ inserted in the outer lateral margin of the basal article. It differs further from *Chætibia* in not having the sixth and seventh pairs of legs jointed and in having the sixth pair less elongate.

The type of the genus is *Chiriscus australis*, new species.

CHIRISCUS AUSTRALIS, new species.

Body ovate, a little more than twice as long as wide, 8 mm. by $3\frac{1}{2}$ mm. Color, in alcohol, light brown, with a small patch of black on either side of the posterior portion of the head and on either side of the antero-lateral parts of the first thoracic segment; there is also a transverse band of black on the terminal abdominal segment.

The head is twice as wide as long, 3 mm. by $1\frac{1}{2}$ mm., with the anterior margin produced into a conspicuous median point.

The head is deeply immersed in the first thoracic segment, but the lateral parts are produced and expanded in wide plates, the margins of which are entire. The eyes have almost disappeared; they are situated some distance from the lateral margin in the posterior half of the head. The first pair of antennæ have the basal article large and dilated, with the post-lateral margin produced in a small rounded lobe; the second article is narrow, elongate, about



FIG. 2. CHIRISCUS AUSTRALIS. MAXILLIPED. $\times 20\frac{1}{2}$.

one and a half times the length of the first, and is inserted in the outer lateral margin of the basal article; the third article is about as long as the second; the flagellum is composed of a single large article, about half the length of the third article of the peduncle, and a minute terminal article. The first antennæ extend beyond the post-lateral angles of the head by a distance equal to the length of the flagellum; the second antennæ are extremely short, extending only to the end of the second article of the peduncle of the first

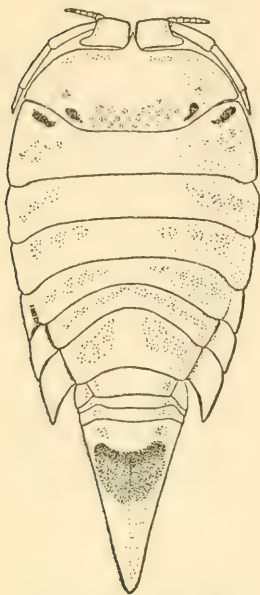


FIG. 1. CHIRISCUS AUSTRALIS. $\times 9$.



FIG. 3. CHIRISCUS AUSTRALIS. FIRST LEG. $\times 11\frac{1}{2}$.

antennæ extend beyond the post-lateral angles of the head by a distance equal to the length of the flagellum; the second antennæ are extremely short, extending only to the end of the second article of the peduncle of the first

antennæ, and are geniculate at the second article; the first article is short; the second is twice as long as the first; the third and fourth are short, about equal in length to each other and to the first article, the fourth having the outer lateral margin produced in a large rounded process or lobe; the fifth article is a little longer than the preceding; the flagellum is composed of eleven articles. The second antennæ are almost entirely concealed in a dorsal view by the first antennæ.

The first, second, and third segments of the thorax are about equal in length in the median line, being each three-fourths mm. long; the fourth, fifth, and seventh segments are a little shorter, being each about one-half mm. in length; the sixth segment is the longest, being 1 mm. long. Epimera are present on all the segments except the first; they are visible in a dorsal view only on the last three, being wide and occupying the entire lateral margin; in the other three segments they are narrow plates and extend only half of the lateral margin. The thorax tapers toward the posterior extremity, which is narrower than the anterior portion. The seventh segment is abruptly narrower than the sixth segment, and is not wider than the first abdominal segment.

The abdomen is composed of three segments, two short segments anterior to the long terminal segment. The terminal segment is long and narrow, 3 mm. by $1\frac{1}{2}$ mm., and tapers to a pointed extremity.

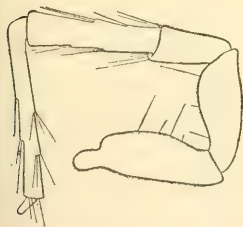


FIG. 5. CHIRISCUS AUSTRALIS.
SIXTH LEG. $\times 20\frac{1}{2}$.

The first pair of legs are strongly prehensile, with the propodus large, dilated, and the dactylus long and reflexed. The carpus is produced on the exterior margin in a long spine-like process at the base of the propodus. The two following pairs of legs are not prehensile, but are similar to the fourth, fifth, and seventh pairs, with the exception that the

basis is more dilated and the carpus produced in a long wide process extending half the length of the propodus. In all five pairs, the last three articles are fringed with long hairs, and there is no dactylus. The sixth pair is much longer than any of the others and has the carpus and propodus elongate. This pair has a small blunt dactylus.

Only one specimen was obtained by the *Albatross* at station 2764, off Rio de la Plata, Argentina, at a depth of $11\frac{1}{2}$ fathoms on sand and broken shells.

Type.—Cat. No. 42092, U.S.N.M.



FIG. 4. CHIRISCUS AUSTRALIS.
SECOND LEG. $\times 20\frac{1}{2}$.

DESCRIPTIONS OF SIX NEW GENERA AND THIRTY-ONE
NEW SPECIES OF ICHNEUMON FLIES.

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This is one of a series of papers based upon new genera and species of Ichneumonoidea or Ichneumon flies, in most cases contained in the collections of the U. S. National Museum and of such a nature as to call for their early publication.

Family BRACONIDÆ.

DOLICHOGENIDEA, new subgenus.

Head with the facial line greater than the transfacial line, otherwise as in *Apanteles* Foerster.

Type.—*Apanteles (Dolichogenidea) banksi*, new species.

APANTELES (DOLICHOGENIDEA) BANKSI, new species.

Female.—Length 2.5 mm.; black and shining; head dullish, mandibles mostly reddish stramineous, joints beyond the second in both maxillary and labial palpi stramineous; dorsulum dullish, scutellum shining, sparsely punctured, the punctures as many as ten or more puncture widths apart, wings whitish except the costa, which is stramineous between the stigma and the base of the wing and brown beyond the stigma, the stigma, which is brown except for a basal yellow mark and the radius, transverse cubitus and third abscissa of the cubitus, which are infuscated, fore legs stramineous beyond the trochanters, mid-legs with their femora mostly black, their tibiæ and tarsi mostly stramineous, hind legs black or blackish except for a basal stramineous annulus to their tibiæ and basal joint of tarsi; propodeum rather dullish except for the poorly circumscribed areola, which is more shining and mostly represented by a depressed basin, virtually exareolate except for the areola and basal area, punctured; first tergal plate almost quadrate, parallel sided, shining, punctured, medially impressed though slightly, second tergal

plate shining, punctured laterally, nearly four times as wide at base as long down the middle, its apical margin not well defined, arcuate so that it is narrower laterally than medially measured antero-posteriorly, exerted portion of the sheaths of the ovipositor practically as long as the tergum of the abdomen proper.

Type.—Cat. No. 13510, U.S.N.M.

Type-locality.—Chesapeake Beach, Maryland, September 4, 1910, collected by Nathan Banks.

Named for Mr. Nathan Banks.

APANTELES (PROTAPANTELES) AFRICANUS, new species.

Belongs to the same group as *Apanteles* (*Protapanteles*) *fulvipes* (Haliday, Marshall), with which it agrees in most particulars except as set forth in the following description:

Female.—Length 3 mm.: first dorsal plate parallel sided or nearly so to the middle, hardly twice as long as wide at base; second dorsal plate poorly circumscribed, narrower at base than long down its middle, nearly twice as wide at apex as long down the middle, membranous portion of first and second segments more or less pale, third tergal segment more or less pale; radius apparently twice as long as the transverse cubitus, most of the veins and stigma blackish in the fore wings, hind tibiæ tipped with fuscous, hind tarsi mostly fuscous.

Male.—Similar to the female.

Type.—Cat. No. 13491, U.S.N.M.

Type-locality.—Pretoria, Transvaal.

Received from C. W. Howard.

APANTELES (PROTAPANTELES) BEDELLIÆ, new species.

Female.—Length 1.75 mm.; facial line not greater than the trans-facial line, head black, antennæ blackish, palpi mostly pale; thorax black including tegulæ and coxæ, wings almost colorless, tinged with brown, basal abscissa of costa stramineous, stigma and post-stigmatic costa dark brown, most other veins in forewings stramineous tinged with fuscous; the radius, transverse cubitus and third abscissa of cubitus darker than the rest excepting the costa, femora and tibiæ mostly stramineous to reddish, the hind femora and tibiæ tipped with fuscous, their tarsi fuscous, or deep brown; propodeum shining, rugulose, with a median longitudinal carina; first tergal plate hardly twice as long as wide at base, apparently as wide at extreme apex as at the corresponding part of its base, the almost parallel sides bulging somewhat beyond the middle and finally sharply recurved so that the plate is as wide at apex as at base, dullish, mostly rugulose; second tergal plate shorter than the third tergal segment, but little wider at base than long down its

middle, its apical width at least one and one-half times the basal width, its sides oblique to the middle beyond which they are almost parallel, in sculpture similar to the first tergal plate, remaining tergal segments virtually smooth and shining throughout, only the third with apparent sculpture and in this confined to extreme base, exerted portion of sheaths of the ovipositor nearly as long as the first tergal segment, abdomen black or blackish throughout.

Male.—Similar, its first tergal plate apparently twice as long as wide at base and parallel sided throughout, the second tergal plate hardly as wide at base as long down the middle; femora more or less blackish, mid tibiæ with apical infuscation, hind tibiæ infuscated except for a pale basal annulus.

Type.—Cat. No. 13501, U.S.N.M.

Type-locality.—Washington, District of Columbia.

“Bred from *Bedellia*, September 9, 1910; T. H. Jones, collector.”

APANTELES (PROTAPANTELES) BENEFICUS, new species.

Female.—Length 1.5 mm.; belongs to a group of species of which the American *Apanteles (Protapanteles) radiatus* Ashmead is a representative, but from that species it may be readily distinguished as follows: Scape and rest of antennæ black, tegument of head black; thorax black, dorsulum dullish, indistinctly sculptured, wings hyaline, apparently tinged with whitish, transverse cubitus not forming an angle at its junction with the radius, anterior coxæ blackish as are all the other coxæ, middle femora brownish, fourth and fifth joints of middle tarsi fuscous, hind legs black or blackish almost throughout; propodeum almost completely smooth and shining all over; first dorsal plate apparently twice as long down the middle as wide at base and virtually smooth and polished throughout, sculptureless, second plate not much narrower at base than long down the middle, also smooth, polished, and sculptureless, the first and second tergal segments rather brownish, rest of tergal segments blackish.

Male.—Quite similar to the female, agreeing in all essential particulars.

Type.—Cat. No. 13492, U.S.N.M.

Type-locality.—Mozambique, Portuguese East Africa.

Received from C. W. Howard, who sent them to the U. S. Department of Agriculture, Bureau of Entomology.

APANTELES (PROTAPANTELES) CHRYSIPPI, new species.

Belongs to a group of species represented by *Apanteles (Protapanteles) solitarius* (Ratzeburg) Marshall.

Female.—Length 2.25 mm.; head black and shining, antennæ blackish or dark brown throughout, facial line not longer than the transfacial line, mandibles brownish, palpi mostly pale, mesonotum mostly dullish and closely punctured, many of the interstices narrower

than the diameter of the average puncture, scutel shining, not so closely, but more distinctly punctured than the mesonotum, the punctures larger, most of the veins stramineous with a brownish tinge, stigma and costa brown, membrane almost colorless, legs mostly stramineous with a brownish tinge, tarsi brownish, hind femora with a brownish tip, all tibiæ with a more or less developed brownish tip, tegulæ dark brown, fore and mid-coxæ brownish, hind coxæ black; radius a little longer than transverse cubitus, forming a distinct angle with the latter; propodeum irregularly reticulate, without a median longitudinal carina; tergum brownish suffused with black, apical half of first plate punctured, the punctures apparently larger than but not so regular as on the scutel; second plate poorly sculptured with ill-defined striæ, shining; middle two-fourths of basal half of third tergal segment with a lunate striate area, exerted portion of sheaths of the ovipositor hardly longer than onychium of mid-legs.

Male.—The third tergal segment almost sculptureless; otherwise very similar to the female.

Type.—Cat. No. 13490, U.S.N.M.

Type-locality.—Mozambique, Portuguese East Africa.

“Reared from larvæ, *Danaïs chrysipus*.” Received from Mr. C. W. Howard.

APANTELES (PROTAPANTELES) CINCTIFORMIS, new species.

Female.—Length 3 mm.; facial line shorter than the transfacial line, head black, scape bright testaceous, rest of antennæ mostly dark brownish, mandibles, palpi, tegulæ, legs including coxæ and trochanters, and membranous portion of first tergal segment all more or less stramineous to reddish stramineous; thorax with the vertical axis equal to the transverse axis, wings transparent tinged with brown, stigma and costa beyond the stigma very dark brown, third abscissa of the radius darker than and a little longer than the second, transverse cubitus and radius concolorous with the third abscissa of the cubitus, scutel smooth and shining, punctate, the punctures several puncture widths apart, not well defined; first tergal plate about one and one-half times as long down the middle as wide at base, parallel sided to the apical third, from thereon with the sides oblique, its apex about two-thirds as wide as its base, rugulose, second tergal plate trapezoidal, rather striate, as long down the middle as the first tergal plate is wide at apex, second tergal segment reddish like the third and fourth and sides of fifth and sixth, distinctly shorter than the third, exerted portion of sheaths of the ovipositor about as long as the first tergal segment.

Type.—Cat. No. 13502, U.S.N.M.

Type-locality.—Great Falls, Virginia, June 18; collected by Nathan Banks.

APANTELES (PROTAPANTELES) GRIFFINI, new species.

Female.—Length 1.75 mm. Related to *Apanteles halli* but with the second dorsal plate mostly sculptured and with the color more as in *Apanteles læviceps* to which latter species it is evidently more closely related than to the former. From *Apanteles læviceps* it may be distinguished by the smaller size, the presence of a more or less smooth sculptureless area on the second dorsal segment, by the apical half of the hind femora being mostly infuscated, by the first joint of the flagel being almost stramineous beneath and by the almost entirely black abdomen; ovipositor normally not exerted.

Male.—Sufficiently similar to the opposite sex to be easily associated therewith, flagel blackish throughout.

Type.—Cat. No. 13482, U.S.N.M.

Type-locality.—Quogue, New York.

Eight females and four females from the type-locality "Griffin collector, Webster No. 6268." Received from the Bureau of Entomology, U. S. Department of Agriculture. "Were sent as having overcome a scourge of cutworms." F. M. Webster.

Named for the collector, Mr. N. E. Griffin.

Genus PSEUDAPANTELES Ashmead.

Type.—*Pseudapanteles annulicornis* Ashmead.

APANTELES (PSEUDAPANTELES) CONSIMILIS, new species.

Pseudapanteles consimilis ASHMEAD, Manuscript 1900 (1899), Smith's Ins., N. J., p. 593.

Female.—Length 3.5 mm. Flagel blackish brown throughout, scape and pedicel mostly yellowish, head appearing wider than long, mandibles yellowish, tipped with castaneous, palpi whitish, tegulæ, base of wings, fore and mid-legs, hind femora, hind coxæ apically, membranous portion of first and second segments and sides and venter of third segment all mostly stramineous, hind coxæ basally castaneous, hind tibiæ pale yellowish at base merging into castaneous, then into blackish brown, hind tarsi dark brown, each joint pale at base; otherwise mostly black, wings hyaline, stigma uniformly dark brown; first abscissa of radius, transverse cubitus, and third abscissa of cubitus brownish; second abscissa of externo-medial, first abscissa of discoidal vein, nervellus and costa more or less stramineous to brownish, other veins almost colorless; propodeum mostly rugose, smooth and polished at base and with a salient longitudinal median carina; first dorsal plate half again as long as wide at apex, where it it is a little wider than at base, nearly parallel sided throughout, its basal third forming an obtuse angle with the apical two-thirds in profile, the basal third mostly striate and smooth, the apical two-thirds

mostly rugose but becoming striate apically, the apical edge interrupted by a smooth area in the middle, second dorsal plate about four times as wide as long down the middle and rugose, though not as strongly as the preceding plate, the third dorsal segment nearly three times as wide at base as long down the middle and almost entirely smooth; exerted portion of ovipositor about as long as the abdomen above.

Type.—Cat. No. 13486, U.S.N.M.

Type-locality.—Long Island, New York. Ashmead collection.

APANTELES (PSEUDAPANTELES) ETIELLÆ, new species.

Facial line not longer than the transfacial line; vertical axis of thorax virtually as great as the transverse axis; propodeum smooth and polished with a distinct median longitudinal carina; first tergal plate smooth and polished like the second, less than twice as long down the middle as wide at base and distinctly narrower at apex than at base, its sides gradually converging from base to apex, only half as wide at apex as at base, second plate at least four times as wide at apex as long down the middle, its apical edge slightly sinuate, hardly as wide at base as long down the middle.

Male.—Length 2.5 mm., black except as follows: Palpi mostly stramineous, tegulæ almost colorless tinged with brown, fore femora apically, their tibiæ and tarsi mostly, testaceous; mid and hind tibiæ basally pale, together with their tarsi mostly dusky, wings whitish, first abscissa of costa stramineous, stigma and costa beyond dark brown, radius at least twice as long as the transverse cubitus, the third abscissa of the cubitus distinctly shorter than the second, these veins, together with the recurrent vein, first abscissa of discoidal, second abscissa of median and transverse median vein, all tinged with brown.

Type.—Cat. No. 13503, U.S.N.M.

Type-locality.—Pullman, Washington.

Received from the U. S. Department of Agriculture, Bureau of Entomology, under "Webster No. 5935, August 10, 1909"; J. A. Hyslop, collector. Ex. *Etiella schisticolor*.

CHELONUS KNABI, new species.

Female.—Length 5.5 mm.; antennæ 34-jointed, joints of the flagel black, finely longitudinally striate, at least twice as long as thick, subequal in length, each joint a little shorter than the one preceding, though from the fourth to the eleventh the joints are nearly equal in length to their immediate predecessor, that is, with the fourth nearly equal to the fifth, the fifth nearly equal to the sixth and so on, scape and pedicel also black, head, including clypeus black, face transversely rugose, with a median longitudinal more or less distinct carina extending from the base or near the base of the clypeus to the base of the

frontal basin, clypeus rather smooth compared with the face, covered with shallow pits, its anterior edge truncate, the truncature about as wide as the anterior edge adjoining, mandibles mostly castaneous, palpi mostly fuscous; thorax black, mostly reticulate all over; propodeum rounded off, coarsely reticulate, the lateral spines represented by a kind of arcuate buttress, base of propodeum with a median longitudinal carina extending from the base of the superior aspect to the beginning of the posterior aspect and flanked on either side by a carina that attains the apex toward which it converges though nearly parallel to its fellow of the opposite side, wings transparent fuscous except proximad to the base of the stigma where the membrane is nearly colorless and the veins mostly stramineous, distad to the base of the stigma the veins are mostly fuscous like the stigma, coxæ and proximal hind trochanters mostly black, rest of trochanters mostly ferruginous like all the femora, hind tibiæ ferruginous except a fuscous stain at base and an apical blackish band enveloping the apical third, remaining tibiæ ferruginous; abdomen black with little more than its basal third ferruginous, the ferruginous color of its base extending laterally to a little beyond the middle, the corresponding ventral area castaneous, the paired carinæ of the base of the abdomen extending nearly to the middle of the ferruginous area where they become lost among the numerous longitudinal reticulo-striations which continue to near the apical concavity where they are replaced by a kind of reticulation mixed with rugosities, the end of the carapace somewhat truncated and with a vague longitudinal sulcus down its middle; pubescence generally distributed, almost imperceptible, whitish or pale ochreous; tarsi fuscous or blackish almost throughout.

Male.—About as long as the female, differing chiefly as follows: Antennæ 33-jointed, carapace not so markedly vaulted, propodeal carinæ and basal carinæ of carapace indistinctly defined, hind tibiæ ferruginous throughout at base, apex of carapace rounded off, not at all parted by a fissure transversely or by a vague sulcus longitudinally, basal two-thirds of carapace mostly ferruginous, the remaining portion mostly black; facial carina indistinct or wanting.

Type.—Cat. No. 13487, U.S.N.M.

Type-locality.—Four Mile Run, Virginia.

Three specimens, two females and one male, collected May 30, 1910, by Frederick Knab, for whom the species is named.

In many particulars this species agrees with *Chelonus laticinctus* Cresson, of which I had the type for comparison. Of the British species it has characters in common with *Chelonus wesmali* Curtis. From each of these, however, it differs abundantly, as may be gleaned from perusing the above description.

The female paratopotype is essentially like the type female, though wanting the basal stain to the hind tibiæ.

CRYPTOXILOS, new genus.

Belongs to the Euphorinæ and has characters in common with *Peristenus* Foerster. Apparently, however, more nearly related to *Loxocephalus* Foerster.

Transfacial line at least one-sixth longer than the facial line, clypeus rather hidden and partly covered by the closed mandibles which latter are falcate and edentate and inserted back of a point on a line with the middle of the eyes, malar line a little longer than width of mandibles at base, antennæ 12-jointed, not much longer than the head and thorax together, inserted close to and opposite the middle of the eyes, the space between the scrobe and the eye not as wide as the scrobe, head as seen from above at least twice as wide as long antero-posteriorly, occipital carina complete; notauli converging to the scutel short of which they unite to form a triangular lobe, recurrent vein wanting, transverse cubitus incomplete, not meeting the cubitus; petiole almost parallel sided not produced laterally.

Otherwise similar to *Peristenus* Foerster.

Type.—*Cryptoxilos dichromorphus*, new species.

CRYPTOXILOS DICHROMORPHUS, new species.

Male.—Length 1.25 mm.; castaneous, shining. Face mostly yellowish beneath the antennæ, divided by a low carina that extends from the anterior ocellus almost to the clypeus, front indistinctly pitted between the scrobes, scape but little longer than the pedicel, first joint of flagel longer than the scape but a little shorter than the second joint of the flagel, remaining joints subequal, excepting the apical joint which is the longest, antennæ stramineous, infuscated, ocelli nearly equidistant and distinctly nearer to each other than to the nearest point on the eyes; thorax shining and somewhat darker than the occiput, wings transparent, faintly infuscated, veins stramineous, stigma very dark brown, forming an obtuse angled triangle and nearly as large as the radial cell, cubitus extending as far beyond the point where the transverse cubitus would meet as the transverse cubitus is long, submedian vein parallel to the median and not extending beyond the basal; propodeum reticulate, with a petiolarea; tegulæ and legs stramineous, basal hind tarsus approximately as long as the next three joints combined, claws apparently simple, empodium of hind onychium apparently nearly as long as the claws; abdomen brownish, smooth and polished except for the petiole which has three dorsal, longitudinal, straight, parallel carinæ, second segment cask-shaped, a little longer than the petiole and at least twice as long as the combined length of the segments beyond, the segments beyond the second apparently not differentiated, tip of abdomen and

protruding genitalia stramineous, claspers simple, nearly parallel sided, tapering, rounded at tip.

Type.—Cat. No. 13497, U.S.N.M.

Type-locality.—Bahia, Brazil.

Type collected on cotton, March 16, 1883; A. Koebele, collector.

DIACHASMA CRAWFORDI, new species.

Female.—Length 6 mm.; sheaths of the ovipositor as long as the body. Head black, antennæ blackish, 53-jointed, face with a median carina extending from as far below the anterior ocellus as the same is wide to a point approximately halfway between the antennal line and the clypeus where the carina becomes reduced so that it is lost on the convexity of the face above the clypeus, clypeus with a median longitudinal welt, the lateral free edges of the clypeus rather reflexed or upturned, clypeus medially terminating in an obtuse angle which is flanked by a sinuosity that is bounded by the lowest corners of the clypeus, which latter are angular, apical half of mandibles more or less brownish, palpi stramineous as are the præpisternum and most of the fore coxæ, with the palpi paler, mandibles but little wider at base than at apex; rest of thorax darker stramineous, scutellar fovea divided longitudinally by a carina, wings infuscated, stigma and veins blackish, radius fully developed throughout and attaining the margin of the wing as far or nearly as far from the extreme tip as the second transverse cubitus is long, stigma forming an obtuse angle on its lower edge and about three times as wide as high, radius inserted a little beyond the middle of the stigma, nervellus almost interstitial, anal cell in hind wings nearly divided by a vein that is almost parallel to the nervellus, mid and hind coxæ stramineous at base and blackish apically; proximal trochanters, distal trochanters of hind legs and most or all of femora and tibiæ black; distal trochanters of fore and mid-legs castaneous as is the base of fore and mid-femora, first, second, third, and fourth joints of fore and mid-tarsi more or less stramineous, fore and mid-onychiæ blackish as are their claws and empodia, hind tarsi blackish throughout; abdomen mostly rather ferruginous, the first dorsal segment with four carinæ defining five channels, the inner carinæ arched and terminating a little beyond the middle of the segment, the outer carinæ extending from base to apex and parallel to the outer margin, sheaths of the ovipositor blackish, ovipositor castaneous.

Type.—Female, Cat. No. 13484, U.S.N.M.

Type-locality.—Cuernavaca, Mexico. Sent to the Bureau of Entomology, U. S. Department of Agriculture, by Mr. D. L. Crawford, who observes that the specimen was "taken while stinging mango with maggots in it." This species is probably a parasite of *Anastrepha ludens* Loew.

Named for D. L. Crawford.

DIAERETUS NIPPONENSIS, new species.

Male.—Length 1.5 mm. Related to *Diaeretus piceus* Cresson from which it may be distinguished by the costulae diverging from the apex of the propodeum not at right angles to the median longitudinal carina and by the nonprojecting petiolar spiracles.

Female.—Flagel 11-jointed, costulae at right angles to the median longitudinal carina on propodeum, otherwise very as in the male.

Type.—Cat. No. 13495, U.S.N.M.

Type-locality.—Japan. Received by the U. S. Department of Agriculture, Bureau of Entomology, from Mr. G. Compere, under data as follows: Cabbage aphid, Japan, 1906; G. Compere collector; No. 15050.

DOLICHOZELE, new genus.

This genus has characters in common with *Zele* Curtis and *Leptozele* Cameron. Compared with *Zele* Curtis this genus differs essentially as follows: Clypeus broadly, shallowly emarginate, almost truncate, hind ocelli larger than the anterior ocellus and nearer the anterior ocellus than to each other or nearest point on eye margin, occiput immarginate; radius received by the stigma distinctly beyond the middle, second discoidal cell completely closed, submedian cell with a brownish spot on the median vein and on the submedian vein, hind coxae shorter than the first abdominal segment; first abdominal segment as long as the next two combined, with its spiracles nearly twice as far beyond the base as they are distant from each other.

Type.—*Dolichozele koebelei*, new species.

DOLICHOZELE KOEBELEI, new species.

Female.—Length, 9 mm. Resembles *Zele testaceator* Curtis, but differs as follows: Penultimate joint of m. p. distinctly longer than the end joint, scape and pedicel combined hardly two-thirds the length of the first joint of the flagel but about as long as the second joint of the flagel, antennae 52-jointed, vertex with a blackish band extending from eye to eye; stigma infuscated, propodeum with concentric arcuate striae; sheaths of the ovipositor about as long as the second abdominal segment. Color in general dull stramineous not at all reddish.

Type.—Cat. No. 13496, U.S.N.M.

Type-locality.—Pernambuco, Benito Province, Brazil. No. 168, January 31, 1883; A. Koebele.

Named for Mr. A. Koebele.

HABROBRACON BENEFICIENTIOR, new species.

The affinities of this species are with *H. brevicornis* (Wesmæl).

Female.—Length 2.5 mm.; sheaths of the ovipositor 0.5 mm. long. From Marshall's description of *H. brevicornis* (Wesmæl) this differs

essentially as follows: Color very as in *Microbracon howardi* Viereck, but tinged with testaceous and with yellowish stramineous color replacing the yellow, wings transparent tinged with brownish, stigma and costal vein brownish, other veins stramineous tinged with brown; third, fourth, and fifth tergal segments partly brownish laterally.

Male.—Similar to the opposite sex but with the dark regions mostly blackish.

Type.—Cat. No. 13494, U.S.N.M.

Type-locality.—"Busi, just inland from Beira, Mozambique." Portuguese East Africa, "From a maize storehouse." Presumably parasitic on one of the Coleopterons that feed upon maize. In a series of specimens the darkening of the third, fourth, and fifth tergal segments is seen to be sometimes quite extensive, again wanting or almost wanting, at least on the third segment. The first tergal segment, on the other hand, is apparently always yellowish or whitish yellow.

HORMIOPTERUS GRACILIFORMUS, new species.

Related to *H. fasciatus* Ashmead, compared with the type of which it differs as follows:

Female.—Scarcely 2.5 mm. long; exerted portion of sheaths of ovipositor approximately 0.5 mm. long. Tergum hardly striate, first tergal segment virtually simple and rounded off at base except for the rudimentary dorsal and lateral carinae, the latter obliquely extending backward and downward, attaining the lower edge of the first tergal segment at a point about one-fourth the length of the lower edge from the base of the segment; in both species the metanotum (postscutel) as seen from the side of the specimen is produced into a low thorn-like process with the apex pointed toward the propodeum.

Male.—Similar to the female.

Type.—Cat. No. 13500, U.S.N.M.

Type-locality.—Wellington, Kansas.

Received from U. S. Department of Agriculture, Bureau of Entomology, under Webster Nos. 5473, cage 119; 5472, cage 330; 6515, cage 497; 5476, cage 294; 5473, cage 300; 5422, cage 121; T. H. Parks collector; reared from an eurytomid in *Agropyron*.

MACROCENTRUS (AMICROPLUS) CRAMBIVORUS, new species.

Female.—Length, 3 mm.; sheath of the ovipositor 4 mm. long. Head black, mouth and palpi stramineous, infuscated; scape, pedicel and first joint of flagel dark stramineous, rest of antennæ brownish to blackish; antennæ 34-jointed; thorax, coxæ and trochanters stramineous, rest of legs rather brownish stramineous, claws black; middle lobe of dorsulum hardly higher than the lateral lobes, notauli

almost smooth; propodeum granular; wings transparent, faintly infuscated, second abscissa of radius about as long as the first transverse cubitus; first, second, and third dorsal abdominal segments stramineous, the second a little shorter than the first and fused with the third, second segment smooth and polished, remaining segments black, lateral furrows of second segment distinct, simple and extending a little back of the middle of the segment, sheaths of the ovipositor blackish, ovipositor dark stramineous.

Male.—Similar to the female but differing as follows: Antennæ 38-jointed, flagel blackish throughout; thorax black; first, second, and third tergal segments black.

Type.—Cat. No. 13481, U.S.N.M.

Type-locality.—Corry, Pennsylvania. Received from the Bureau of Entomology, U. S. Department of Agriculture, "Webster No. 6703," lot No. 31 and 41; W. W. Yothers, collector; reared from larvæ of *Crambus*. The paratypes are from the type-locality excepting some females as follows: "No. 196 Ex. *Crambus caliginosus*," "No. 16920," "No. 705, June 23," "From unknown pupa, August 18, 1872," and additional specimens from Jacksonville, Florida, and Washington, District of Columbia. Ashmead collection. The atopoparatypes (paratypes not from type-locality) paler than the types and paratopotypes, but in color pattern, structure, and sculpture apparently typical.

MICROBRACON HOWARDI, new species.

Belongs to that category of Marshall's section I having a median longitudinal carina on the propodeum (*Tropidobracon* Ashmead). Compares well with (*Bracon*) *Microbracon fulvipes* Nees, from which it differs as follows:

Female.—Length 3.5 mm.; sheaths of the ovipositor 5.5 mm. long; mostly stramineous and yellow, head and thorax shining, abdomen dullish; head mostly stramineous, except for the orbits which are more or less yellow and the interocellar area which is black, vertex exceedingly finely sculptured; dorsulum indistinctly sculptured, its median longitudinal two-fourths brownish anteriorly, yellowish posteriorly, the outer fourths mostly blackish, scutel yellow, rest of thorax stramineous maculated with brownish except the mesepisternum which is mostly yellow, legs stramineous excepting the tarsi which are brownish; propodeum mostly brown, stramineous laterally, perfectly smooth and polished, the carina distinctly developed throughout; tergum of abdomen mostly granular, yellowish and stramineous, in part with brownish stains, second tergal segment mostly reticulate, the third with the reticulations so arranged as almost to make well defined striæ.

Type.—Cat. No. 13493, U.S.N.M.

Type-locality.—Chai-Chai, Mozambique, Portuguese East Africa.

Received from C. W. Howard by the U. S. Department of Agriculture, Bureau of Entomology.

MICROPLITIS MELIANÆ, new species.

Male.—Length, 2.5 mm. Related to *Microplitis cinctus* Ashmead, compared with the type of which it differs chiefly as follows: Antennæ blackish throughout, tegulæ and all coxæ black; scutel shining, with ill-defined punctures; first tergal plate nearly twice as wide at base as at apex, parallel sided to beyond the middle and nearly twice as long as wide at base, smooth, sculptureless and shining, remaining segments smooth and shining virtually sculptureless, tergum blackish, the membranous portion of first and second segment rather brownish; hind femora and tibiæ not concolorous throughout.

Type.—Cat. No. 13508, U.S.N.M.

Type-locality.—Grand River, Iowa.

“From *Meliana albilinea* caterpillar of V stage.”

Experiment 342, July 5, 1910, and Experiment 601, September 20, 1910; R. L. Webster.

PLATYSPATHIUS, new genus.

Apparently related to *Spathius* from which it may be distinguished as follows: Greatest distance between lowest point on outer eye margin and occipital carinæ about one and one-half times the greatest distance between uppermost point of outer eye margin and the occipital carina; notauli converging toward the hind third of the mesonotum, at the beginning of which they terminate, the notauli as far as they go distinct and only half as far from each other where they end as where they begin, fore wings with the median vein strongly bent or curved toward the submedian which it almost touches, subdiscoidal vein interstitial with the median; first dorsal segment depressed, apparently three times as wide at base as thick dorso-ventrally, approximately half as wide at base as at apex and nearly four times as long down the middle as wide at base, uniformly depressed throughout; second dorsal segment obtrapezoidal, its apical margin indistinctly arched back so that this segment is about as long down the middle as wide at base though laterally shorter than wide at base; suture between second and third segments indistinct, third segment shorter down the middle than laterally, gaster (abdomen beyond the petiole or first segment) bulbous.

Type.—*Platyspathius pictipennis*, new species.

PLATYSPATHIUS PICTIPENNIS, new species.

Female.—Length, 4.5 mm.; sheaths of the ovipositor 2.5 mm. long; mostly dark castaneous, finely sculptured, dullish to shining; antennæ 26-jointed, rather stramineous except for the 21st to 26th joints which are rather blackish, joints of the flagel subequal, the first a

little longer than the second and nearly as long as the scape and pedicel combined; posterior third of mesonotum with a faint median longitudinal carina, fore wings mostly infuscated, with a whitish fascia extending from near the middle of the anterior margin of the costal cell nearly perpendicularly to the hind edge of the wing; basal third of stigma and about one-fifth of the first cubital cell adjoining, whitish, this latter area comprising the first part of a second fascia which reappears from the junction of the cubitus and the first transverse cubitus to the hind margin of the wing; there is a hyaline spot in the marginal cell and the tip of the wing is washed out or almost hyaline; most veins in fore wings brownish, rest of stigma blackish; hind wings colorless except for most of the venation which is stramineous; tegulae stramineous; propodeum with the upper aspect separated from the lateral nearly parallel sided aspects by a longitudinal carina on each side, the lateral areas hardly more than one-fourth the width of the median area at base, the latter with a short median longitudinal carina at base; first dorsal segment almost triangularly produced laterally at base into a kind of buttress, first and second tergal segments dullish, the following segments of the tergum blackish and more or less shining.

Male.—Similar to the other sex but lacking the lateral processes to the first tergal segment and with the lateral aspects of the propodeum not so well circumscribed.

Type.—Cat. No. 13489, U.S.N.M.

Type-locality.—Xalasi (Maputo), Lorenzo Marquez, Portuguese East Africa.

Received from C. W. Howard, by the U. S. Department of Agriculture, Bureau of Entomology.

The maculation of the fore wings in this species recalls the Tineoid genus *Argyresthia*.

POLYSTENIDEA, new genus.

May prove to be the same as *Polystenus* Foerster, to which it seems to be more nearly related than to any other genus.

Head back of the eyes extending nearly to or a little beyond the eye as seen in profile, antennae not more than 14-jointed; legs slender, basal joint of hind tarsi nearly as long as the next three joints combined, disk of propodeum and disk of first dorsal segment approximately equal in length, notauli wanting; abdomen with only four segments visible above. In other particulars very as in *Hecabolus* Curtis.

Type.—*Polystenidea parksi*, new species.

POLYSTENIDEA PARKSI, new species.

Male.—Length 2.5 mm. Head black, finely sculptured, rather dullish, as seen from above, extending a little beyond outside line of

eyes back of the eyes, as seen from in front wider than long or with the facial line shorter than the transfacial line, ocelli not prominent, equidistant or nearly so, about one-third as far from each other as from the nearest eye margin, antennæ 13-jointed, scape and pedicel pale, flagel brownish, joints subequal, the first joint a little longer than the second, mandibles and palpi mostly pale; thorax castaneous mostly blackish above, finely sculptured; propodeum with a median longitudinal carina that extends to a little beyond the middle and then bifurcates to form a nearly parallel sided petiolarea; hind wings without a parastigma, tegulæ, stigma, and most veins rather dusky stramineous, legs stramineous; abdomen finely sculptured, castaneous laterally, mostly blackish above, basal facet of first dorsal segment bounded by a distinct carina and rather triangular with a delicate median carina extending from its apex to the apex of the first segment, first dorsal segment trapezoidal, nearly two-thirds as long as the second segment which latter is trapezoidal although nearly quadrate and at least one-third again as long as the third, the third one-third again as long as the fourth, second segment with a faint incomplete longitudinal median carina.

Type.—Cat. No. 13488, U.S.N.M.

Type-locality.—Wellington, Kansas.

Received from the U. S. Department of Agriculture, Bureau of Entomology. "Swept from *Agropyron*, April 9, 1910;" T. H. Parks, collector.

Named for Mr. T. H. Parks.

POLYSTENIDEA METACOMET, new species.

Female.—Length 1.5 mm. Head black, rather smooth and shining; as seen from above, extending nearly to the outside line of the eyes back of the eyes, antennæ 14-jointed, scape, pedicel, and mandibles mostly pale; thorax black, legs mostly stramineous, rather infuscated; exerted portion of ovipositor as seen from above not as long as the apical segment of the abdomen.

In other points this species answers well to the description of the genotype as described above.

Type.—Connecticut Agricultural Experiment Station, New Haven, Connecticut.

Type-locality.—New Haven, Connecticut; collected by the writer July 4, 1905.

STENOPLEURA, new genus.

Related to *Protapanteles* Ashmead, from which it may be distinguished in the depressed thorax which is apparently wider from side to side than thick dorso-ventrally; lower edge of scrobe a little below or on a line with an imaginary straight line drawn across the face and

connecting the middle point of each inner eye margin. Habitus quite different from *Protapanteles*, *Apanteles*, and *Pseudapanteles*, very suggestive of *Goniozus* and allied genera in the Bethyliidæ.

The male of the type-species was not known to the describer at the time the species was first described. At any rate, it has apparently never been described. It differs from the female as described by Cameron especially in having the joints of the flagel at least three times as long as wide at base, otherwise it is very similar to the female except for the usual antigeny, as is obvious from an examination of a male received from C. W. Howard who sent specimens of this species to the U. S. Department of Agriculture, Bureau of Entomology, that were reared from *Sesamia fusca* in Portuguese East Africa.

Type.—*Apanteles sesamiæ* Cameron.

Family ICHNEUMONIDÆ.

ANEMPHERES DIAPHANIÆ, new species.

Female.—Length 8.5 mm. Upper edge of scrobe apparently not reflexed nearly as far from the anterior ocellus as the outer edges of the lateral ocelli are from each other, front rather uniformly rugulose, antennæ 38-jointed, scape and pedicel yellowish beneath; dorsulum covered with whitish pubescence, tegulæ not prominently elevated, ridge bounding prepectus of mesothorax poorly developed or rudimentary above, episternum of mesothorax almost smooth and polished in part posteriorly, propodeum with only the basal three sides of the areola developed, no other raised lines present except the poorly developed upper lateral boundary of petiolarea, sulcus of propodeum very shallow, linear, transversely striate, spiracles nearly round, mid-coxæ tipped with yellow, mid-trochanters yellow, mid-femora mostly brownish, hind trochanters yellow, their femora and tibiæ reddish brown, longest spur of hind tibiæ straight, wing membrane nearly colorless, tinged with fuscous, veins and stigma blackish, second abscissa of cubitus longer than the third, nervellus not broken; abdomen in profile clavate, petiole smooth and rounded without carinæ or fossæ, distance from base of petiole to spiracle more than twice that from spiracle to apex, petiole from a little before spiracle to apex bullous and reddish, rest of petiole black; second dorsal segment black and reddish, apical margin black, smooth except for a fine carina between base and thyridia, the latter longer than wide and about as far from the base of the segment as from each other, rest of abdomen reddish except for a blackish area at base of third segment.

Otherwise very similar to *Campoplex oxyacanthæ* Boie.

Type.—Female, Cat. No. 13485, U.S.N.M.

Type-locality.—Raleigh, North Carolina. "Bred from pupal cases of *Diaphania hyalinata*, October 15, 1909. Under N. C. Exp. Sta. Col., Cat. No. 56.25. Received by the U. S. Department of Agriculture, Bureau of Entomology, from Prof. R. S. Smith.

CREMASTUS HYMENIÆ, new species.

Judging from the accepted classification of Ophioninæ this species should not figure as a *Cremastus* because the occipital ridge is not broken and the radial cell extends more than halfway between the stigma and tip of the wing. In other particulars it is so closely similar to the genotype of *Cremastus* that I am constrained to give it this position.

Female.—Length 6.5 mm.; stramineous, head with a broad blackish stain extending from the occipital foramen to the scrobes, orbits, malar space and clypeus yellow, rest of head mostly stramineous, dorsulum with three brownish areas; areola poorly defined below the costulæ, finely sculptured and dull, the sculpture similar to that of the other areas of the propodeum; wings hyaline, most of veins and stigma dark brownish; postpetiole and second tergal segment finely closely striated, petiole proper blackish, second tergal segment mostly blackish as is the third at base, exerted portion of sheaths of the ovipositor about half the length of the tergum of the abdomen.

Male.—Similar to the opposite sex.

Type.—Cat. No. 13507, U.S.N.M.

Type-locality.—Oahu, Hawaiian Islands.

“Bred from *Hymenia fascialis*, August 16, 1910.” H. O. Marsh, collector.

Genus HYPERALLUS Foerster.

The following species described under this genus would seem to differ from Foerster's description only in having the longer of the hind spurs at least half as long as the first joint of the hind tarsi. The thyridia of the second dorsal segment are not much more developed than in *Scopesis*. Assuming that the thyridia are not conspicuous in our species the same would be best received into *Scopesis*. Our species is apparently, however, sufficiently different from *Scopesis* to give *Hyperallus* standing as separate from *Scopesis*.

HYPERALLUS CALIROÆ, new species.

Compared with *Scopesis guttigera* (Holmgren) Thomson, this differs as follows:

Female.—Length, 3.5 mm.; front hardly depressed, first flagellar joint virtually as long as scape and pedicel combined, head black, dullish in front, polished behind, scape and pedicel yellowish, first and second flagellar joints rather stramineous, remaining joints more or less dark brown; clypeus mostly yellowish as are the mandibles, palpi stramineous or yellowish, posterior ocelli about as far from each other as from the nearest point on the eye, but nearer to the anterior ocellus than to each other; thorax shining, poorly sculptured; dorsulum brownish, more or less stained with blackish; prothorax mostly

stramineous, tubercles and tegulae yellowish as is the disk of the upper division of the mesepisternum, disk of scutellum brownish as is the disk of the metanotum (postscutellum), rest of thorax mostly black or blackish; propodeum black, the areola poorly or not at all satisfactorily defined, virtually confluent with the basal area and petiole area, apical transverse carina well developed on each side of the median longitudinal carinae, lateral carinae virtually wanting, median longitudinal carinae wanting or poorly defined where they bound the basal area; wings transparent tinted with brown, veins and stigma mostly dark brown, legs mostly stramineous, hind tibiae with most of apical third blackish, hind tarsi mostly fuscous, fore and mid-coxae and all trochanters more or less yellowish; abdomen shining; basal tergite granular, blackish except for the apical fifth which is mostly stramineous with two longitudinal carinae; second tergal segment granular, with the apical two-fifths mostly stramineous as are the thyridia, remaining tergal segments smoother than the preceding, although more or less similarly colored, ovipositor not exerted.

Male.—Similar except for the thorax, which is almost entirely black and in the better developed carinae of propodeum and first tergal segment.

Type.—Cat. No. 13504, U.S.N.M.

Type-locality.—Tallulah, Louisiana.

Received from the U. S. Department of Agriculture, Bureau of Entomology, under Hunter No. 1936, II, 14, 8-10-10, 7-12-10. Par. *Caliroa amygdalina*, R. A. Cushman, collector; additional data on specimens bearing the same number and locality are II, 10, 5-17-10, 4-16-10; II, 17, 9-4-10, 8-12-10, 9-7-10, 8-12-10.

Genus CAMPOLETIS Foerster

Type.—*Limnerium (Campoletis) prodeniae*, new species.

LIMNERIUM (CAMPOLETIS) PRODENIÆ, new species.

Female.—Length, 5 mm. Black, covered with silvery pubescence that obscures the tegument only on the face and there only when viewed in certain lights; cheeks in the middle hardly more than half as wide as the eye as seen from the side, malar line a little shorter than the mandibles are wide at base, clypeus depressed along the anterior margin which is smooth and polished in the middle where it is produced into a kind of lip approaching in character the anterior edge in *Sagarites*, lateral suture between clypeus and face appearing distinct owing to the apparent reflection of the lateral edge of the clypeus, scape partly brownish in front, rest of antennae black or blackish, mandibles yellowish except apically where they are as usual more or less castaneous to blackish, palpi yellowish; inner edge of eyes slightly, shallowly impressed above the middle, greatest diameter of lateral ocellus hardly more than half as long as the ocell-

ocular line, lateral ocellar line a little longer than the greatest diameter of the lateral ocellus, postocellar line nearly one and one-half times as long as the lateral ocellar line; costulae developed, extending to the lateral longitudinal carinae, which latter are not well defined, basal area and areola nearly as in *Limnerium oxylus* Cresson except that the third abscissa of the median longitudinal carina is nearly parallel to its fellow of the opposite side, apical transverse carina poorly developed, more or less wanting, second abscissa of radius straight as compared with the first and a little more than one and one half times as long as the same, stigma nearly three times as long as wide or high, areolet mesochorine in shape, petiolate, nervellus angulate below the middle, the portion below the angulation post-furcal, hind claws apparently simple; tegulae, base of wings, anterior, middle and distal posterior trochanters yellow, anterior and middle coxae more or less brownish, hind coxae black, proximal posterior trochanters mostly blackish, fore and mid-femora translucent brownish, hind femora castaneous, fore and mid-tibiae translucent brownish with yellowish above except apically, hind tibiae variegated with a yellowish band at base followed by a fuscous band then a yellow band, and finally with the apical third infuscated, tarsi more or less brownish; abdomen with a more or less developed apical brownish band to the dorsal segments and with the greater part of the sides of the compressed segments brownish, plica yellow infuscated.

Male.—Similar to the female. The type lacks entirely the apical transverse carina.

Type.—Cat. No. 13483, U.S.N.M.

Type-locality.—Mount Washington, Ohio.

The types were received from the U. S. Department of Agriculture, Bureau of Entomology, with the following legends: "Bred from *Prodenia ornithogalli*, August 21, 1909." H. M. Miller, collector.

MEGARHYSSA GREENEI, new species.

Female.—Length, 27 mm.; sheaths of the ovipositor 35 mm. long; similar to *Megarhyssa lunator* (Fabricius Cresson), from which it may be distinguished by the maculation of the wings being confined to the basal half of the marginal cell and to the apical third of the discocubital cell and by the length of the sheaths of the ovipositor which compared with the length of the body are comparatively shorter than in *Megarhyssa lunator* (Fabricius, Cresson).

Male.—Similar in color with the female but with traces of infuscation along the basal vein; abdomen differing from that in *Megarhyssa lunator* (Fabricius, Cresson) in ground color, and in the third to seventh tergal segments lacking a median longitudinal furrow.

Type.—Cat. No. 13499, U.S.N.M.

Type-locality.—Harrisburg, Pennsylvania; female June 21, male August 22, 1908. Collected by A. B. Champlain.

The paratypes are from Boonton, New Jersey, August 14, 1901, collected by Geo. M. Greene; Canada; Pequaquawaming Point, Baraga County, Michigan, "woods on maple," July 23, 1903, collected by Morgan Hebard; Indiana (Baker), No. 2002; Harrisburg, Pennsylvania, June 8, 1908, August 22, 1908, P. R. Myers, collector; New Haven, Connecticut, August 10, 1909, A. T. Bourne; Philadelphia, Pennsylvania, July 4, 1899, H. Skinner.

In the smallest paratype the body is 17 mm. long and the sheaths of the ovipositor 22 mm. long.

MESOCHORUS INFERNALIS, new species.

Female.—Length, 2.5 mm. Related to *M. scitulus* Cresson, from which it may be distinguished as follows: Basal areas brownish, basal area about three times as wide at base as at apex and nearly four times as long down the middle as wide at apex, areola a little more than twice as long as wide between the costulae, sides of areola basad of costulae a little shorter than sides of areola beyond the costulae and about twice as long as the areola at apex, petiolarea about as long as the areola, but twice as wide as the same, one-third as wide at base as at apex, the basal sides a little shorter than the apical sides; basal third of first abdominal segment stramineous, apical third partly castaneous, hind femora stramineous, hind tibiae banded at base and apex with fuscous, their tarsi stramineous.

Male.—Similar to the female. Basal areas blackish; areola and second lateral area brownish; apical third of first abdominal segment black.

Type.—Cat. No. 13480, U.S.N.M.

Type-locality.—Santa Maria, Texas. Received from the U. S. Department of Agriculture, Bureau of Entomology, under Webster, No. 4612. Reared in connection with *Apanteles* (*Protapanteles*) *flaviconchæ* Riley, which is probably its host. The date is March 15, 1909. Collector, T. D. Urbahns.

MESOCHORUS PATULUS, new name.

Mesochorus areolatus VIERECK, Trans. Amer. Ent. Soc., vol. 29, p. 92, separate p. 91, 1903; not Provancher, Nat. Can., vol. 14, 1883, pp. 4, 5.

MESOCHORUS NIGRISIGNUS, new species.

Female.—Length, 3.5 mm.; exerted portion of sheaths of the ovipositor at least two-thirds the length of the first tergal segment; stramineous, shining, head and dorsulum tinged with brownish; pronotal groove not divided by a longitudinal median carina, areola pentagonal, its bounding carinae sharply defined, but little more than twice as long down the middle as wide between the junction of the costulae, the latter width nearly twice that of the areola on its shortest

side; hind tibiæ whitish, brownish at base and apex; first tergal segment with gradually converging sides to the beginning of the apical two-thirds, beyond this point gradually widening so that it is at least twice as wide at apex as at base, smooth and polished; setting of the spiracles virtually not at all elevated to a higher plane than the rest of the segment, postpetiole with a shallow almost tear-shaped fossa down the middle, second tergal segment with a deeply, triangularly emarginate black band immediately beyond the thyridia.

Type.—Cat. No. 13509, U.S.N.M.

Type-locality.—Grand River, Iowa.

Presumably parasitic on *Microplitis melianæ* Viereck. "From *Meliana albilinea*, Experiment 500, July, 1910." R. L. Webster.

PHYGADEUON (BATHYMETIS) PATULUS, new species.

Male.—Length, 7.5 mm. Compared with the description of *Phygadeuon* (*Mastrus*) *neodiprioni* Viereck as given below this species differs as follows: Face shining, with rather clearly defined punctures, clypeus with a testaceous mark on each side, antennæ 30-jointed, flagel brownish throughout, darker above on basal half and throughout beyond the middle than above at base; tegulæ yellow, coxæ and trochanters of fore legs and trochanters of middle legs mostly yellow, fore tibiæ and tarsi virtually stramineous, middle lateral area ribbed with rather prominent rugæ; tergum smooth, polished, almost sculptureless throughout.

Type.—Cat. No. 13506, U.S.N.M.

Type-locality.—Crawford, Nebraska.

"Bred from a Diprionid July 18, 1910." M. H. Swenk.

Genus DAICTES Foerster (= ISOTIMA Foerster.)

The following species is regarded by the writer as an *Isotima* with an areolet, as is found in *Hemitles* Gravenhorst, strictly speaking. As it agrees with the diagnosis of *Daictes* Foerster except in having an incomplete areolet and the latter name has page precedence, it is proposed to regard it as a *Daictes* Foerster and assign it as a subgenus of *Phygadeuon* at present, it being apparently a Phygadeuonine in spite of the conformation of the areolet. Compared with the genotype of *Stiboscopus* (Foerster) Ashmead, *Stiboscopus thoracicus* Ashmead, the description of *Daictes* will read as follows:

Antennæ thickened so that the first flagellar joint is hardly more than three times as long as thick at base, greatest width of head back of the eyes, as seen in profile as great as the corresponding width of the eyes seen from the same point of view, distance from the antennal line to the apex of clypeus about as great as the distance from middle of face to eye margin; apical transverse carina

angularly produced into a flattened process where it joins the lateral longitudinal carina, costule poorly developed almost lost in part among the sculpture, first abscissa of the discoidal vein as long as the remaining abscissæ combined, the side of the stigma adjoining the disco-cubital cell almost half again as long as the side adjoining the radial cell; spiracles of first tergal segment prominent, the same segment with a distinct carina extending from the spiracles to the apex of the segment.

PHYGADEUON (DAICTES) FUKAI, new species.

Female.—Length, 5.5 mm.; head black, dullish, indistinctly punctured, scape and mandibles black, shining as is the clypeus, pedicel blackish, first, second, and third joints of the flagel brownish, remaining flagellar joints black or blackish, lateral ocellus a little nearer the anterior ocellus than to the eye margin, palpi stramineous, infuscated; thorax black and shining, indistinctly punctured, tegulæ brownish, wings suffused with brownish, veins dark brown, stigma dark brown except at base, where it is yellowish, fore wings yellow at base, legs mostly reddish brown, coxæ black, tibiæ and tarsi stramineous, infuscated, proximal trochanters more or less blackish, distal trochanters more or less concolorous with femora; propodeum black, shining, indistinctly punctured, the fused angular area and third lateral area rugose; first tergal segment black and polished, the dilated portion finely aciculated, second and third tergal segments reddish, polished, more or less indistinctly sculptured, remaining tergal segments black, polished, almost sculptureless, sheaths of the ovipositor blackish, about as long as the first tergal segment.

Type.—Cat. No. 13498, U.S.N.M.

Type-locality.—Konosu, Saitama, Japan.

T. Fukai, collector.

Named for Mr. T. Fukai.

Genus MASTRUS Foerster.

The species to be described below is evidently a Phygadeuonine with an incomplete areolet. In Foerster's classification this would go to *Leptodemus* on condition that the areolet be ignored. Now the genotype of *Leptodemus* would appear to be *L. cariniscutis* Cameron as that is the first species to be included under *Leptodemus* to the knowledge of the writer. Accordingly the description of *Leptodemus* Foerster is amplified through Cameron's description of *Leptodemus cariniscutis* Cameron. As the *Leptodemus* Foerster, Cameron has the scutel carinate laterally on the basal half and the wings with a complete areolet, which is not the case in the following species, it is deemed unwise to call it a *Leptodemus* Foerster, Cameron. In

Foerster's classification of the Hemitelini where our species would go on account of the incomplete areolet we find that it attaches itself to *Mastrus* Foerster. As *Mastrus* has as yet no species in it we propose to take the liberty to include our species and transfer *Mastrus* to the Phygadeuoninæ near *Leptodemas*.

PHYGADEUON (MASTRUS) NEODIPRIONI, new species.

Female.—Length 6 mm.; exerted portion of sheaths of the ovipositor about two-thirds the length of the tergum, head black and shining except for the face which while black is dullish and mostly closely punctures, the punctures not clearly circumscribed, basal half of mandibles mostly testaceous, the apical half mostly castaneous margined with black; antennæ 27-jointed, from testaceous to brownish beneath, fuscous above, palpi mostly stramineous; thorax black and shining, tegulæ brownish, wing base yellow, wing transparent tinged with brown, most of veins and most of stigma blackish, coxæ and trochanters the color of brownish amber, femora, fore and mid-tibiæ reddish, hind tibiæ reddish tinged with brown, tarsi mostly brownish; propodeum black and shining, poorly sculptured except in the confluent angular and third lateral areas where the sculpture consists of coarse rugæ; first tergal segment black on its basal half becoming reddish tinged with black beyond, first tergal segment beyond the spiracles, or the postpetiole, longitudinally striated laterally; second tergal segment reddish, shining, the apical two-fifths depressed and very smooth, the basal three-fifths not depressed and granularly sculptured; remaining tergal segments smooth and polished almost sculptureless, the third and fourth brighter red than the preceding; fifth reddish suffused with black at base, blackish apically margined with stramineous; sixth segment blackish margined with stramineous; seventh segment blackish except in most of its middle third where it is membranous and stramineous, sheaths of the ovipositor blackish, ovipositor mostly translucent reddish brown.

Type.—Cat. No. 13505, U.S.N.M.

Type-locality.—Crawford, Nebraska.

"Bred from a Diprionid July 18, 1910." M. H. Swenk, No. 1.

Genus TOXOPHOROIDES Cresson.

Type.—*Lycorina*? *apicalis* Cresson.

Related to *Lycorina* Holmgren but differs especially as follows:

Apical joint of antennæ as long as or longer than the two preceding joints combined; scutel rounded off at apex and narrower at apex than long down the middle; propodeum without a basal area and with only the arcuate transverse carina¹ fully developed, no other

¹In the male as represented by *Glypta zanthozonata* Ashmead, even this carina is incomplete.

carinæ present except the median and lateral longitudinal carinæ which latter are much abbreviated and arise at the apex of the sclerite but do not attain a point anywhere near the middle of this segment, basal segment with a flaring buttress on each side of the basal half of the segment, the basal segment not at all channeled down the middle; apical joint of hind tarsi shorter than the two preceding.

Still another species of *Toxophoroides* is *Glypta scitula* Cresson.

FINAL SUPPLEMENT TO THE CATALOGUE OF THE PUBLISHED WRITINGS OF CHARLES ABIATHAR WHITE, 1897-1908.

By TIMOTHY W. STANTON,

Custodian of the Mesozoic Collection, U. S. National Museum.

Dr. Charles A. White, who died in Washington June 29, 1910, at the age of eighty-four, had been officially connected with the United States National Museum for more than thirty years as curator of paleontology, honorary curator of Mesozoic fossils, and, finally, after retirement from more active duties, as associate in paleontology. A brief biographical notice will be published in the Annual Report of the United States National Museum.

An annotated list of his published papers was included in Bulletin 30 of the United States National Museum, published in 1885, and a supplement bringing the record down to 1897, with a total of 211 entries, was printed in the Proceedings of the United States National Museum, volume 20, pages 627-642. It is appropriate that the institution with which Doctor White was so long associated should complete the record of his activity as a scientific writer by printing the following final supplemental list containing 27 titles of papers published between 1898 and 1908. The titles are taken from a chronologically arranged and numbered manuscript list prepared by Doctor White himself.

212.

WHITE, C. A. Household Fuels and their Economic Uses. (Edited by his daughter, Marian White.) American Kitchen Magazine, vol. 9, pp. 16-18; 59-62; 137-142; 182-184; 221-225, and vol. 10, pp. 13-17; 49-54; 124-129; 162-164; 207-209. Boston, 1898-1899.

213.

WHITE, C. A. Early Homes and Home-makers of Iowa. Annals of Iowa, ser. 3, vol. 4, pp. 179-195. Des Moines, 1899.

214.

WHITE, C. A. The structure and significance of certain botanical terms. Science, new ser., vol. 12, pp. 62-64. New York, 1900.

215.

WHITE, C. A. Epitropism, Apotropism and the Tropaxis. *Science*, new ser., vol. 12, pp. 143-146. New York, 1900.

216.

WHITE, C. A. Varietal Mutation in the Tomato. *Science*, new ser., vol. 14, pp. 841-844. New York, 1901.

217.

WHITE, C. A. Memoir of Rev. Willis Hervey Barris, D.D. *Annals of Iowa*, ser. 3, vol. 5, pp. 219-224. Des Moines, 1901.

218.

WHITE, C. A. The Mutation Theory of Professor de Vries. *Annual Report of the Smithsonian Institution for 1901*, pp. 631-640. Washington.

219.

WHITE, C. A. The Saltatory Origin of Species. *Bull. Torrey Botanical Club*, vol. 29, pp. 511-522. New York, 1902.

220.

WHITE, C. A. My Tomato Experiments. *New York Independent*, vol. 54, pp. 1460-1464. New York, 1902.

221.

WHITE, C. A. Petiolate Connation in *Trifolium Pratense*. *Torreya*, vol. 2, pp. 183, 184. New York, 1902.

222.

WHITE, C. A. Aggregate Atavic Mutation in the Tomato. *Science*, new ser., vol. 17, pp. 76-78. New York, 1903.

223.

WHITE, C. A. My Boyhood Recollections of the Sac and Fox Indians. *Annals of Iowa*, ser. 3, vol. 8, pp. 617-625. Des Moines, 1903.

224.

WHITE, C. A. A Visit to the Quarry-Caves of Jerusalem. *Popular Science Monthly* vol. 62, pp. 544-549. New York, 1903.

225.

WHITE, C. A. Spontaneous Fission of Olive trees in Palestine. *Plant World*, vol. 6 pp. 57, 58, one plate. Washington, 1903.

226.

WHITE, C. A. De Mutatie-Theorie en de Paleontologie. *Album du Natuur*, 1903 7 aflevering, pp. 231-238. Haarlem, Netherlands. Translation into Dutch from the English manuscript.

227.

WHITE, C. A. Die Mutationstheorie und der Paläontologie. *Natur und Schule* vol. 3, pts. 5-6, pp. 248-253; Berlin and Leipzig, 1904. Translated into German from the same manuscript as entry 226.

228.

WHITE, C. A. The Mutations of *Lycopersicum*. *Popular Science Monthly*, vol. 67, pp. 151-161. New York, 1905.

229.

WHITE, C. A. The Relation of Phylogenesis to Historical Geology. *Science*, new ser., vol. 22, pp. 105-113. New York, 1905.

230.

WHITE, C. A. The Ancestral Origin of the North American Unionidae, or Fresh Water Mussels. *Smithsonian Miscellaneous Collections*, vol. 48, (Quarterly Issue), pt. 1, pp. 75-88, pls. 26-31. Washington, 1905.

231.

WHITE, C. A. Memoir of John Strong Newberry. *Biographical Memoirs of the National Academy of Sciences*, vol. 6, pp. 1-24. Washington, 1906.

232.

WHITE, C. A. The Black Locust Tree and its Despoliation. *Popular Science Monthly*, vol. 68, pp. 211-218. New York, 1906.

233.

WHITE, C. A. The Northern Limit of the Papaw Tree. *Science*, new ser., vol. 23, pp. 749-751. New York, 1906.

234.

WHITE, C. A. Biographical Memoir of Dr. Charles Christopher Parry. *Annals of Iowa*, ser. 3, vol. 7. Des Moines, 1906.

235.

WHITE, C. A. The Archaic Monetary Terms of the United States. *Smithsonian Miscellaneous Collections*, vol. 50 (Quarterly Issue), pp. 93-104. Washington, 1907.

236.

WHITE, C. A. Aggregate Mutation of *Gossypium*. *Science*, new ser., vol. 27, p. 191. New York, 1908.

237.

WHITE, C. A. The Phenogamous Parasites. *American Naturalist*, vol. 42, pp. 12-33. Boston, 1908.

238.

WHITE, C. A. The Aggregate Mutation of Parasitic Plants. *American Naturalist*, vol. 42, pp. 98-106. Boston, 1908.

239.

WHITE, C. A. The origination of organic Forms. *Annals of Iowa*, ser. 3, vol. 8, pp. 343-358. Des Moines, 1908.

NOTES UPON TWO RARE FLATFISHES (GYMNACHIRUS
FASCIATUS GÜNTHER AND G. NUDUS KAUP).

By W. C. KENDALL,
Assistant, U. S. Bureau of Fisheries.

On January 29, 1903, on station 7438, in Jewfish Bush Lake, 6¼ miles northwest by north of the west end of Long Key, Florida, in 8 feet of water, where the bottom consisted of "coral bar," the U. S. Fish Commission steamer *Fish Hawk* took in a small "scrape dredge" a specimen of *G. fasciatus* Günther, 2½ inches long, of which this is the first published record, and the only one of the species since that of the specimen described by Günther¹ from some unknown locality.

Günther's description of *G. fasciatus* indicates that it differs from *G. nudus* Kaup only in the number of dorsal and anal fin rays and the presence of a rudimentary pectoral fin on the right side.

The present specimen agrees essentially with the description by Günther, but perhaps showing a few more faint crossbars; being oval rather than circular, broadest posteriorly, and having an irregularly curved lateral line, arched somewhat in front, then curving gradually downward, then upward, thence straight to the tip of caudal, and somewhat longer pectoral.

Head 4; depth 1.81; lower eye 4.28; distance from lower eye to tip of upper jaw 2.70; depth of caudal peduncle 2 in head. Lower pectoral ray prolonged, longer than eye. Eye in pectoral 1.4; D. 68; A. 48; V. 5; P. 2; C. 16.

Transverse rows of cilia on body white tipped; preopercular and opercular ridges, chin, mouth, and snout fringed with cirri; ventral fringed; strongly fringed in front of dorsal to tip of snout, making it difficult to tell where dorsal begins; tips of dorsal, anal, and caudal rays bifid.

Color on right side brown with fourteen or more narrow, transverse, darker bars, extending on vertical fins, and plain lighter brownish on

¹ Catalogue of the Fishes in the British Museum, vol. 4, 1862, p. 488.

Condensed description from Günther:

Total length 7½ inches; head about 4½ (5½ in total length); depth about 1½ (2 in total length with caudal); D. 68; A. 50; P. 2; V. 5; pectoral very small, 3 in orbit; jaws hidden in thick skin; lips and left side of head covered with fringes; gill-opening not extending upward as far as pectoral; vertical fins in thick skin.

Yellowish olive with 14 brown cross bands, as broad as the interspaces, all extending on dorsal and anal, the first across snout, second and third across eye; caudal with 3 brown cross bands; tips of the rays of the vertical fins white.

left side; tips of vertical fins, caudal rays, and pectoral white. Preserved in U. S. National Museum.

On October 20, 1906, Mr. Vinal N. Edwards, agent of the Bureau of Fisheries, at Woods Hole, Massachusetts, collected in Tisbury Great Pond, near the outlet, Marthas Vineyard, Massachusetts, a specimen of naked sole, of which the only previous record is the original one of Kaup,¹ who in 1858, under the name *Gymnachirus*

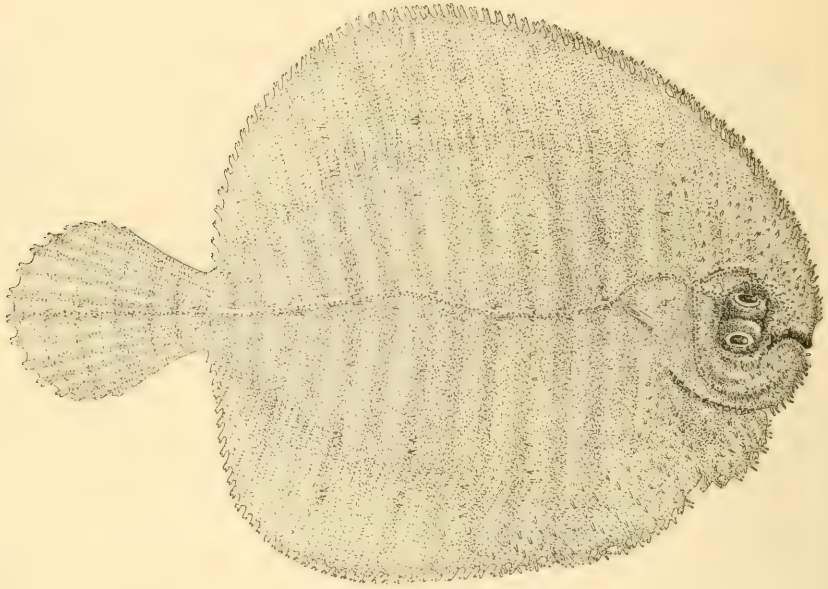


FIG. 1.—GYMNACHIRUS FASCIATUS.

nudus, described a scaleless sole from Bahia, Brazil, making it the type of a new genus.

The Tisbury Great Pond specimen of *G. nudus* is somewhat larger and more circular in outline than the Florida specimen of *G. fasciatus*, darker in color, and has a straighter lateral line. It also appears to have a longer head, somewhat smaller eye, and longer snout, but otherwise, except in the absence of pectoral, agrees with it very closely as it does with the description of *G. fasciatus* of Günthér.

¹ Übersicht der Soleinæ der vierten subfamilie der Pleuronectidæ, Weigenmann Archiv für Naturgeschichte, vol. 1, 1858, p. 101.

Abridged translation of description:

"Without vestige of scales on body and fins. Anterior nostril in lip, next corner of mouth; second above this, midway between the eyes. Five rays in right ventral fin; no left ventral. * * *

"Somewhat longer than deep, profile and chin with cilia. Lateral line above middle of opercle, high, curved, and reaching tip of snout. The slimy brown body with 14 black crossbars, which extend upon the fins. Irregular concentric rings about the eyes. Caudal fin edged with white, with two black bands at beginning.

"D. 51; A. 42; V. 0-5; C. 17.

"Bahia; presented to the Paris collection by the Geneva Museum."

Total length about $2\frac{3}{4}$ inches; head 3.82; depth 1.85; lower eye 4.75; distance from lower eye to tip of upper jaw 2.77; depth of caudal peduncle 1.70 in head. D. 64; A. 50; V. 5; C. 16.

Strongly fringed about the head, in front of dorsal and ventral, and crossrows of cilia on body; tips of rays of vertical fins and caudal bifid.

Color in formalin very dark brown with slight traces of fourteen or more darker crossbars on body, which have disappeared after a long

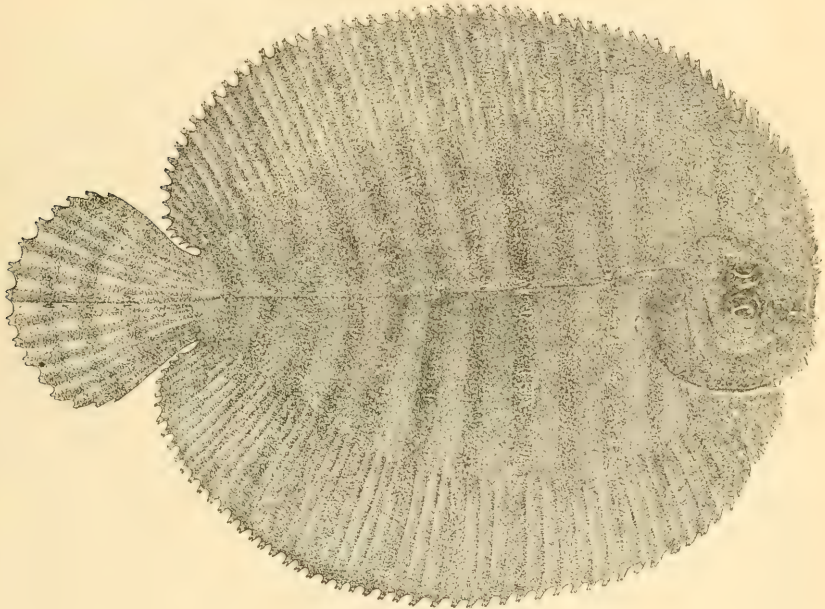


FIG. 2.—GYMNACHIRUS NUDUS.

time in alcohol, the body becoming almost black; left side very dusky but not so black; tips of vertical fin rays white. (Cat. No. 67356, U.S.N.M.)

More remarkable than the presence of this bottom fish in southern Massachusetts waters is the fact that it was taken in a so-called pond or estuary usually inclosed from the sea several months of the year. Of course, in the pond it is a chance occurrence, probably being one of the numerous stray species from southern waters brought north by the Gulf Stream as a surface-swimming young.

DESCRIPTIONS OF TINEOID MOTHS (MICROLEPIDOPTERA)
FROM SOUTH AMERICA.

By AUGUST BUSCK,

Of the Bureau of Entomology, U. S. Department of Agriculture.

The U. S. National Museum is indebted to Mr. William Schaus for the material on which the following paper is based, as well as for the bulk of the Central and South American material of tineoid moths it possesses, which is considerable.

In the working up of this material the writer has carefully avoided any interference with Lord Walsingham's part of the *Biologia Centrali-Americana*, which is now in press or partly issued, and with the material for which the writer is thoroughly familiar. For this reason very many new species and genera from South America, now contained in the National Museum, were passed by and these remain to be described when the genera shall have been established by the publication of the *Biologia*.

In the identification of the forms already described from South America, Zeller's careful descriptions usually suffice to establish the identity of the species; Felder's species also may be recognized with reasonable certainty from his colored figures. Walker's numerous descriptions, on the other hand, are as a rule quite inadequate for recognition, but the writer has had the opportunity to study his types in the British Museum, and the National Museum has obtained carefully colored figures of these types, which proved a valuable aid in their identification.

Family GELECHIIDÆ.

PLEUROTA LITERATELLA, new species.

Plate 8, fig. 12.

Labial palpi very long, typically *Pleurota*-formed, brown with whitish base. Face and tongue whitish. Head and thorax light brown. Forewings long, narrow, pointed, spear-shaped, light brown; dorsal half somewhat lighter and more yellowish than costal half and separated from it by an indistinct longitudinal streak of darker

brown; at the end of the cell is a faint blackish shade, hardly discernible as two small black dots; on the middle of the wing are two small, well-defined ocher-yellow dots, edged with reddish scales, one on each side of vein 1^b; extreme dorsal edge ocherous towards base. Hindwings yellowish white. Abdomen above salmon red; underside and anal tufts yellowish white. Legs yellowish white, tufts on posterior tibiæ brown.

Alar expanse.—32–38 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13557, U.S.N.M.

Cotype in British Museum.

A striking species typical of the genus in oral and venational characters, but with rather unusual narrow, spear-shaped forewings.

PSORICOPTERA APICEPUNCTA, new species.

Plate 9, fig. 35.

Labial palpi light ocherous, mottled with brown. Antennæ brown with basal third deep black. Face ocherous. Head light brown. Thorax light brown; patagia with base black. Forewings light deer brown, finely mottled with indistinct, transverse, black striation: on the middle of the cell is a small black, oblong spot, and at extreme apex is another deep black, very prominent, larger spot. Cilia light brown. Hindwings dark silky fuscous. Abdomen dark fuscous above, underside light brown. Legs ocherous brown.

Alar expanse.—28 mm.

Habitat.—Cayenne, French Guiana; Panama; Tuis, Turrialba, and Sixola River, Costa Rica. Wm. Schaus, collector.

Type.—Cat. No. 13558, U.S.N.M.

Cotype in British Museum.

A striking, clear-cut species, typical of the genus and not mistakable for any other described species.

Family CECOPHORIDÆ.

FILINOTA, new genus.

Type.—*Filinota hermosella* Busek.

Labial palpi long, recurved, reaching beyond the vertex; second joint slightly thickened with smoothly appressed scales; terminal joint long, but shorter than second, slim, smooth, pointed. Antennæ longer than the forewings, finely ciliated (1); basal joint without pecten. Tongue long, curled, scaled. Forewings long and narrow, nearly five times as long as broad; costa and dorsum nearly parallel; termen evenly rounded; apex bluntly pointed; 12 veins; 7 and 8 stalked; 7 to costa; 2 from before end of cell; 3 and 4 stalked from

end of cell; 1^b furcate at base. Hindwings broader than the forewings; costa straight; dorsum and termen evenly rounded; apex rather pointed; 7 veins; 8 free; 6 and 7 parallel; 3 and 4 coincident; 5 approximate to 3+4. Posterior tibiæ nearly smooth, slightly hairy above.

Closely related to the European genus *Carcina* Hübner, but further developed and differing in the narrow wings and the coincident veins 3 and 4 in the hindwings; also it has lost the pecten on the basal joint of the antennæ and vein 7 has reached the costal side of apex.

FILINOTA HERMOSELLA, new species.

Plate 8, fig. 7.

Labial palpi light golden yellow, touched exteriorly with carmine. Face and head straw yellow; collar carmine. Antennæ carmine with golden underside and basal joint and with pale yellow tip, preceded by a broad blackish band. Thorax golden yellow with central carmine spot. Ground color of the forewings bright carmine with golden yellow, blackish brown, and silvery white ornamentation; costal edge from near base to apex and terminal edge golden; on the dorsal edge are two silvery white spots, one at basal fourth continued up into a whitish yellow spot on the cell, the other triangular at apical third. Three small golden yellow dashes are found on basal half of the wing, one at the base, one just within the dorsal margin beyond the first silvery spot, and one following the continuation of that spot on the middle of the cell. On the middle of the apical part of the wing is a large conspicuous silvery white dash surrounded first by carmine, then by blackish brown scales, which latter are continued into long winding lines in the central part of the carmine, between the various white and golden spots. Cilia blackish brown. Hindwings paler carmine with golden cilia. Abdomen carmine above, yellow laterally and on the underside. Front legs carmine, annulated with black; hind legs yellow with a deep black, longitudinal line on first tarsal joint. Underside of wings bright carmine.

Alar expanse.—15-17 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13559, U.S.N.M.

A very striking brilliantly colored insect.

FILINOTA PERUVIELLA, new species.

Plate 8, fig. 9.

Labial palpi light golden yellow. Face silvery white. Head yellow touched with carmine. Antennæ yellow. Thorax yellow with carmine anterior and posterior spots. Forewings light yellow with carmine and blackish brown streaks. Base of costal edge carmine; three longitudinal carmine lines on basal part of the wing; from

basal fourth of costa to the middle of dorsum and back to the apical third of costa runs a narrow blackish brown line shaped like a V, lightly edged with carmine; across the tip of the wing runs a similar brown line, also edged with carmine, parallel with the outer leg of the V and connected with it by two longitudinal, somewhat oblique carmine lines. Cilia brownish yellow. Hindwings silvery white. Abdomen light yellow. Legs yellow.

Alar expanse.—17 mm.

Habitat.—Peru. Schaus collection.

Type.—Cat. No. 13560, U.S.N.M.

An equally striking species, closely allied to the type of the genus but with quite different pattern and of lighter color.

Genus PELEOPODA Zeller.

Peleopoda ZELLER, Horæ Soc. Ent. Rossicæ, vol. 13, 1877, p. 385.

Type.—*Peleopoda lobitarsis* Zeller.

Though Zeller's generic descriptions are totally inadequate for absolute determination, I feel reasonably assured in applying his name *Peleopoda* to the present genus, which has the following characters: Labial palpi rather short, hardly reaching vertex; second joint thickened with loose scales toward apex; terminal joint short, pointed. Antennæ about half the wing length, ciliated; basal joint without pecten, thickened with scales. Tongue short. Thorax and abdomen robust. Forewings elongate, two and one-half times as long as broad; slightly broadened outwardly; costa straight, a little deflected toward apex; apex bluntly pointed; termen straight, oblique; 12 veins; 7 and 8 stalked; 7 to termen; 9 and 10 connate or stalked from end of cell, closely approximated to stalk of 7 and 8; or 9 out of stalk of 7 and 8; 2 and 3 closely approximated from end of cell; 1^b furcate at base. Hindwings broader than forewings; costa straight; termen and dorsum evenly rounded; apex bluntly pointed; 8 veins; 6 and 7 parallel; 3 and 4 stalked; 5 cubital, parallel with 4. Posterior tibiæ and tarsal joints with heavy bunches of compressed hairs above.

PELEOPODA MARONIELLA, new species.

Plate 8, fig. 16.

Labial palpi light ochreous, shaded with dark brown exteriorly. Face reddish brown below, white just beneath vertex. Head whitish. Antennæ white above, reddish on the underside; ciliation (1). Thorax heavily scaled, white, faintly tinted with ochreous; posterior tuft tipped with reddish brown. Forewings whitish, thickly overlaid with pink, brown, and golden scales. Costal edge from base to apical fifth rosy pink, which color spreads out on the middle of the wing and is diffused as a tint over the entire tip of the wing, more

especially on the veins. Apical fifth of costa golden yellow, edged below by a blackish brown streak. On the middle of dorsum is a large brown area and dark brown scales are sprinkled over most of the wing aggregating into short dark streaks, of which the longest is on the middle of the wing at the base, two smaller ones on the cell and still smaller and less defined ones along the apical veins. Just beyond the cell is a large diffused very pale golden blotch. Cilia whitish with dark brown streaks. Hindwings golden fuscous with dark brown veins. Abdomen dark golden brown above; genitalia and underside golden white. Hind legs heavily tufted on tibiæ and tarsal joints; pink on the inner side, dark brown exteriorly. Underside of wings golden fuscous with costa of forewings broadly rosy pink. Veins 9 and 10 of forewings stalked.

Alar expanse.—26 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13561, U.S.N.M.

PELEOPODA NOTANDELLA, new species.

Plate 8, fig. 15.

Labial palpi dark yellow, shaded externally with carmine. Lower face yellow, upper face white, along the eyes carmine. Antennæ reddish yellow, ciliation (1). Thorax and head white, collar touched with red. Forewings pinkish white with red golden and blackish brown ornamentation. Basal half of costal edge rosy pink; outer third dark golden yellow, which color widens out to an oval costal spot just before apex. Beyond the cell is a large ill-defined pale golden spot. Dark brown scales are sprinkled over the cell, over and around the pale golden spot and below the dark yellow apical spot; an ill-defined streak of brown scales runs from the end of the cells to termen and along the terminal edge are five small brown dots. Cilia rose. Hindwings pale brick red, cilia lighter. Abdomen pale red above, underside and genitalia golden yellow. Legs yellowish with heavy pale rose-colored tufts on tibiæ and tarsi. Underside of wings pale brick red. Forewings with vein 10 connate with and vein 9 out of stalk of 7 and 8.

Alar expanse.—19–20 mm.

Habitat.—St. Jean, Maroni, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13562, U.S.N.M.

Cotype in British Museum.

PELEOPODA IRENELLA, new species.

Plate 8, fig. 17.

Labial palpi carmine red; tip of apical joint white. Face, head, and thorax white. Antennæ yellow, dotted with black above. Forewings

white, but heavily overlaid with dark brown and saffron yellow scales. A large spot on the middle of costa and the basal half of dorsum pure white. The golden yellow consists of a broad streak along the fold, a large ill-defined spot at the end of the cell transversed by a white zigzag line, and a broad ill-defined band, running from this spot down to termen and along the terminated edge around apex to costa. The space between this golden yellow edge and the central yellow spot is suffused with dark brown scales, densest toward apex; a large dark brown triangular spot occupies the space along basal third of costa across the cell to the yellow fold. Hindwings blackish brown; cilia lighter brown. Abdomen dark brown above; underside pale golden; genitalia saffron. Underside of the wings dark fuscous. Front legs thickened with tufts of carmine red, tipped with white. Hind and middle legs yellowish, shaded with brown; tarsal tufts small, whitish.

Alar expanse.—25 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13563, U.S.N.M.

HASTA, new genus.

Type.—*Hasta argentidorsella* Busck.

Labial palpi very long, recurved, overarching the thorax; second joint particularly long with basal half thin and upper half thickened with compressed scales which protrude at apex; terminal joint thin, smooth pointed, shorter than second. Antennæ simple, with pecten on basal joint. Forewings two and a half times as long as broad; costa evenly arched; apex bluntly pointed; termen sinuate below apex; anal angle pronounced; 12 veins; 7 and 8 stalked; 7 to termen; 9 out of the stalk of 7 and 8; 2 and 3 stalked; 1^b furcate at base. Hindwings as broad as forewings; costa straight; apex blunt; termen and dorsum evenly rounded; 8 veins; 6 and 7 parallel; 3 and 4 connate; 5 cubital. Posterior tibiæ roughly haired.

Allied to *Anchinia* Hübner, but without raised scales on the forewings, and differing as well in palpal structure as in the venation and form of the forewing.

HASTA ARGENTIDORSELLA, new species.

Plate 8, fig. 3.

Labial palpi ochereous; tip of second joint brown. Face light yellow. Head dark ochereous. Thorax ochereous with a large central and posterior white patch. Forewings light yellowish brown, lightest along the costa; dorsum from base nearly to tornus silvery white, the color reaching up beyond the fold in an ill-defined triangle just beyond the middle of the wing; this dorsal white is broken by a dark brown spot, reaching from the upper dark part of the wing to the dorsal

edge before the middle of the wing, and by a group of deep blackish brown scales at apical third. Hindwings light yellowish fuscous. Abdomen and legs ochereous.

Alar expanse.—16–18 mm.

Habitat.—Castro, Parana, Brazil. Schaus collection.

Type.—Cat. No. 13564, U.S.N.M.

This species reminds one in form and ornamentation of the wings somewhat of certain *Cerostoma* species.

GONADA, new genus.

Type.—*Gonada falculinella* Busck.

Labial palpi recurved, reaching vertex; second joint thickened with appressed scales; terminal joint shorter than second, slim, smooth, pointed. Antennæ $\frac{3}{4}$, finely serrated and ciliated; basal joint without pecten. Tongue short. Forewings two and one-half times longer than broad, falcate; costa strongly arched; apex pointed, produced over the deeply incised termen; anal angle strongly produced; dorsum sinuous. Twelve veins; 7 and 8 stalked, both to costa; 9 separate; 10 distant; lower corner of cell, bearing 2, 3, 4, and 5, strongly produced; 3 and 4 connate. Hindwings as broad as forewings; costa straight; termen and dorsum evenly rounded; 8 veins; 6 and 7 parallel; 5 cubital, parallel with 4; 3 and 4 short-stalked. Posterior tibiae roughly haired above.

Allied to *Necedes* Walsingham, differing in wing form and palpi and in the connate veins 3 and 4 of the forewings.

GONADA FALCULINELLA, new species.

Plate 8, fig. 5.

Labial palpi light yellow, with a dark brown longitudinal streak on the upper side of second joint from base to apex, continued on the anterior side of terminal joint. Face whitish, ochereous brown along the eyes. Head and thorax light ochereous. Antennæ light ochereous, dotted with dark brown above. Forewings light purplish brown with dorsal area below the fold from base to apical third of dorsum light yellow. The entire wing is sparsely and irregularly sprinkled with black atoms. Costal edge narrowly blackish brown. Cilia light brown, with tips black at tornus. Hindwings light yellowish fuscous; cilia light yellow. Abdomen light yellow. Legs whitish, forelegs blackened exteriorly. Underside of forewings brown with the dorsal yellow design of the upper side plainly discernable.

Alar expanse.—23 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13565, U.S.N.M.

This species has a close superficial resemblance to *Falculina ochricostata* Zeller.

CRYPTOLECHIA ROSEOMARGINELLA, new species.

Plate 9, fig. 37.

Base of second joint of labial palpi blackish brown; tip and apical joint rosy white sprinkled with brown. Face, head, and thorax light ochereous. Forewing shining ochereous white with dark brown dusting, and with entire costa and terminal edge broadly rosy red. The dark brown scales are irregularly sprinkled over the wing with a first and second discal spot basely emphasized. From apical fourth of costa runs a dark brown line in an outward curve across the wing to dorsum. Cilia rosy with a faint dark marginal line. Hindwings very light lemon yellow with white cilia. Abdomen ochereous. Legs ochereous white. Venation and palpi typical of the genus.

Alar expanse.—20 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13566, U.S.N.M.

A striking species unlike any known to the writer, but to be associated with *C. canariella* and *C. huachuella* Busek, described from Arizona.

Family STENOMIDÆ.

STENOMA MAJOR, new species.

Plate 8, fig. 8.

Labial palpi ochereous. Antennæ ochereous fuscous, ciliated (1). Face whitish. Head and thorax light ochereous. Forewings elongate with costa evenly arched, reaching its highest point beyond the middle, thence abruptly declined to the sharply pointed, slightly protruded apex; termen oblique; dorsum straight; light ochereous with the entire edge narrowly dark ochereous brown and with three nearly equidistant and parallel, transverse, oblique ochereous brown streaks across the wing; the first of these streaks begins at basal third of costa and reaches to the fold, which is itself ochereous brown; the second begins before the middle of costa and reaches to tornus; the third begins beyond the middle of costa and reaches termen. Hindwings light yellow. Abdomen and legs yellow; tarsal joints not tufted as in the allied species.

Alar expanse.—50–60 mm.

Habitat.—Callao, Peru. Mrs. M. J. Pusey, collector.

Type.—Cat. No. 13567, U.S.N.M.

Cotype in British Museum.

The largest species known in the genus, closely related to *Stenoma lorotoma* Busek and *S. fraternella* Busek, but lighter in color, with much more pointed wings and with the three oblique streaks somewhat differently placed.

STENOMA IO, new species.

Plate 8, fig. 2.

Second joint of labial palpi carmine red; terminal joint dark brown with yellow tip, short. Antennæ reddish ochreous shaded with black above. Face light carmine. Head and collar deep brown. Thorax light brown with darker purple reflections. Forewings broad, not quite two and one-half times as long as wide; costa gently arched from base to apex; apex sharply pointed, somewhat produced; termen slightly sinuate; tornus produced, evenly rounded; dorsum straight from tornus to basal third, thence abruptly inclined toward base; color chestnut brown, overlaid on the basal two-thirds with a darker purple tint; the two shades rather sharply defined by a line from about the middle of costa to the beginning of the dorsal cilia. On the end of the cell lies a large irregularly triangular ocellate spot, deep velvety brown surrounded by a thin line of light yellow; obliquely below and before lies a similar smaller oblong spot on the fold and on the cell is a small aggregation of dirty yellow scales. Cilia short, dirty yellow with a black line parallel with the edge of the wing. Hindwings bright brick red, cilia yellowish. Abdomen and legs deep brick red. Underside of body and of both wings bright brick red.

Alar expanse.—46 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13568, U.S.N.M.

A very striking species unlike any described *Stenoma*, but most nearly allied to the foregoing group.

STENOMA ACRONITIS, new species.

Plate 8, fig. 19.

Second joint of labial palpi deep black with white tip; terminal joint white, sprinkled with black. Antennæ yellowish fuscous. Face dirty white, sprinkled with black. Head pure white. Thorax white, sprinkled with gray. Forewings short and broad with tufts of raised scales; costa straight; apex rounded; termen oblique; color chalky white, sparsely speckled with brown atoms and with blackish brown design; from basal fourth of costa runs a blackish brown streak in over the cell, outwardly, through the end of the cell, toward the middle of termen, but dividing shortly before the edge into two branches, of which one curves upward to a black, triangular, costal spot at apical fourth, while the other curves downwards and ends on the dorsal edge before tornus; the streak is not continuous, but is interrupted and enlarged at its entrance into the cell and at the end of the cell; between its base and the aforementioned large

costal spot is a small black costal dash; around the edge of the wing is a thin black line from the large costal spot to tornus, on which a series of small black dots, one at the terminus of each vein. Cilia dirty white. Hindwings dark, blackish fuscous. Abdomen blackish fuscous with dirty white anal tuft. Legs dark fuscous; tarsi black with white annulations.

Alar expanse.—34–40 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector. British Guiana. C. W. Bebee, collector.

Type.—Cat. No. 13569, U.S.N.M.

Cotype in British Museum.

STENOMA MENDORON, new species.

Plate 8, fig. 20.

Labial palpi dirty white, sprinkled with brown and with base of both joints black. Antennæ ochreous annulated with black above. Face and head white. Collar and thorax white sprinkled with brown, thorax with light-brown posterior tufts. Forewings rather short with straight costa, rounded apex, and termen oblique; with tufts of raised scales; ground color white sprinkled liberally with light brown; three equidistant small, black costal spots, the outer two most prominent, all edged with brown; at the end of the cell a short deep black transverse dash preceded by a brown spot; from this a perpendicular brown streak down to dorsal edge just before tornus; at apical fifth a premarginal line of brown spots parallel with termen. Cilia white with equidistant brown tufts appearing as a marginal line of brown dots. Hindwings triangular dark brown; cilia whitish with a brown marginal line. Abdomen dark fuscous with underside and anal tuft ochreous. Forelegs of the male deep brown with black, white annulated tarsi; hindlegs brown with darker tarsi, annulated with white. The females have somewhat lighter hindwings and abdomen and especially lighter more ochreous legs.

Alar expanse.—24–26 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13570, U.S.N.M.

Cotype in British Museum.

Closely related to *Stenoma acronitis*, but smaller and with a more mottled design.

STENOMA NESTES, new species.

Plate 8, fig. 18.

Labial palpi dirty white, liberally sprinkled with dark brown; basal half of second joint black above. Face dirty white. Antennæ yellowish with brown annulations. Head and throax white strongly

suffused with brown. Wings of the form as in the two preceding species. Forewings with tuft of raised scales, reddish white, strongly suffused with brown scales; three blackish brown equidistant costal spots, the basal one the smallest, the outer most prominent, large triangular; a short deep black transverse dash at the end of the cell, preceded by a pure white spot, before which a thin longitudinal deep black line across the cell to base of vein 11; a large ill-defined cloud of dark brown scales above tornus; cilia reddish white with small dark brown dots around the margin from apical fifth of costa to tornus. Hindwing dark brown, cilia lighter brown, with a dark basal line. Abdomen dark fuscous with ochreous tip and underside. Legs ochreous white mottled with brown; tarsi dark brown with ochreous annulations.

Alar expanse.—25–28 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13571, U.S.N.M.

Closely allied to the two foregoing species, intermediate in size, darker than both, more reddish in color and easily distinguished by the thin longitudinal black line on the cell and by the dark spot near tornus.

STENOMA TRASTICES, new species.

Plate 9, fig. 34.

Second joint of labial palpi light brown with white tip; terminal joint light brown with two darker brown annulations. Face white. Antennæ dark brown with lighter basal joint. Head light ochreous. Collar rich brown. Thorax speckled with white and dark brown scales. Forewings with the bluish white ground color heavily obscured by dark brown and black scales, especially on dorsal half. At basal fourth is a dark brown costal spot; just beyond the middle of costa is a small blackish brown zigzag streak, and at apical fourth is a large dark brown costal blotch which extends over most of the tip of the wing with exception of an oblong yellow dash before apex and of the extreme edge which is whitish. Cilia dark brown. Hindwings dark brown. Abdomen dark brown above, ochreous underneath. Legs light brown with dark brown tarsi.

Alar expanse.—16–22 mm.

Habitat.—Cayenne and St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13572, U.S.N.M.

Cotype in British Museum.

STENOMA APICALIS, new species.

Plate 8, fig. 13.

Labial palpi reddish brown. Antennæ dark fuscous. Face and head dark brown. Collar and thorax golden brown. Forewings in

shape like the three preceding species with scale tufts; base light golden ochereous with a thin dark brown costal margin and a broader dark dorsal margin; the central two-thirds of the wing dark brown mixed with bluish white scales, the three upper ones of which are golden ochereous, while the two smaller lower ones have the same color as the surrounding parts; all the tufts, but especially the lower ones, are followed by black scales. The central dark color stops on the edges at apical fourth, but projects on the middle out into a sharp tongue which reaches the terminal edge and separates two large light golden brown round areas, the upper including apex the lower surrounding tornus; these light terminal areas are sparsely edged with white scales. Cilia dark brown, darkest at apex. Hindwings dark blackish brown. Abdomen dark brown with ochereous anal tuft. Legs dark brown; tarsi with ochereous annulation.

Alar expanse.—25 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13573, U.S.N.M.

Related to the foregoing species, but of more complex design and color, easily recognized by the apical golden brown areas.

STENOMA LACTIS, new species.

Plate 8, fig. 6.

Labial palpi creamy white with base of second joint and tip of terminal joint black. Antennæ dark fuscous. Face and head white. Thorax white tinted with yellow and with an ochereous posterior tuft. Forewings short and broad of the same shape as in *Stenoma mendoron*: basal third ochereous white, terminal two-thirds dark fuscous, the limits of the two colors sharply drawn by a slightly outwardly curved pure white line from basal fourth of costa to shortly before the middle of dorsum. In the dark part of the wing are several small scale tufts mixed with black scales; at the end of the cell is a small ochereous tuft followed by black. Cilia fuscous. Hindwings triangular, dark fuscous. Abdomen dark fuscous with ochereous underside and anal tuft. Legs ochereous, mottled with fuscous; tarsi darker with ochreous annulations.

Alar expanse.—19–21 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13574, U.S.N.M.

Cotype in British Museum.

Allied to the foregoing species; easily recognized by the sharply contrasting basal and apical parts of the forewings.

STENOMA FASCIATUM, new species.

Plate 8, fig. 10.

Labial palpi light ochreous, second joint shaded with black exteriorly, terminal joint with extreme base black. Antennæ yellowish fuscous. Face light ochreous. Head and thorax ochreous fuscous. Forewings elongate oval; apex not indicated; termen evenly rounded; light grayish ochreous with a broad blackish brown oblique fascial this begins on costa from basal fourth to the middle of costa and reaches to the middle of dorsum; the edges are not even but reasonably parallel and sharply defined against the lighter basal and apical parts of the wing; at apical third is an indistinct and ill-defined dark fuscous cloud parallel with the fascia and mainly noticeable by its outer edge, which appears as a dark, thin, undulating line from a small costal spot to tornus. Hindwings dark fuscous. Abdomen dark fuscous above with ochreous underside and anal tuft; legs ochreous.

Alar expanse.—21–24 mm.

Habitat.—Cayenne, French Guiana. Wm. Schaus, collector. British Guiana. C. W. Bebee, collector.

Type.—Cat. No. 13575, U.S.N.M.

Easily recognized by the rounded apex and the bold design of the forewings.

STENOMA VENATUM, new species.

Plate 8, fig. 14.

Second joint of labial palpi ochreous shaded with black; terminal joint black with ochreous tip. Antennæ blackish above, ochreous underneath. Face light ochreous. Head blackish brown. Thorax light ochreous with two small black lateral dots and with black posterior tuft. Forewings light grayish ochreous, whitish above the cell, with all veins sharply marked by black lines; terminal edge black; two black dots near base within the dorsal edge. Cilia ochreous fuscous. Hindwings dark fuscous with ochreous cilia. Abdomen dark fuscous above with whitish ochreous underside. Forelegs blackish brown with narrow ochreous annulation at the joints; hind-legs ochreous.

Alar expanse.—26 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13576, U.S.N.M.

A striking species closely allied to *Stenoma reusclariana* Cramer, *disjecta* Zeller and *loxogrammos* Zeller, but without any large black dorsal areas, as found in those species.

STENOMA GUNNI, new species.

Plate 8, fig. 4.

Second joint of labial palpi ocherous below, white above, and blackish brown at base and apex; terminal joint blackish brown, with a white annulation just before apex. Face whitish, head dark brown. Thorax dark green, strongly metallic, with posterior tuft of same color. Basal third of forewings strongly metallic, iridescent, dark purplish brown with green metallic dorsal edge, separated from the purplish part by a thin white line; this dark base is sharply defined against the white ground color of the middle part of the wing, and reaches to basal fourth on costa and to near the middle of dorsum; the following white part is mottled by soft gray spots of which a large quadrangular one lies on the dorsal edge and reaches nearly to the middle of the wing; another large gray spot forms an ill-defined fascia from costa to dorsum and is followed by a narrow white line across the wing; the apical part outside of this white line is light golden brown. Cilia gray. Hindwings with strongly developed costal area ciliated to the base, much broader than the forewings; dark greenish brown, with whitish cilia. Abdomen dark brown with ocherous anal tuft. Legs whitish gray with smoky tarsi.

Alar expanse.—24–25 mm.

Habitat.—St. Laurent, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13577, U.S.N.M.

This species would have been determined by Zeller as a typical *Antæotricha*. It belongs to the group *herilis* Felder, *reciprocella* Walker, and *ribbei* Zeller, from all of which it differs by the deep metallic green dorsal base and by the golden tips of the forewings. I am unable to maintain the genus *Antæotricha* Zeller as distinct from *Stenoma* Zeller.

STENOMA COMMA, new species.

Plate 8, fig. 11.

Labial palpi light ocherous. Face and head light ocherous. Thorax darker reddish ocherous. Forewings white, the basal half heavily overlaid with light ocherous brown scales, such as are also sprinkled over the apical part of the wing; at the end of the cell is a short transverse dark-brown streak; from apical fourth of costa runs an outwardly curved brown line down to tornus; apical and terminal edge blackish brown; cilia white. Hindwings ocherous white with light fuscous tip and with a very conspicuous black dash on vein 1^b; cilia white. Abdomen and legs light ocherous.

Alar expanse.—14–15 mm.

Habitat.—Cayenne, French Guiana, and Cuba. Wm. Schaus, collector.

Type.—Cat. No. 13578, U.S.N.M.

A dainty little light species at once distinguished by the black contrasting dash on anal part of the hindwings.

STENOMA SPERATUM, new species.

Plate 9, fig. 31.

Labial palpi whitish on the inner side, reddish brown exteriorly. Lower part of face silvery white; upper part and the base of the antennæ rich reddish brown. Head dark gray. Thorax brown. Forewings dull brown with a large central oval spot on the disk light leaf-green, slightly edged with yellow and with a dark-brown margin; a smaller round green spot lies on the dorsal edge just below the end of the large discal spot. Cilia dark brown. Hindwings light ochereous brown. Abdomen and legs ochereous brown.

Alar expanse.—20 mm.

Habitat.—Cayenne, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13579, U.S.N.M.

STENOMA SALOME, new species.

Plate 9, fig. 39.

Labial palpi and face light ochereous. Head and thorax light drab. Forewings light-drab colored, with reddish-brown ornamentation; near base is a thin, outwardly bent, brown zigzag line across the wing, followed by a small metallic blue dot on the fold and a small dark-brown dot on the cell. Across the middle of the wing runs a brown line, obliquely from before the middle of costa to beyond the middle of dorsum; this is followed by a light ochereous spot, edged with brown at the end of the cell; on apical third of costa is a small brown, triangular spot, continued faintly in a very thin, notched, outwardly bent brown line across the wing; apical half of costa, entire terminal edge, and apical half of dorsum reddish brown with a marginal series of darker brown dots within; cilia whitish. Hindwings light ochereous fuscous with whitish cilia. Abdomen and legs ochereous fuscous.

Alar expanse.—22–23 mm.

Habitat.—Castro, Parana, Brazil. Schaus collection.

Type.—Cat. No. 13580, U.S.N.M.

STENOMA INSCITUM, new species.

Plate 9, fig. 33.

Labial palpi whitish ochereous, shaded with dark brown exteriorly. Face and head ochereous white. Thorax fuscous. Patagia white with purplish-brown base. Collar purplish brown. Forewings whitish fuscous, the ground color being white but strongly and unevenly overlaid with dark fuscous except for a large oblong pure white costal spot reaching from basal fourth to apical fourth. At the end of the cell is a dimly indicated darker fuscous spot from which a faint dark

fuscous irregular line runs to dorsal edge near base. Extreme tip of wing dark bronzy brown. Cilia white. Hindwings dark fuscous with whitish cilia. Abdomen dark fuscous above; underside and legs ocherous.

Alar expanse.—19–22 mm.

Habitat.—St. Laurent, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13581, U.S.N.M.

STENOMA THORISTES, new species.

Plate 9, fig. 22.

Labial palpi whitish ocherous, shaded with brown exteriorly. Face light ocherous. Antennae brown. Head drab. Thorax rich brown anteriorly, light drab posteriorly. Forewings light drab with a purple sheen and with deer-brown markings; basal third is mottled with brown scales except along costa in ill-defined and somewhat variable pattern; central part of the wing is unmottled, except for a small brown costal spot; on the apical third is a broad ill-defined brown fascia across the wing, margined externally by an outwardly curved line of small black dots; around the terminal edge and reaching round both on costa and dorsum is a marginal row of more prominent small black dots. Cilia drab. Hindwings light dirty straw-yellow with a marginal row of small, black, nearly confluent dots. Abdomen ocherous fuscous above; underside light ocherous; anal tuft deep ocherous. Legs ocherous; hind legs with first tarsal joint strongly tufted as in *S. elegans* Zeller, *S. loxotoma* Busck, and *S. fraternella* Busck, with which species it otherwise has no close affinity.

Alar expanse.—29–34 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13582, U.S.N.M.

Cotype in British Museum.

Allied to *Stenoma immundum* Zeller and *S. sororium* Zeller, differing in the brown markings, not present in those species.

STENOMA MARONI, new species.

Plate 9, fig. 23.

Second joint of labial palpi dark purplish brown; tip and apical joint whitish. Face ocherous white. Head and thorax dark brown. Forewings light brown with a broad dark reddish brown transverse band occupying the larger middle part. This dark brown shade is well defined and extends from base to apical fourth of dorsum obliquely across the wing to outer half of costa with tolerably parallel edges; at basal third is a light ocherous gray slightly dark ocellated dorsal spot. From the outer edge of the dark shade runs an undulat-

ing dark brown line down to dorsum just before tornus. Along the terminal edge is a faint row of dark brown dots. Cilia light brown. Hindwings dark brownish fuscous with a light ochereous marginal line before the cilia. Abdomen dark brown above; underside and legs light ochereous.

Alar expanse.—24–28 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13583, U.S.N.M.

Cotype in British Museum.

STENOMA VANIS, new species.

Plate 9, fig. 32.

Labial palpi ochereous, shaded with dark brown exteriorly. Face ochereous. Head and thorax dark purplish brown; thorax with bright reddish brown posterior tuft. Forewings light brown with dark brown and reddish brown markings as follows: From inner angle of dorsum runs a broad rich reddish brown shade to the end of the cell; from middle of costa runs a blackish brown shade outwardly toward but not reaching the middle of termen; costal edge outside of this shade broadly blackish brown; dorsal edge from base to beyond middle broadly blackish or purplish brown. Terminal edge broadly reddish brown. Cilia dark brown with light ochereous base. Hindwings dark brownish fuscous with ochereous cilia. Abdomen dark brown above, underside ochereous. Legs ochereous; forelegs shaded with dark brown anteriorly.

Alar expanse.—25–30 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13584, U.S.N.M.

Cotype in British Museum.

STENOMA ADDON, new species.

Plate 9, fig. 36.

Labial palpi white, second joint tinted with ochereous exteriorly and with a black spot on the inner (upper) side at base. Face white, brownish along the eyes. Head and thorax gray. Forewings with the white ground color suffused with light soft gray, somewhat darker on dorsal than on costal half. Two dark grayish brown zigzag lines across the wing very faint on the costal side, stronger and emphasized by heavy washed, dark shades externally on the dorsal side; the one begins at basal third of costa and runs to middle of dorsum, the other begins on the middle of costa and runs to apical fourth of dorsum; yet farther out on the wing is a thin evenly outwardly curved line across the

wing. Cilia white. Hindwings dark fuscous with white cilia. Abdomen dark fuscous above, underside whitish, anal tuft ochereous. Legs ochereous white.

Alar expanse.—25 mm.

Habitat.—Rockstone, Essequibo River, British Guiana; Cayenne and St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat No. 13585, U.S.N.M.

Cotype in British Museum.

Of the group represented by *S. crocuta*, *genetta*, and *fraterna* Felder; larger than either of these and differing in the heavy, dark, washed out bases of the transverse faciæ. It comes still nearer to the larger *S. binubila* Zeller, which is even more like the following species, but the size alone sufficiently separates both species.

STENOMA PHÆBE, new species.

Plate 9, fig. 42.

This may best be described by comparison with the foregoing species, to which it comes very close. The upper, costal, half of the forewings is nearly pure white instead of merely lighter gray as in *S. addon*, and only the two outer fasciæ can be traced in this part of the wing. The first, basal, fascia is represented by the dorsal spot only, broadly washed out and somewhat nearer the base than in *S. addon*. The series of small black marginal dots is rather more distinct than in the former species. The hindwings whitish, light fuscous toward tip, are strikingly lighter than the hindwings of *S. addon*.

Alar expanse.—21–22 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13586, U.S.N.M.

Evidently very close to *I. binubila* Zeller and nearly identical in pattern, but the much smaller size and the different localities of the two species make the distinctness of the present species reasonably certain.

STENOMA SIMILIS, new species.

Plate 9, fig. 43.

Closely allied to *Stenoma phæbe*, but smaller and with a more sharply defined pattern. Labial palpi whitish shaded with fuscous. Face silvery white. Head and thorax dark gray. Forewings with costal half light, nearly white; dorsal half dark fuscous; three nearly equidistant transverse oblique streaks; the basal one stopping at a small black dot on the middle of the cell; the second one continued somewhat farther up and including a small black dot at the end of the cell; the third reaching across to the costal edge; the bases of the two first streaks are strongly washed into large blackish dorsal shades, reach-

ing nearly to the following streak. Hindwings whitish fuscous. Abdomen dark fuscous above; underside and legs whitish.

Alar expanse.—17–19 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13588, U.S.N.M.

Cotype in British Museum.

STENOMA DEMAS, new species.

Plate 9, fig. 40.

Second joint of labial palpi white, shaded externally with blackish fuscous; terminal joint white, with base and an annulation near the tip black. Face silvery white. Head and thorax ocherous. Forewings white, with a large black basal spot on dorsum and a bold oblique black fascia across the wing beyond the cell; this fascia is evenly concave on the inner side, irregularly bent on the outer side, and broader at the dorsal end than at costa. Extreme apical edge black. Cilia white. Hindwings white. Abdomen light ocherous fuscous above; legs and underside white.

Alar expanse.—14 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13588, U.S.N.M.

While this species is clearly nearly related to and very similar to the foregoing group of species, it is at once distinguished by its small size and its striking clear-cut wing pattern.

STENOMA HAMON, new species.

Plate 9, fig. 41.

Labial palpi blackish brown, with the tip of second joint and the base of terminal joint shaded with white. Face white. Head and thorax dark fuscous. Forewings white, sprinkled with brown atoms, and with three oblique irregular blackish brown lines across the wing; the first of these is nearly straight, only slightly zigzag, and runs from basal fourth of costa to shortly before middle of dorsum; the second line is much more irregular and runs reasonably parallel with the first just outside the cell; the third line is evenly convex, with a sharp indentation at costal third. Around the entire edge is a prominent series of small equidistant dark brown dots. Hindwings dark fuscous. Abdomen dark fuscous above; underside light ocherous. Legs ocherous; tarsi annulated with black.

Alar expanse.—22–23 mm.

Habitat.—St. Jean, Maroni River and Cayenne, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13589, U.S.N.M.

Genus GONIOTERMA Walsingham.

Gonioterma WALSINGHAM, Proc. Zool. Soc. Lond., 1897, p. 101.

Type.—*Gonioterma burmanniana* Cramer.

This is one of the few genera, erected in this family, which seems tenable, and it undoubtedly represents a natural group of Stenomid moths, characterized by the square forewings and the black costal spots; but it should be observed that even this group is none too sharply defined in nature and that many species come uncomfortably close to it in appearance, without having *vein 8 of the forewings to termen* below apex, which character I consider the one essential in the differentiation from *Stenoma* Zeller. Such species would fall in Walsingham's genus *Anadasmus*, which I can not maintain as distinct from *Stenoma* Zeller, on account of the perfectly gradual transition between the extremes of wingform.

GONIOTERMA ROSA, new species.

Plate 9, fig. 28.

Labial palpi rosy, shaded with black exteriorly. Face and head light ochereous. Thorax rosy ochereous. Forewings light rosy ochereous with two conspicuous dark brown, costal spots, one just beyond the middle of the wing, one at apical fifth; from basal third of costa runs a thin light brown straight line obliquely across the wing to the middle of dorsum; on the end of the cell is a very faint, transverse line of dark brown scales; along the terminal edge is a series of short black marginal streaks; cilia dark reddish fuscous. Hindwings light reddish yellow; cilia light straw-colored. Abdomen and legs light ochereous.

Alar expanse.—23 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13590, U.S.N.M.

Of the general shape and ornamentation of *Gonioterma burmanniana* Cramer and *Gonioterma isabella* Felder; smaller than both these species and easily recognized by its quite different color.

GONIOTERMA ANNA, new species.

Plate 9, fig. 27.

Labial palpi white, second joint shaded exteriorly with dark brown. Face and head ochereous white. Forewings very light rosy drab with three triangular, equidistant, blackish brown, costal spots, the two outer ones large and very prominent, the basal one at basal third of costa smaller; on the end of the cell is a small transverse dark brown spot; from the tip of the outer costal spot runs an outwardly curved

row of small equidistant dark brown dots across the wing to dorsum; extreme terminal edge deep black; cilia dark brown. Hindwings whitish with yellow tips, cilia yellowish fuscous. Abdomen and legs light ochereous.

Alar expanse.—18–21 mm.

Habitat.—Geldersland, Surinam River, Dutch Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13591, U.S.N.M.

Quite close to the foregoing species, from which it is distinguished by the additional costal spot and the absence of an oblique line across the forewings, as well as by the different color and smaller size.

GONIOTERMA STELLA, new species.

Plate 9, fig. 29.

Labial palpi whitish with base and exterior side of second joint dark brown. Face and head light drab. Thorax light bluish drab, sprinkled with black atoms. Forewings light bluish drab, sprinkled with black scales; two dark brown costal spots, one on the middle of costa, one at apical sixth; a similar spot is found on the cell at basal third; from the tip of the outer costal spot runs a faint, outwardly curved, row of small black dots just within terminal edge to dorsum, and on the extreme terminal edge is a more pronounced, marginal series of short, blackish brown streaks; the outer third of the wing has a slightly lighter ground color than the base; cilia bluish, darker near apex, nearly white at tornus. Hindwings dark ochereous fuscous; cilia whitish. Abdomen and legs dark fuscous.

Alar expanse.—26–28 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13592, U.S.N.M.

Cotype in British Museum.

Larger than the two foregoing species; distinguished by its bluish color and the dark discal spot.

GONIOTERMA INGA, new species.

Plate 9, fig. 30.

Labial palpi bluish white with base and outer side of second joint dark brown. Face ochereous white. Head bluish. Thorax light brown with bluish sheen. Forewings light bluish drab, darker in shade than in *G. stella*; two deep black costal spots, one on the middle, the other at apical fifth; extreme costal edge rust-red, the color of the underside; a faint outwardly curved row of small black dots from outer costal spot to dorsum, parallel with the terminal edge; a similar row on the terminal edge; cilia reddish. Hindwings

light yellow. Abdomen ocherous fuscous above, underside whitish, anal tuft ocherous. Legs ocherous white with darker ocherous tarsi.

Alar expanse.—22 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13594, U.S.N.M.

Closely related to and very similar to the foregoing species, especially *G. rosa*, but distinguished from all of them by the slightly produced apex and the sinuate termen below apex.

GONIOTERMA EMMA, new species.

Plate 9, fig. 24.

Labial palpi light brown, darker brown at apex and on exterior side of second joint. Face ocherous. Head light brown. Thorax and forewings light deer-brown with three dark brown, not very conspicuous, triangular, nearly equidistant costal spots, one at basal third, one on the middle of costa, and one at apical fourth; from the latter runs an outwardly curved row of minute dots to dorsum. Cilia dark brown. Hindwings dark brownish fuscous. Both fore and hind wings with a strong sheen. Abdomen dark brown above, light ocherous on the underside. Legs ocherous with darker tarsi.

Alar expanse.—26–28 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13594, U.S.N.M.

Easily distinguished from other species in this genus by its darker color, especially of the hindwings.

GONIOTERMA VITA, new species.

Plate 9, fig. 26.

Labial palpi ocherous white, shaded with brown exteriorly. Face and head ocherous white. Thorax light ocherous. Forewings light straw yellow, with a large brown shade resting on the dorsal edge and covering most of the wing; the brown shades gradually into the yellow and leaves base, costal, and terminal edge pure yellow; on the costal edge are two very small dark brown dots, one on the middle and one at apical sixth. Cilia dark ocherous. Hindwing light straw yellow. Abdomen and legs ocherous.

Alar expanse.—24–25 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13595, U.S.N.M.

Not closely similar, but clearly allied to the other species described in this genus.

Family OLETHREUTIDÆ.

OLETHREUTES GERDA, new species.

Plate 9, fig. 21.

Labial palpi dark brown, ochereous on their inner side. Face and head light brown. Thorax dark purplish brown. Forewings deep purplish brown with a large golden yellow terminal patch; basal half nearly black; costal edge and apical part rich brown without the purple tint, which is most prominent on the middle of the wing; along the costal edge is a series of short outwardly directed bluish metallic streaks intervened by small black dots; at the upper end of the cell is a fan-shaped group of thin black lines; in the yellow terminal patch, which is slightly striated transversely with black, is a row of these black dots, followed by a perpendicular bluish metallic streak before the black cilia. Hindwings deep blackish brown. Abdomen blackish brown above, lighter brown on the underside. Legs dark brown.

Alar expanse.—24–28 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13596, U.S.N.M.

Cotype in British Museum.

A large species distinguished by its wing form and the very dark hindwings.

Family TORTRICIDÆ.

TORTRIX AURIFERANA, new species.

Plate 9, fig. 33.

Labial palpi dark ochereous. Antennal strongly biciliate. Face and head dark brown. Thorax golden yellow. Forewings light shining golden yellow with ochereous brown ornamentation, consisting of a broad line from base along basal half of costal edge, thence across the wing obliquely to dorsal edge just before tornus, and thence upward across the wing parallel with terminal edge to costa just before apex. Near base of dorsal edge is a small thin brown line directed toward the middle of the wing. Cilia golden. Hindwing golden white. Abdomen and legs ochereous.

Alar expanse.—14–15 mm.

Habitat.—Castro, Parana, Brazil. Schaus collection.

Type.—Cat. No. 13597, U.S.N.M.

Cotype in British Museum.

Superficially very similar to the common North American *Epagoge sulphuriana* Clemens, but, unlike this species, apparently constant in ornamentation.

TORTRIX PARANA, new species.

Labial palpi brown, shaded with purple and black. Face, head, and thorax dark golden brown. Forewings dark golden yellow with dark reddish brown and black markings; from middle of costa runs a straight-edged narrow dark brown band obliquely across the wing to tornus; from apical fourth of costa runs a similar parallel band across the wing to termen; on the middle of the cell is a large ill-defined dark brown spot dusted with black scales; costal edge mottled with small black dots. Cilia light golden. Hindwings light silvery fuscous. Cilia white. Abdomen and hindlegs dark ochereous; forelegs blackish brown.

Alar expanse.—13–14 mm.

Habitat.—Castro, Parana, Brazil. Schaus collection.

Type.—Cat. No. 13598, U.S.N.M.

Cotype in British Museum.

Nearly related to the foregoing species; differing in pattern and in the dark golden color of the forewings.

Family HEMEROPHILIDÆ.

ORDUPIA, new genus.

Type.—*Ordupia friserella* Busck.

Labial palpi curved, upturned, reaching vertex; second joint thickened with smoothly appressed scales; third joint shorter than second, smooth, bluntly pointed. Antennæ short, less than half the wing-length; thick smooth above, below with one row of thick, closely set, short-haired lamellæ, which are twice as long as the thickness of the base. Head smooth. Forewings with straight edges, apex bluntly pointed, termen oblique, tornus pronounced; 12 veins, all separate; 2 from before the end of the cell, 3–9 from end of cell; 8 to termen; 1^b furcate at base. Hindwings broader than the forewings, triangular with straight costa and nearly straight termen; 8 veins; 3 and 4 stalked; 5, 6, and 7 parallel. Posterior tibiæ with smoothly appressed long hairs above.

A peculiar noctuid-like form allied to *Hemerophila* Hübner, which genus may be a development from *Ardrupia*. The very peculiar one-sided antennæ and the course of vein 8 in the forewing as well as the very different general habitus easily distinguish the present genus.

Named in fond memory of my indebtedness for my early training in Ordrup College, Denmark, under that eminent and beloved teacher, Prof. H. C. Frederiksen.

ORDRUPIA FRISERELLA, new species.

Plate 9, fig. 25.

Labial palpi brownish ochereous. Face whitish ochereous. Antennæ ochereous. Head and thorax light brownish ochereous with a blackish

sheen. Forewings light ochereous brown overlaid with darker brown; on the middle of the wing is a broad transverse shade of dark brown, poorly defined from the lighter basal and apical parts; at the end of the cell is a small round black dot; a similar dot but much fainter is found on the middle of the cell and a third, also faint, on the fold. Cilia dark brown. Hindwings light ochereous brown; cilia whitish. Abdomen whitish ochereous on first two segments; posteriorly deep mahogany brown above and bright reddish ochereous below; anal tuft ochereous. Legs whitish ochereous.

Alar expanse.—29–36 mm.

Habitat.—St. Jean, Maroni River, French Guiana.

Type.—Cat. No. 13599, U.S.N.M.

Cotype in British Museum.

This species is easily mistaken for a noctuid on account of its size and robustness as well as its color and wing-form.

Family TINEIDÆ.

TINEA BOLIVIANA, new species.

Labial palpi saffron yellow with black bristles. Face and head saffron yellow mixed with dark brown. Thorax dark brown. Forewings unicolored dark slaty brown, shining, with extreme costal and dorsal edge and tufts in the cilia saffron yellow. Hindwings dark slaty brown with dorsal cilia saffron yellow. Abdomen saffron yellow. Legs yellow, shaded with dark brown. Venation typical, 7 and 8 in forewings stalked to costa; all veins separate in hindwings.

Alar expanse.—19–20 mm.

Habitat.—Bolivia. Schaus collection.

Type.—Cat. No. 13600, U.S.N.M.

Cotype in British Museum.

A typical species of the unicolored group of the genus easily recognized by the saffron yellow edges and abdomen.

PLUMANA, new genus.

Type.—*Plumana piperatella* Busck.

Male.—Labial palpi short porrected, somewhat rough-scaled. Tongue obsolete. Antennæ biciliate throughout (2). Head smooth, forewing elongate about three times longer than broad; costa straight gently arched toward the bluntly pointed apex; termen oblique; tornus well developed; 11 veins; vein 6 absent; 7 and 8 long stalked; 7 to costa; 1^b furcate at base. Hingwings broader than forewings, triangular; 7 veins; 4 absent; all separate and nearly parallel; 5 cubital. Legs smooth.

Female.—Presumably apterous.

Allied to *Fumca* Hubner, though of quite different general habitus; differing in the less strongly developed antennæ ciliation, the less hairy labial palpi, and in the long-stalked veins 7 and 8 of the forewings.

PLUMANA PIPERATELLA, new species.

Plate 8, fig. 1.

Male.—Labial palpi blackish brown; face naked, black (possibly denuded). Antennæ yellowish. Head and thorax smoky white. Forewings smoky white with transverse striation of numerous blackish brown dots, which on the edges form a series of equidistant marginal spots all around the wing; a larger round brown dot at the end of the cell; posterior third of costa smoky brown. Cilia dirty white with a smoky brown line, parallel with the terminal edge. Hindwings smoky fuscous. Abdomen fuscous. Legs smoky white with the exterior surface fuscous.

Female.—Unknown, probably apterous.

Alar expanse.—16–17 mm.

Habitat.—St. Jean, Maroni River, French Guiana. Wm. Schaus, collector.

Type.—Cat. No. 13601, U.S.N.M.

Cotype in British Museum.

EXPLANATION OF PLATES.

PLATE 8.

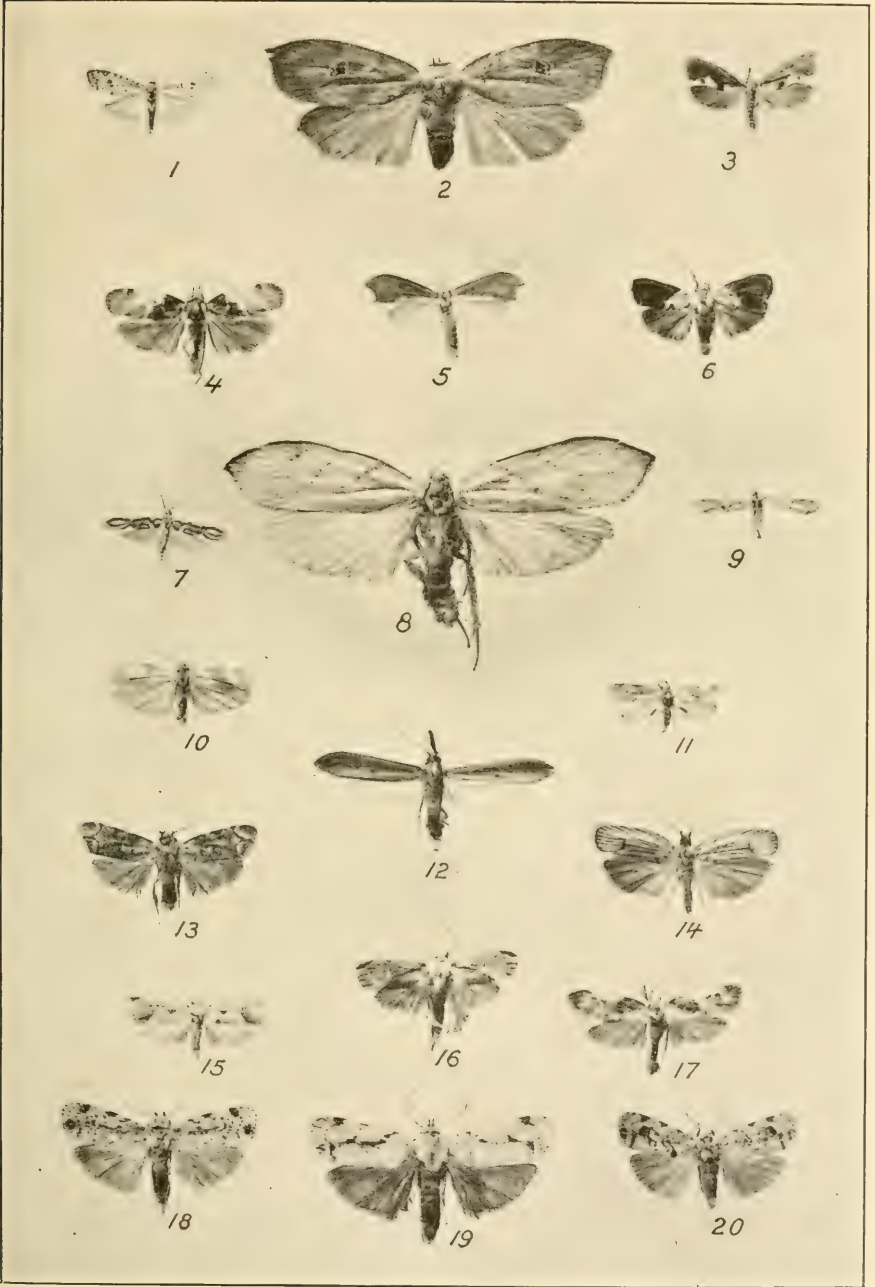
- Fig. 1. *Plumana piperatella* Busck.
 2. *Stenoma io* Busck.
 3. *Haata argentidorsella* Busck.
 4. *Stenoma gunni* Busck.
 5. *Gonada falculinella* Busck.
 6. *Stenoma lactis* Busck.
 7. *Filinota hermosella* Busck.
 8. *Stenoma major* Busck.
 9. *Filinota peruviana* Busck.
 10. *Stenoma fasciatum* Busck.

- Fig. 11. *Stenoma comma* Busck.
 12. *Pleurota literatella* Busck.
 13. *Stenoma apicalis* Busck.
 14. *Stenoma venatum* Busck.
 15. *Peleopoda notandella* Busck.
 16. *Peleopoda maroniella* Busck.
 17. *Peleopoda irenella* Busck.
 18. *Stenoma nestes* Busck.
 19. *Stenoma acronitis* Busck.
 20. *Stenoma mendoron* Busck.

PLATE 9.

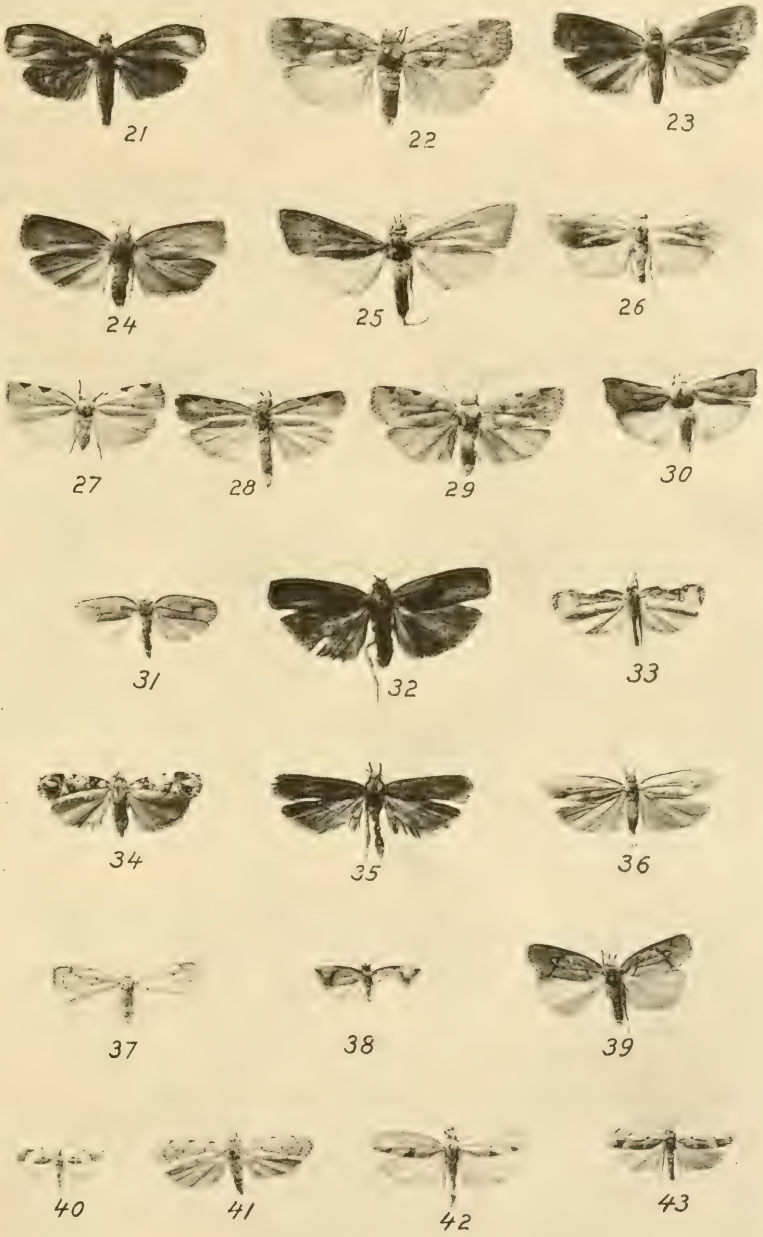
- Fig. 21. *Olethreutes gerda* Busck.
 22. *Stenoma thoristes* Busck.
 23. *Stenoma maroni* Busck.
 24. *Gonioterma emma* Busck.
 25. *Ordrupia friserella* Busck.
 26. *Gonioterma vita* Busck.
 27. *Gonioterma anna* Busck.
 28. *Gonioterma rosa* Busck.
 29. *Gonioterma stella* Busck.
 30. *Gonioterma inga* Busck.
 31. *Stenoma speratum* Busck.
 32. *Stenoma vanis* Busck.

- Fig. 33. *Stenoma inscitum* Busck.
 34. *Stenoma trastices* Busck.
 35. *Psoricoptera apicepuncta* Busck.
 36. *Stenoma addon* Busck.
 37. *Cryptolechia roseomarginella* Busck.
 38. *Tortrix auriferana* Busck.
 39. *Stenoma salome* Busck.
 40. *Stenoma demas* Busck.
 41. *Stenoma hamon* Busck.
 42. *Stenoma phæbe* Busck.
 43. *Stenoma similis* Busck.



TINEOID MOTHS FROM SOUTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGE 230.



TINEOID MOTHS FROM SOUTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGE 230.

AN ELECTRIC RAY AND ITS YOUNG FROM THE WEST COAST OF FLORIDA.

By BARTON A. BEAN and ALFRED C. WEED,
Of the Division of Fishes, U. S. National Museum.

Under date of July 21, 1910, Mr. A. G. Reynolds, of Veteran, Hillsboro County, Florida, addressed the U. S. National Museum as follows:

A few days ago an electric ray or torpedo (*Torpedo*) fish (*Tetronarce occidentalis* Storer) 17 by 9 inches in size, gave birth in my laboratory, to fourteen young ones, nine males and five females, about $3\frac{1}{2}$ by 2 inches in size. Is this fact of any special interest, or would the specimens themselves be an acquisition to the Museum?

In answer to a memorandum sent Mr. Reynolds by the Museum, the following letter, dated August 13, 1910, was received from him:

Yesterday I sent you by express the torpedo and fourteen young ones mentioned in a previous letter. The specimens are cured in formaldehyde. I fear I did not make it very clear about the young ones. The mother was dead when received, the birth of the family being forced. She was caught in a net off Long Key (opposite here) by a pompano fisherman.

I think by your letter you were expecting these fish to be alive, but trust the preserved specimens will be of use to you.

The ray and fourteen young in a fine state of preservation were duly received and proved to be *Narcine brasiliensis*. Excellent photographs were taken by Mr. T. W. Smillie, the photographer of the U. S. National Museum. The following comparisons between the adult and young, as well as with the variety *umbrosa*, are given as a slight addition to our present knowledge of this interesting species:

The size of the specimens is sufficiently indicated in the letter quoted.

A few facts concerning the coloration, and other characters of these and the other specimens in the U. S. National Museum should be noted.

1. The dark patch across the snout seems to be a constant character which appears more or less prominently at all ages and in all the color varieties.

2. The shape of the caudal fin is variable, the young (fetal) specimens having the caudal rounded (see plate 11) while in the adults it is truncate. (See plate 10.)

3. The adult males seem to be proportionally narrower than the females. This difference is not apparent in the young. The males that are referable to the subspecies *umbrosa* are especially narrow. We have no females of this form.

4. The difference in color between the young and the adult should be noted. The young have the dark spots very definite in outline while in the adult they are much less distinct and are sometimes formed by a close grouping of small spots about the size of a pin head.

An interesting life-history note on *Narcine brasiliensis* by Russell J. Coles is published in Bulletin 28, of the American Museum of Natural History, 1910, page 337. We quote the note in full:

In July, 1909, I first saw this electric ray and captured two specimens which were presented to the laboratory of the Bureau of Fisheries at Beaufort, N. C. They were the first recorded on our Atlantic coast north of Florida. In July, 1910, I captured and preserved eleven specimens at Cape Lookout and know of the capture of more than a dozen others by the native fishermen during the same week; and none were seen either before or after that week. This ray can give a very powerful electric shock. I have been knocked down many times by this shock while experimenting with the fish, yet could make no record of this peculiar form of electricity as it had no effect on my battery-testing ammeter and it would not light a little electric lamp which only required two and a half volts. Probably it might have been recorded by a voltmeter, but I had none with me.

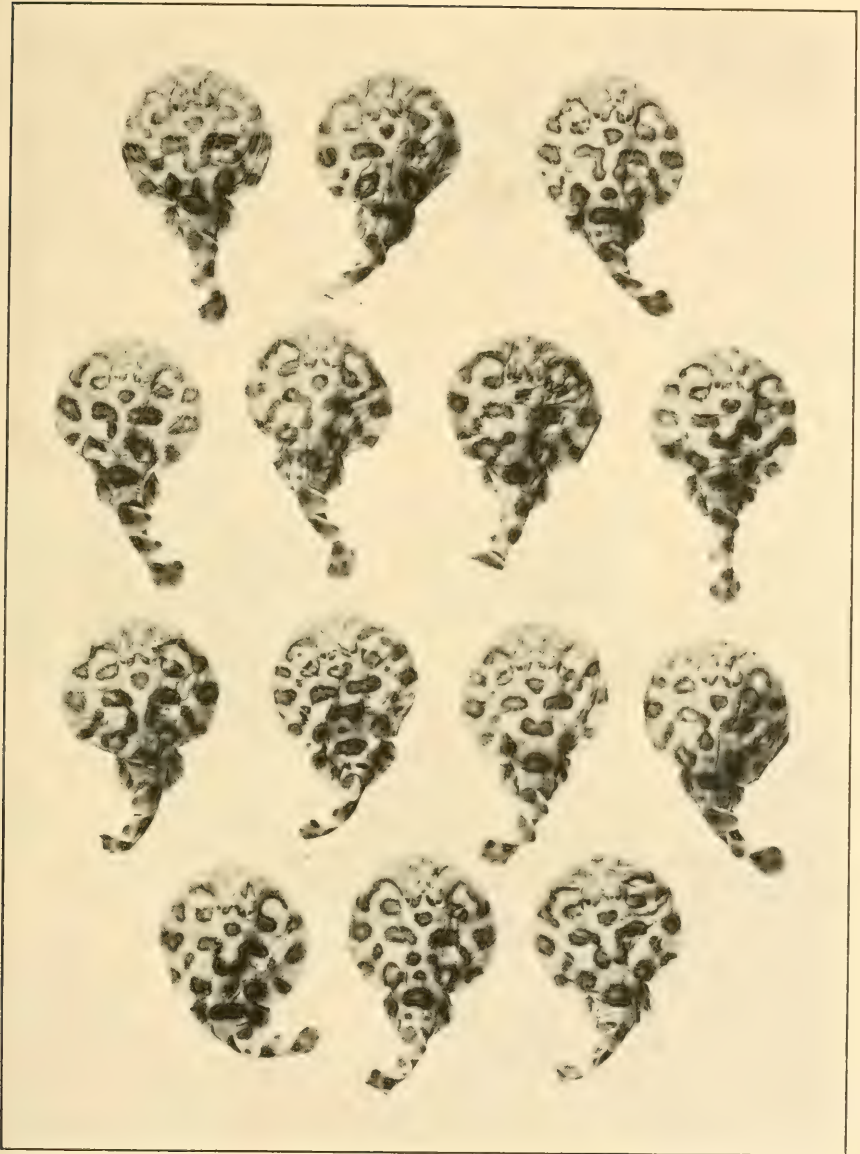
Several specimens which I found buried in the sand in shallow water with only the eyes and a little of the head and back showing were speared, and others were caught in the haul net.

Several bare foot native fishermen were knocked down by accidentally stepping on them in shallow water. These rays remain soft and rubber like in a formalin solution which hardens other specimens.



ADULT FEMALE OF NARCINE BRASILIENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 232.



YOUNG OF NARCINE BRASILIENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 232.

A NEW TREMATODE (STYPHLODORA BASCANIENSIS)
WITH A BLIND LAURER'S CANAL.

By JOSEPH GOLDBERGER,

Passed Assistant Surgeon, U. S. Public Health and Marine-Hospital Service.

While studying the helminthological collections in the U. S. National Museum, I found three toto mounts, one series of frontal sections, and six specimens in glycerine-alcohol all of one species of a trematode from the liver of a *Bascanion constrictor* collected by Dr. Albert Hassall near Alexandria, Virginia, on July 13, 1892. One of the toto mounts was presented to Prof. Ch. Wardell Stiles by Doctor Hassall, while the remaining specimens form a part of the Hassall collection.

For the privilege of studying this material I am indebted to both Doctor Hassall and Professor Stiles.

EXTERNAL CHARACTERS.

Size.—The specimens in alcohol vary in length from 3.8 to 4.88 mm. and in width from 1.72 to 2.92 mm.; the three mounted specimens vary from 3.7 to 5 mm. in maximum length and from 2 to 3 mm. in maximum width.

Color.—The worms in alcohol are of an olive green tint with a dark area corresponding to the egg-distended uterine coils.

Form.—The body is dorso-ventrally flattened; in ventral view it is oval in outline with a somewhat attenuated, bluntly pointed oral end and a bluntly rounded caudal margin. A transverse section near the cephalic end is subcircular in outline; farther caudad transverse sections are elliptical with relatively very short dorso-ventral diameter. Thus, a transverse section in the testicular zone of one specimen measures 1.42 mm. in transverse diameter and 0.375 mm. in dorso-ventral diameter.

Surface.—The surface cuticle is thin, measuring about $4\ \mu$ in thickness and is armed with delicate spines. The spines are not very numerous and do not appear to be uniformly distributed, being very

sparse or altogether absent at the caudal pole. In the median line of the venter, at about the junction of the cephalic with the middle third of the body length, is the circular aperture of the acetabulum. At a point about the acetabular diameter cephalad of the cephalic

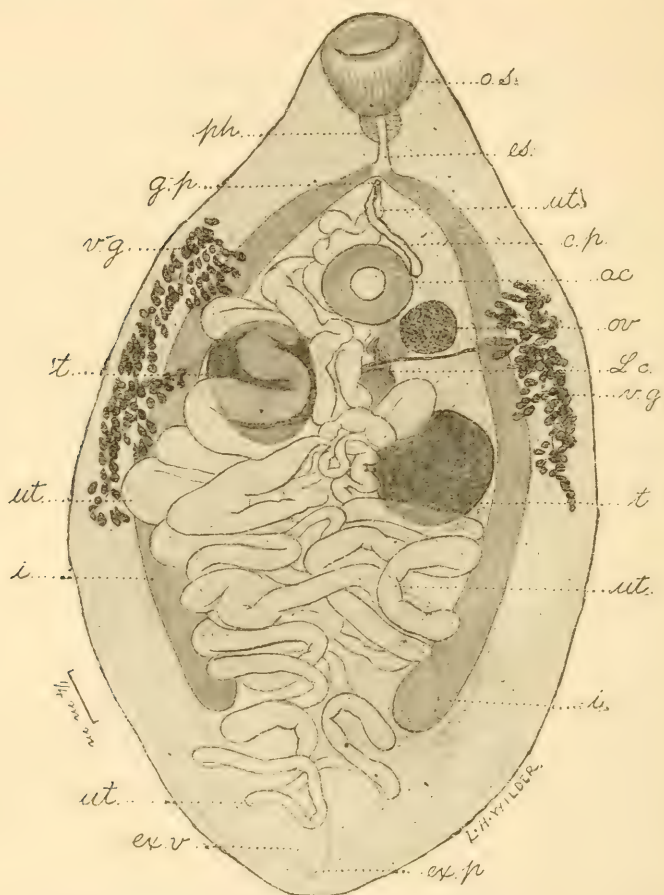


FIG. 1.—VENTRAL VIEW SHOWING TOPOGRAPHY. *ac.*, ACETABULUM; *c. p.*, CIRRUS POUCH; *es.*, ESOPHAGUS; *ex. p.*, EXCRETORY PORE; *ex. v.*, EXCRETORY VESICLE; *g. p.*, GENITAL PORE; *i.*, INTESTINE; *L. c.*, LAURER'S CANAL; *o. s.*, ORAL SUCKER; *ov.*, OVARY; *ph.*, PHARYNX; *t.*, TESTIS; *ut.*, UTERUS; *v. g.*, VITELLARIA. FROM A PRESS PREPARATION. ENLARGED. ORIGINAL.

margin of the acetabulum and in or very slightly to the right of the median line is the genital pore.

Acetabulum.—The acetabulum varies in diameter in four sectioned specimens between 0.270 and 0.345 mm. It is of a loose-meshed structure like that in *Athesmia foxi*.¹ Its aperture appears to be somewhat smaller than that of the mouth.

¹ Goldberger and Crane, 1911.

INTERNAL ANATOMY.

Digestive tract.—The oral aperture is ventro-terminal in position, circular in outline, and somewhat larger than the aperture of the acetabulum. It leads into a well-developed oral sucker. The latter, measured in sections, varies between 0.420 and 0.435 mm. in maximum longitudinal, 0.300 and 0.315 mm. in maximum dorso-ventral, and between 0.300 and 0.360 mm. in maximum transverse diameter. It is therefore somewhat larger than the acetabulum. Its structure



FIG. 2.—SAGITTAL SECTION TO SHOW PREPHARYNGEAL ATRIUM. *p. ph.*, PREPHARYNX. (FOR OTHER LETTERING SEE FIG. 1.) ENLARGED. ORIGINAL.

is of the same loose-meshed character as the acetabulum. Attached to the base of the oral sucker is a relatively roomy prepharyngeal atrium or prepharynx (fig. 2). This is succeeded by a pharynx that measures about 0.105 mm. in longitudinal diameter. Around the base of the latter is an accumulation of gland cells. In its turn the pharynx is succeeded by an esophagus that forks laterally into the intestinal ceca at a point just cephalad of the level of the genital pore. The intestinal ceca pass caudad paralleling the lateral body margins, to terminate in slightly separate planes at about the level of junction

of the penultimate with the caudal fifth of the body length. The ceca are narrowest at the esophageal ends; their diameter increases slightly in the direction of their cecal extremities. The oral sucker, prepharynx, pharynx, and esophagus are lined with a cuticular layer; the intestinal lumen is lined by a layer of large cubical epithelial cells.

Genital system—Male organs.—The testes are in the intercecal area in a zone slightly preequatorial. They are placed one to the right and the other to the left of the median sagittal plane, near the mesial or mesio-ventral aspect of the corresponding gut, but not abutting the field of the latter, although in press preparations they may appear to do so (as for instance in fig. 1 drawn from a press preparation). The testicular zones overlap more or less, but do not coincide, and their fields are separate. The cephalically placed testis may belong to the right or to the left side; in four of seven specimens studied the right testis is in advance, in three it is the left. The testes are irregularly globular in form, without surface indentations, approximately equal in size, and measure about 0.195 mm. in diameter. A relatively stout-walled vas efferens springs from the cephalic aspect of each. Each vas passes mesio-cephalad assuming a position close to the dorsal aspect of the corresponding ramus of the excretory vesicle. The vas of the side in which the ovary is placed passes in its course in close relation first to the ventral aspect of the globular cecal end of Laurer's canal, then close to the ventral aspect of the receptaculum seminis; later it passes close to the mesial aspect of the ovary, between the latter and the shell gland. Cephalad of the shell gland, the vas tends toward the axial region to meet and unite with its fellow at the base of the cirrus pouch. The cirrus sac is an elongate cylindrical thin-walled structure measuring about 0.525 mm. in length and about 0.105 mm. in maximum diameter. It incloses a slightly coiled vesicula, a short prostatica, and a protrusile cirrus. With the cirrus retracted the ductus ejaculatorius discharges into an atrium which also receives the vagina. The pouch lies dorso-cephalad of the acetabulum, its axis directed obliquely cephalo-ventrad. In press preparations (fig. 1) the pouch appears to take a somewhat curved (crescentic) course laterally of the acetabulum somewhat as described and pictured by Looss¹ for *Styphlodora solitaria*; in sections, however, one finds that the pouch, although submedian, is, as here described, dorso-cephalad, not lateral of the acetabulum. The base of the pouch is in a plane slightly cephalad of the caudal margin of the acetabulum.

Female organs.—The ovary is a globular body, somewhat smaller than the acetabulum and considerably smaller than the testes; it is placed to one side of the median plane in a zone that abuts or slightly overlaps the acetabular zone cephalically, and is separated to a variable extent from the zone of the cephalically placed testis, caudally.

¹1902, p. 506, fig. 24.

It is placed in the same side of the intercecal area as is the caudally placed testis within whose field the ovarian field falls. The oviduct springs from the dorso-mesial aspect of the ovary and tends dorso-mesially and caudad. Almost immediately after its origin it receives a short duct from the receptaculum seminis; a little beyond this point it gives off a duct that passes caudad close to the ventral aspect of the receptaculum seminis at the level of the caudal margin of which it dilates into a globular body of about the size of the ovary (fig. 3). This duct corresponds, in its relation to the oviduct, and in its structure, to Laurer's canal, but instead of passing to and opening on the surface it ends in the manner described for Laurer's canal in *Aspidogaster conchicola*. The globular cecal end of this canal contains spermatozoa, sperm-morulas, round deeply staining bodies suggesting nuclei and a few vitelline cells. Immediately after the origin of

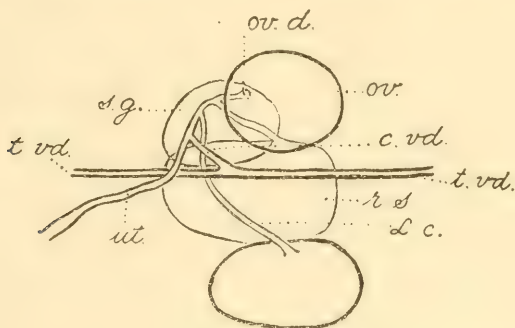


FIG. 3.—DIAGRAM TO SHOW RELATIONS OF LAURER'S CANAL AND ITS GLOBULAR END. *c. vd.*, COMMON VITULLO-DUCT; *ov. d.*, OVIDUCT; *r. s.*, RECEPTACULUM SEMINIS; *s. g.*, SHELL GLAND; *t. vd.*, TRANSVERSE VITELLO-DUCT. (FOR OTHER LETTERING SEE FIG. 1.) ORIGINAL.

Laurer's canal the oviduct enters an ill-defined, irregular mass of cells forming the shell-gland within which it is joined by the common vitello-duct to form the ootype. The shell gland lies close to the mesial and mesio-dorsal aspect of the ovary and close to the ventral aspect of the receptaculum seminis. The seminal receptacle is an ovoid structure somewhat larger than the ovary close to the dorso-caudal aspect of which it lies; it is filled with spermatozoa. The uterus, a continuation of the ootype, emerges from what may be regarded as the ventral aspect of the shell gland, passes ventrad, then caudad. The uterine coils extend to quite near the caudal margin; they fill the posttesticular portion of the intercecal area and its extension caudad. There is a descending and an ascending uterine limb that may be distinguished by the difference in the tint of the contained eggs, the eggs in the ascending limb being the darker. Both limbs form transverse coils in adjacent (right and left) lateral

fields that are distinct, but dovetail to some extent. In one of the preparations one of the transverse coils of the ascending limb lies on the opposite side, among the coils of the descending limb. As the uterus enters the testicular zone its coils fill the area between the testes, encroaching to some extent on the testicular fields; then it ascends laterally of the mesial aspect of the ovary to assume a more simple course cephalad of the latter and dorsally of the cirrus sac to discharge finally into the genital atrium.

The vitellaria, consisting of a moderate number of groups of a well-developed follicles, are situated ventro-laterally of the intestinal ceca in a zone the cephalic limit of which is a plane slightly caudad of the cephalic margin of the acetabulum and the caudal limit, the plane of the caudal margin of the caudal testis. In one of the preparations the grouping of the follicles is very clearly evident; each gland in this specimen appears to be made up of nine groups. A duct leaves each group of follicles; these ducts unite to form one or two secondary yolk ducts that leave each gland to pass toward the axial region dorsally of the gut. When two ducts leave the gland they unite later to form a single transverse vitelloguct. The transverse duct of one side unites with its fellow of the other side close to the ventro-caudal aspect of the shell gland to form a common duct. The common duct passes cephalo-dorsad into the shell gland to unite with the oviduct as already described (fig. 3).

Excretory system.—The excretory bladder is roomy and is in the form of a Y. The lateral stems are short; beginning at about the level of the cephalic margin of the globular cecal end of Laurer's canal they unite at the level of its caudal margin to form the median stem. This passes caudad in the intercecal area dorsally of the folds of the uterus and between the testes to near the caudal margin, terminating by a short duct that discharges on the dorsal surface at a point slightly removed from the caudal margin.

SYSTEMATIC POSITION.

From the foregoing description it will be seen that in the topographic relations of its organs this worm conforms to the diagnosis of the genus *Styphlodora* Looss.¹ I therefore place this worm in this genus under the name of *Styphlodora bascaniensis*. It stands close to *Styphlodora solitaria* Looss, from which, however, it differs in several respects most notably in that Laurer's canal instead of opening on the dorsum terminates blindly. This peculiarity of Laurer's canal has heretofore been noted, so far as I am aware, only in one other trematode, namely, *Aspidogaster conchicola*.

The specific diagnosis of *Styphlodora bascaniensis* may be summarized as follows:

¹ 1902, p. 507.

Specific diagnosis.—Dorso-ventrally flattened, oval distomes with bluntly pointed oral and rounded caudal margin, 3.8 to 4.88 mm. long by 1.72 to 2.92 mm. wide. Cuticle 4μ thick, armed with delicate spines which are few or absent at caudal pole; acetabulum at junction of cephalic and middle third of body; genital pore the length of acetabular diameter preacetabular, submedian. Oral aperture ventro-terminal, larger than acetabular aperture; oral sucker larger than acetabulum; pharynx present with prepharyngeal atrium; esophagus short, forks just cephalad of level of genital pore; ceca terminate at level of junction of penultimate with caudal fifth of body length.

Testes irregularly globular, smooth, equal, right and left, pre-equatorial, postacetabular, in intercecal area; testicular zones overlap, fields are separate. Cirrus pouch present, dorso-cephalad of acetabulum; incloses a vesicula, a short prostatica and a protrusile cirrus.

Ovary is globular, smooth, smaller than acetabulum or testis, submedian; ovarian zone abuts or overlaps caudal limit of acetabular zone. Laurer's canal present, but terminates in a blind globular end. Receptaculum seminis present, large. Uterus with descending and ascending limb in separate, right and left, adjacent fields, extends to near caudal margin, intercecal. Vitellaria ventro-lateral of ceca; follicles in groups extend from slightly caudad of cephalic margin of acetabulum to plane of caudal margin of caudal testis. Excretory bladder roomy, Y shaped. Excretory pore dorso-subterminal.

Habitat.—Liver of *Bascanion constrictor*, Virginia, U. S. A.

Type.—Cat. No. 7326, U.S.N.M.; cotypes No. 5863 and No. 7112.

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BEEES IN THE COLLECTION OF THE UNITED STATES
NATIONAL MUSEUM. 2.

By T. D. A. COCKERELL,
Of the University of Colorado, Boulder.

The present contribution deals principally with Asiatic bees, and includes a number of new species collected by Dr. W. L. Abbott in localities rarely visited by naturalists. Especially interesting are those obtained at very high altitudes in the Himalayan region, belonging to a peculiar fauna, recently made known in part through the work of the British Tibet expedition.¹ Doctor Abbott's collections have long priority over those of the British expedition, but descriptions of the latter have, in part, been published first.

HALICTUS NIKKOENSIS, new species.

Female.—Length slightly over 6 mm., anterior wing $4\frac{1}{2}$; head, thorax, and abdomen olive-green; head large, broader than thorax, facial quadrangle larger than the small mesothorax; clypeus not produced, its lower part blackened, its surface shining, with distinct but very sparse punctures; mandibles dark red subapically; supra-clypeal area shining; front and vertex dullish, very densely granular-punctate; cheeks broad, unarmed; antennæ dark, apical part of flagellum ferruginous; hair of head and thorax dull white, scanty; mesothorax and scutellum shining, with fine close punctures, yet not so close on disk as to hide the surface; area of metathorax looking granular under a lens, but really covered with very fine, vermiform anastomosing wrinkles; tegulæ testaceous; wings yellowish, with a sort of dilute orange tint; stigma and nervures pale ferruginous, outer nervures distinct; second s. m. narrow, only about half as broad as third, receiving first r. n. at about beginning of its last third; legs dark, with pale yellowish hair, anterior and middle knees pallid, tarsi reddish, the hind basitarsus darker; hind spur with two large broad blunt teeth, the first about quadrate, the second very low, very much broader than long; abdomen finely punctured, the hind

¹ See Entomologist, Sept., 1910.

margins of the segments more or less testaceous, and covered with grayish-white hair bands, those on the first two segments wanting in the middle, but on the third and fourth entire.

Habitat.—Nikko, Japan (Koebele).

A species of the group of *H. tumulorum*, noticeable for the large head, with a well-developed occipital region. Among the described Japanese species it is nearest to *H. alexoides* Strand, but this latter is larger, with the tarsi and basitarsi of the female clear yellow.

Type.—Cat. No. 13529, U.S.N.M.

In the following key the new species is contrasted with several other related forms:

- Abdomen densely covered with pubescence, the apical hair bands, if any, not conspicuous..... 1.
 Abdomen with very conspicuous apical hair bands..... 2.
 1. About 9 mm. long; hair of abdomen distinctly ochreous, wings slightly milky. (Buda; Friese)..... *cariniventris* Morawitz.
 Smaller; hair of abdomen dense, pale grayish; vertex and mesothorax bluish. *vestitus* Lepeletier.
 2. Metathorax dark, greenish-black (Innsbruck; Friese)..... *tumulorum* Linnæus.
 Metathorax clear green..... 3.
 3. Mesothorax small, closely punctured but shining, the surface visible between the punctures..... *nikkoensis* Cockerell.
 Mesothorax very densely punctured, granular..... *subauratus* Rossi (including *seladonius* Fabricius) and *virescens* Lepeletier (including *gramineus* Smith.)

HALICTUS CALCEATUS Scopoli.

Gersau, Switzerland, July 30, and Rigi Culm, Switzerland, August 1, 1909 (T. D. A. and W. P. Cockerell).

HALICTUS QUADRINOTATUS Kirby.

A male at Wangen, Baden, August 5, 1909 (Cockerell).

HALICTUS PAUXILLUS Schenk.

Two females at Wangen, Baden, August 5, 1909 (Cockerell). Frey-Gessner remarks that one would take this for a small *H. albipes*, but it has the mesothorax less densely punctured, with the surface between the punctures plainly visible. This is well said, for among a series of *H. albipes* received from Doctor Friese I find a *pauxillus*, collected by him at Buda.

HALICTUS INTERRUPTUS Panzer.

One female at Wangen, Baden, August 5, 1909 (Cockerell).

HALICTUS TUMULORUM Linnæus.

My wife and I collected this in 1909 at Troyes, France, August 8; Gersau, Switzerland, July 30; Wangen, Baden, August 5.

HALICTUS MORIO Fabricius.

Wangen, Baden, August 5, 1909 (Cockerell).

ANDRENA KNUTHI Alfken.

Two males from Wakasa, Japan (T. Fukai). The dark markings on the upper part of the clypeus may be barely visible (excepting the usual spots, which are always distinct), or the whole upper two-fifths of the clypeus may be black. The abdomen is extremely shiny, with the hind margins of the segments testaceous.

ANDRENA PRÆCOCIFORMIS, new species.

Male.—Length 8 to 9 mm., black, with long white hair on head, thorax, and legs, black at sides of face, upper part of cheeks behind, and a little on scutellum. In Schmiedeknecht's table of European species it runs to *A. parvula*, but it actually resembles *A. præcox* Scopoli, so much so that at first sight it seems to be the same. It differs from *præcox* by the rather smaller size; the cheeks, though broad, dullish except near the eye, and not angled behind (shiny and angled in *præcox*); the mandibles moderate, without the very long falciform apical tooth of *præcox*; the head above and cheeks with less black hair; the sides of thorax behind with hair all white; the metathorax rougher; the hind margins of abdominal segments a little reddish, and with a tendency to thin marginal hair bands at sides. Mesothorax dull and rough; metathorax very dull and rough, the area ill defined, minutely granular, roughened basally, its apical angle acute; tegulae very dark rufo-piceous; wings as in *præcox*, but stigma darker (variable); first r. n. joining the broad second s. m. about middle; abdomen shining, without distinct punctures. Antennal joints 3 to 5 measured as follows in two specimens: the type, (3.) 374, (4) 255, (5.) 340 μ . Another, (3.) 323, (4) 306, (5) 340 μ . The latter specimen is the larger.

Habitat.—Japan, specimens numbered 166 and 54.

The Californian *A. knuthiana* Cockerell is also allied. *A. japonica* Alfken is also compared with *præcox*, but it is larger and evidently different.

Type.—Cat. No. 13530, U.S.N.M.

ANDRENA RUPSHUENSIS, new species.

Female.—Length slightly over 11 mm.; black, with pale hair, the form rather slender, at first sight rather suggesting a male; hair of head and thorax long and loose, white below, very pale ochreous above, vertex and sides of front with dark fuscous hair; face very broad, eyes small, so that the facial quadrangle is about $1\frac{2}{3}$ as broad as long; malar space large, brilliantly shining; mandibles with the apical half obscurely ferruginous; cheeks broad, shining; process of labrum broad, truncate; clypeus brilliantly shining, well punctured, except a broad smooth median band; front dull and roughened; facial foveæ broad, occupying much more than half space between

antennæ and eyes, dark seal brown, not separated from eye, ending a little above level of top of clypeus; antennæ black (flagellum brownish-black), the third joint almost as long as the next three combined; mesothorax shining, the disk with distinct but well separated punctures; scutellum shining; base of metathorax dull and granular, without rugæ, the area scarcely defined; tegulæ dark rufotestaceous; wings moderately dusky; stigma and nervures ferruginous, rather dark; first r. n. reaching second s. m. far beyond middle; legs black, the tarsi dark ferruginous; spurs ferruginous; hair of legs dull white on femora, pale orange on tarsi; mainly reddish on tibiæ; the orange scopa of hind tibia has collected a quantity of red pollen; abdomen shining, with only feeble piliferous punctures, hind margins of the segments narrowly testaceous; first segment with much long pale hair; segments one to four with conspicuous white apical hair-bands, that on first thin in the middle; caudal fimbria purplish-sooty, as also the thick apical fringe of fifth segment.

Habitat.—Rupshu, Ladak, 16,000 feet, July 21 and 22, 1897 (W. L. Abbott).

In Schmiedeknecht's table this runs to 153, and runs out because of the yellow or orange scopa, combined with the absence of distinct punctures on the abdomen. The superficial appearance is that of a rather pale *A. fulvicrus* Kirby, but the latter has a strongly punctured abdomen. This seems to have no special affinity with any of the numerous species described from northern India and adjacent regions. It may possibly be identical with one of the 52 described by Morawitz from Turkestan, but I think not, as the bee-fauna of the higher altitudes in the Himalayas seems to be wholly distinct (as to species) from that of the lower levels, as might be expected.

Type.—Cat. No. 13531, U.S.N.M.

ANDRENA PILIPES Fabricius.

Pekin, China, April 21-30, 1901 (M. L. Robb). These Chinese specimens run exactly to *pilipes* in Schmiedeknecht's table, and upon comparison with a specimen of *A. pilipes* from Sicily, I fail to find any tangible difference. One specimen (female) is stylopized.

ANDRENA THORACICA Fabricius.

Pekin, China, April 20, 1901 (M. L. Robb). Three females in rather poor condition. These run exactly to *thoracica* in Schmeideknecht's table, and agree perfectly with his description. I possess only the male of European *thoracica*, but it agrees in general with these females, except for the usual sexual differences; especially characteristic are the pallid wings with ferruginous nervures, the second s. m. large. In both sexes the b. n. falls a little short of the t. m.

The collection contains three other species of *Andrena* from Pekin which I fail to recognize, but they are in indifferent condition, and I can not venture to describe them as new.

NOMIA CHALYBEATA Smith.

One male; Foochow, China (H. R. Caldwell). This agrees well enough with Smith's description of his type from Shanghai, but Bingham describes *chalybeata*, which he records from Tenasserim, as having rufo-fulvous legs. I can only suppose that Bingham had a different species. The Foochow specimen has a good deal of black hair on the mesothorax and scutellum, and the flagellum and apical margins of the wings are darker than Smith indicates. There are, perhaps, several closely allied species or races of this immediate group, but if so more material is needed for their elucidation.

NOMIA PUNCTULATA Dalla Torre.

Described from China. A male and female from Japan (*Mitsukuri*) do not appear to differ in any respect. The female has three emerald green bands on the abdomen, while the four of the male are more bluish green. The species is very close to the Indian *N. elliotii* Smith, but easily separated by the absence of a band on the first abdominal segment.

NOMIA TERMINATA Smith, var. a.

Female.—Length about 14 mm., anterior wing $11\frac{1}{2}$; black, without any evident bands on abdomen; postscutellum unarmed; wings strongly yellowish, the apex broadly clouded with fuscous. Hair of head and thorax ferruginous, but on mesothorax and anterior part of scutellum thin and mixed with fuscous; mandibles black; clypeus shining, depressed in middle, with very strong, sparse punctures; supraclypeal area elevated and punctured; clypeal keel or ridge evanescent; abdomen shining, feebly punctured, the hind margins of second and third segments at sides with pale yellowish tegumentary bands.

Two females from Khow Sai Dow Mountain, 1,000 feet, Lower Siam, February, 1899 (W. L. Abbott). On account of the feeble clypeal keel, the rudiments of tegumentary bands on abdomen, and the feebly punctured abdominal segments, I was inclined to regard this as a distinct species. Close comparison with the descriptions of Smith and Bingham convinced me that the insect was at best a variety, however. Bingham states that the clypeal keel is slight, and Smith says the abdomen is smooth and shining. The rudiments of tegumentary bands may have been overlooked.

N. aureipennis Gribodo, from Perak, is smaller (female, 11 mm.), and the tegumentary bands on the second and third segments are better developed, though interrupted in the middle. This, though very closely allied, has better claims to distinction.

PSEUDOMELECTA INTERRUPTA Cresson.

Kerrville, Texas, April, 1907 (P. Durham).

COELIOXYS (LIOTHYRAPIS, new subgenus) APICATA Smith.

One female; Trong, Lower Siam, January–February, 1899 (W. L. Abbott). This agrees with an Indian *C. apicata* from F. Smith's collection. The species is taken as the type of a new subgenus *Liothyrapis*, distinguished by the absence of hair on the eyes. According to Friese and others, *C. apicata* is a synonym of *C. decipiens* Spinola, described from Egypt, and the same species is said to extend to South Africa, whence it was described as *C. verticalis* Smith. I have a female of *C. verticalis* from Doctor Brauns, collected at Willowmore, Cape Colony, December 1, 1904. It is a different looking insect from *apicata*, although structurally almost the same. The apical part of the second abdominal segment (beyond the groove) is shorter, the more abundant pale pubescence gives the insect a hoary appearance, the legs are largely red, and the wings are hardly so dark. I am satisfied that *apicata* and *verticalis* should be regarded as different species.

I have no material of the genuine *C. decipiens*, but according to Spinola it has black legs, and the wings hyaline, only smoky at the distal margin. Probably it is separable from *apicata* on the one hand and *verticalis* on the other.

COELIOXYS SIAMENSIS, new species.

Female.—Length 12 mm.; black, including legs and antennæ, with white pubescence; hair on inner side of tarsi pale golden; eyes pale green, their hair short but thick; face with much white hair; vertex with very large coarse punctures; cheeks behind eyes densely covered with pure white hair, this white area sharply bounded behind by a keel or ridge; mesothorax and scutellum with exceedingly large punctures, those on scutellum more irregular and less dense; hind margin of scutellum turned upwards, more or less notched in the middle; lateral teeth strong; prothorax, margins of mesopleura, tubercles, and metathorax covered with white hair, which also forms a spot behind each tegula, a pair of spots on anterior margin of scutellum, and a tuft below each scutellar tooth; area of metathorax irregularly plicate at base, otherwise smooth; tegulæ piceous; wings with about the apical half dark fuscous; spurs dark reddish brown; abdomen with slight purple tints, shining, strongly but sparsely punctured, with narrow pure white hair-bands at the apical margins of the segments, broadly interrupted in the middle; last dorsal segment very finely punctured, narrowed and keeled apically; last ventral elongate-conical, not notched at sides, consid-

erably exceeding dorsal, moderately bent downward; penultimate ventral segment sparsely punctured basally, densely striatulate at apex.

Habitat.—Trong, Lower Siam, two females, one in poor condition (W. L. Abbott).

In Bingham's table this runs to *C. confusus* Smith, and indeed it has been identified by Doctor Ashmead as this species. I believe it is distinct, from the characters cited by Bingham for *confusus*, the two being separable as follows:

Clypeus higher than usual, but otherwise normal; last ventral segment rather broad, though with nearly straight sides; apical margin of scutellum turned upward; abdomen strongly though sparsely punctured, the basal segment like the others.

siamensis.

Clypeus very large, transverse anteriorly; last ventral segment extremely narrow; apical margin of scutellum not turned upward; abdomen finely punctured, the punctures most dense on basal segment.....

confusus.

Bingham does not specifically state that the hind scutellar margin of *confusus* is not upturned, but Nurse describes *C. perseus* as the only Indian species having this character.

C. leptotaxis Enderlein, from Sumatra, seems also to be allied.

In its general superficial appearance *C. siamensis* much resembles *C. penetratrix* Smith, from Willowmore, Cape Colony (Brauns).

Type.—Cat. No. 13532, U.S.N.M.

EPEOLUS PUSILLUS Cresson.

Victoria, Texas, April 1, 1907, at flowers of *Callirrhoe involucrata* (Nuttall), one male (J. D. Mitchell).

STELIS COSTALIS Cresson.

One male; Dallas, Texas, May 11, 1908 (R. A. Cushman).

STELIS LOUISÆ, new species.

Male.—Length about 7 mm., similar to *S. costalis*, but second r. n. meeting second t. c.; clypeus with a very broad yellow transverse band, lobed above, leaving the upper part and lower margin dark; pleura with a large chrome yellow patch; coxæ, trochanters, and femora, except at apex, black; apices of femora and all of tibiæ and tarsi, pale yellowish-ferruginous, the anterior tibiæ quite yellow in front; first abdominal segment more coarsely punctured, its band broader, with the posterior excavations ferruginous; second segment with only lateral spots; fifth with only a small transverse yellow mark in middle, but bands on third and fourth as in *costalis* (probably these abdominal markings are variable); short hair on and about apex of sixth segment black. The labrum is dark, whereas in *costalis* it is clear red. The insect is smaller and narrower than *S. costalis*.

Habitat.—Mound, Louisiana, May 12, 1905 (C. R. Jones).

Type.—Cat. No. 13533, U.S.N.M.

DIANTHIDIUM SIMILE Cresson.

Two males; Kerrville, Texas, April, 1907, collected by H. Durham, one dated April 14, at flowers of *Marrubium vulgare*. The Texas *D. simile* is not altogether typical, and should perhaps be separated.¹

DIANTHIDIUM PARVUM Cresson.

Two of each sex; Flagstaff, Arizona, at flowers of *Iris*, June 11, 1909 (F. C. Pratt). This species has the same structure as *D. simile*, and is perhaps only to be regarded as a western race. The male of *D. pudicum* Cresson is distinct by the more strongly lobed apex of abdomen.

DIANTHIDIUM TEXANUM Cresson.

One of each sex; Dallas, Texas; the female, March 2, 1908 (with a second label, evidently erroneous, giving date April 28, 1908); the male, May 3, 1908 (C. E. Hood). Cresson describes only the male, but the female looks just the same, except that the middle third or more of the clypeus is black. The ventral scope is yellowish white.

ANTHIDIUM PECOSENSE Cockerell.

One male and two females; Flagstaff, Arizona, at flowers of *Iris*, June 11, 1909 (F. C. Pratt). The male type of *pecosense* has the second r. n. meeting the outer t. c.; in the three Arizona specimens it goes beyond it, in the manner of *Dianthidium*. A minute comparison of the males leaves no doubt that they belong to the same species. The female is similar but rather smaller, with the clypeus and lateral face marks yellow, as in the male; mandibles with much yellow; labrum black; a yellow occipital stripe, broadly interrupted in the middle; cheeks black; thoracic yellow markings better developed than in male, with the axillæ and hind margin of scutellum (narrowly interrupted in middle) broadly yellow; legs with more yellow, the femora with a large yellow stripe or band; band on first abdominal segment notched behind, not divided into four spots; sixth segment yellow, with broad low rounded lateral lobes; ventral scope glittering pale fulvous.

ANTHIDIUM POUDREUM Titus.

This has been printed *pondreum*, a misprint for *poudreum*. Mr. Pratt took four males and two females at Flagstaff, Arizona, at *Iris* flowers, at the same time as the *A. pecosense* cited above. The Arizona males are more robust than Colorado specimens usually are. The female is like that of *A. pecosense*, but the clypeus has a large black triangle with the apex pointing downwards, the whole clypeus being divided into three subequal triangular areas, one black and two yellow. The yellow of the mesothorax is confined to a stripe

¹ See Cockerell, Proc. Ent. Soc. Washington, vol. 9, 1908, p. 72.

above each tegula, the abdominal bands are lighter, and the femora are black without the large yellow stripes. Some of the characters formerly cited to separate male *pecosense* from *poudreum* are not constant. A constant character in the Arizona males is the absence of yellow on the mesothorax.

The following key separates some females of *Anthidium* in which the scopa is pale. My *A. blanditum prædentatum* seems to belong rather with *placitum*. The female of *A. pecosense* so nearly agrees with the description of *A. blanditum* from Nevada as to suggest that the two represent variations or races of one species.

- Clypeus yellow, with at most lower edge, and two dots near upper margin, dark; mesothorax with an angular pale stripe on each side..... 1.
 Clypeus at least largely dark..... 2.
1. Pubescence pale..... *blanditum* Cresson.
 Pubescence fulvous, especially above; legs with less black... *pecosense* Cockerell.
 2. Mesothorax without light markings; bands on abdominal segments 1 to 5, each broken into four spots..... *maculosum* Cresson.
 Mesothorax with light markings..... 3.
 3. Mesothorax with an angular pale stripe on each side..... 4.
 Mesothorax with a straight mark or a spot on each side..... 5.
 4. Clypeus with a median black stripe..... *placitum* Cresson.
 Clypeus with a black bidentate mark on upper part; legs with more black.
placitum prædentatum Cockerell.
 5. Sixth abdominal segment above yellow, except at base; wings darker.
poudreum Titus.
 Sixth abdominal segment with two rounded pale spots; wings paler.
montivagum Cresson.

Through the kindness of Professor Gillette I received a pair of supposedly authentic *A. poudreum*, collected at Fort Collins and Palmer Lake, Colorado. They are both *A. tenuifloræ* Cockerell, but it is clear from the description of *poudreum* that it could not have been based on specimens of *tenuifloræ*.

ANTHIDIUM PORTERÆ Cockerell.

Two males and one female; Marfa, Texas, June 6, 1908 (Mitchell and Cushman).

ANTHIDIUM TENUIFLORÆ Cockerell.

Two males; Helena, Montana, August 6 (W. M. Mann). New to Montana.

ANTHIDIUM PHILORUM Cockerell, var. **ABBOTTI**, new variety.

Male.—Length, 10 mm.; all the pubescence white; clypeus, lateral face-marks, and mandibles except apex, cream-color, as also a spot above top of each eye; antennæ wholly black; thorax without light markings; tegulæ black; basitarsi light yellow, the other tarsal joints light ferruginous; abdominal bands all interrupted in the middle (though the last two very narrowly), and deeply and broadly excavated (that on second segment interrupted) at sides; no light markings on first or last segments; apical segment with broad divergent

lateral lobes, and a slender median spine; penultimate segment strongly dentate at sides, the margin next to the teeth not denticulate.

Habitat.—Rupshu, Ladak, 16,000 feet, July 23, 1897 (W. L. Abbott).

In Friese's table this runs to *A. affine* Morawitz, but differs in various particulars; for example, the lateral lobes at the end of the abdomen have no inwardly-directed point and are not notched on the outer side. There is the strongest resemblance to the Rocky Mountain *A. tenuifloræ* Cockerell; superficially they appear the same, but on close comparison many minor differences appear.

A. philorum was described from a female obtained by the British Tibet expedition, at an altitude of 13,000 feet in the Himalayas. The male here recorded may, I think, be safely referred to it.¹

Type.—Cat. No. 13534, U.S.N.M.

PROANTHIDIUM KASHGARENSE, new species.

Female.—Length about 10 mm.; robust, black with deep chrome-yellow markings, the femora and the basal declivity of the abdomen largely red; head and throat very densely, rather coarsely punctured, the rather coarse pubescence rufofulvous above, paler below, pale yellowish-gray on pleura and sides of metathorax; face broad, eyes converging below, dull green slightly suffused with reddish; clypeus and broad lateral marks yellow, the latter broadly obliquely truncate above, the lower side of the truncation on the orbit; lower edge of clypeus black, with a strong transverse groove; mandibles yellow except the broad edge, which bears many black teeth, a big one at the end being followed by six very small ones, after which come several big ones; an entire yellow band across occiput, broadened at sides and ending in a sharp point; antennæ black, joints 2, 5, and 6 red beneath; mesothorax wholly black; tubercles largely yellow; scutellum and axillæ very broadly margined with yellow; axillæ not dentiform; scutellum projecting, with a sharp posterior edge, the lateral corners subangulate but rounded; tegulæ punctured, yellow with a large rufous spot; wings dusky, strongly so in and beyond marginal cell; b. n. going basal of t. m.; first r. n. meeting first t. c.; second r. n. going well beyond second t. c.; legs yellow except at extreme base, the femora suffused with red; hair on inner side of tarsi fulvous, on outer side pale golden; abdomen with pale fulvous hair, including the scopa; basin of first segment sharply margined; apex broadly rounded, turned outwards; all the segments with broad deep yellow bands, the first three or four rather narrowly interrupted in middle, but none notched at sides.

¹Since writing the above I have received a male of true *A. philorum* from the British Museum. It differs from Doctor Abbott's insect in having large pale-yellow marks on the last abdominal segment, and the first segment having a large pale-yellow patch on each side, continued mesad as a slender scimitar-shaped mark.

Habitat.—Kashgar, Chinese Turkestan, August 26, 1893 (W. L. Abbott).

This is a species of *Proanthidium*, related to *P. oblongatum*, from which it differs by the fulvous scopa and the greater amount of yellow on the thorax, as well as other details. *Proanthidium* Friese must not be confused with *Protanthidium* T. and W. Cockerell, which is a quite different genus.

Type.—Cat. No. 13535, U.S.N.M.

LITHURGUS APICALIS OPUNTIAE Cockerell.

One female; Del Rio, Texas, May 8, 1907 (F. C. Bishopp).

MEGACHILE PAMIRENSIS, new species.

Male.—Length 13 mm.; black, the tarsi ferruginous, the anterior and middle basitarsi variably dusky at base; head ordinary; eyes obscure reddish; mandibles dark, with two apical teeth, the outer one long; vertex and front dull and roughened; face and lower and hind part of cheeks densely covered with long white hair; anterior part of cheeks, and vertex, with fuscous hair, but occiput with long pale hair; antennæ black, third joint longer than second, but shorter than fourth; mesothorax and scutellum densely punctured; thorax above with dull white hair slightly tinged with ochreous, or strongly suffused with reddish-fuscous, especially on scutellum; hair of pleura and metathorax also variable in the same manner; tegulae shining black, slightly reddish posteriorly; wings moderately dusky, not dark; a brownish cloud in marginal cell; legs with long hair, varying from white to brown like that of the thorax, but the middle and hind tarsi and anterior tarsi in large part, with clear ferruginous hair, matching their tegumentary color; anterior coxæ densely covered with long hair, unarmed; anterior tarsi rather thick, but not otherwise modified; tibial spurs ferruginous; abdomen with black hair on basal part of first segment, but otherwise the hair on first three segments is warm ochreous; on the other segments it is black, except that on the fourth it is largely ochreous or practically all black; sixth segment depressed, the broadly rounded distal margin bearing a series of eight to ten prominent subequal teeth; seventh segment with a broadly rounded median lobe; no distinct hair-bands, but the pale hair on the first three segments is so arranged as to produce a somewhat banded effect; fourth ventral segment not emarginate.

Habitat.—Tagdumbash, Pamir, 13,000 feet, June 14, 1894 (W. L. Abbott). Two males.

A very distinct species, related to the *M. ericetorum* group. The appearance of the abdomen (but not the apical structure) is much like that of *M. circumcincta*. The mandibles and antennæ are formed essentially as in *ericetorum*, and the sixth abdominal segment is

similar, but the seventh is quite different. *M. piliventris* Morawitz has the sixth abdominal segment serrate, but the anterior tarsi are broadly dilated.

Type.—Cat. No. 13536, U.S.N.M.

MEGACHILE LADACENSIS, new species.

Male.—Length, 11–11½ mm.; black, the anterior femora in front, their tibiæ, extreme apex of middle and hind tibiæ in front, and middle and hind tarsi all ferruginous, the middle basitarsus suffused with blackish basally; first three joints of anterior tarsi very pale yellowish, last two ferruginous; head ordinary, rather broad; eyes dull green; mandibles thick, with two apical teeth, which are more or less reddish; beneath at base, the mandibles have a large process, which fits into a little shelf on under side of head, the edge of which is covered with ochreous tomentum; clypeus normal, shining and minutely punctured; front minutely roughened; face covered with long white hair; hair of vertex and thorax above thin, dull white; mesothorax closely punctured, except in the middle of the disk, where it is shining, with scattered punctures, but the posterior middle is dull; anterior edge of scutellum shining; tegulæ ferruginous, clouded with brownish toward base; wings hyaline, faintly dusky; anterior coxæ with stout dark spines, a little patch of orange pubescence at the base of each; anterior tarsi little broadened, but with a long white fringe behind, covering a yellowish one about half as long; the light yellow basitarsus parallel-sided, more than twice as long as broad, the inner apical corner produced, finger-like; hair on inner side of hind tarsi very pale orange; hind spurs pale brownish; abdomen shining, rather sparsely punctured, the hind margins of the segments rather broadly testaceous or ferruginous; first two segments with thin, long white hair; hind margins of second to fourth with thick apical fringes of white hair, that on second developed only at sides, that on third broadly interrupted, that on fourth entire; extreme sides of third and fourth segments with some yellowish hair; no black hair on abdomen anywhere; fifth and sixth segments with long ochreous or fulvous hair, the fifth with a white fringe under the fulvous; projecting margin of sixth segment broadly shallowly emarginate, and at sides variably inclined to be crenulate; seventh segment with a strong median projection, and a little one on each side; ventral segments broadly pale-margined, fourth emarginate.

Habitat.—The type is labeled Rupshu, Ladak, 16,000 feet, July 21, 1897 (W. L. Abbott).

Another male collected by Doctor Abbott is labeled Tsomorari Lake, Rupshu, Ladak, 16,000 feet, July 31, 1897. Apparently close to *M. dentiventris* Smith, but that has black tegulæ, and the end of the abdomen is different.

Type.—Cat. No. 13537, U.S.N.M.

MEGACHILE RUPSHUENSIS, new species.

Female.—Length 10 mm.; black, the small joints of tarsi ferruginous; hair of head, thorax, and legs rather dull white, thin, not at all mixed with dark; head rather large; mandibles broad, without distinct teeth (doubtless worn); clypeus closely punctured, with an imperfect median ridge, the lower margin thickened, slightly crenulated, and with a minute median tubercle; front dull, except in front of ocelli, where it is shining; vertex shining, sparsely punctured; antennæ black; mesothorax shining, closely punctured at sides, but the disk broadly smooth, very sparsely punctured, the smooth area reaching back to scutellum; scutellum with a slight median eminence, which is shining; tegulæ dark reddish, with paler margins; wings slightly dusky; all the tarsi thick, with the hair on inner side orange; hind basitarsus rather broad and flat; spurs ferruginous; abdomen shining, with white hair-bands as in *M. ladacensis*, but no ferruginous hair dorsally, the last dorsal segment having appressed white hair; ventral scopa very bright fox-red, containing pollen of the same color.

Habitat.—Rupshu, Ladak, 16,000 feet, July 23, 1897 (W. L. Abbott).

I thought at first that this was the female of *M. ladacensis*, but the smaller size and differences in sculpture make this improbable, notwithstanding the close superficial resemblance. It is not impossible, however, that they may belong together.

Type.—Cat. No. 13538, U.S.N.M.

MEGACHILE INIMICA Cresson.

Runge, Texas, at flowers of *Helianthus*, September 13, 1904, three females (J. C. Crawford); Dallas, Texas, at flowers of *Gaillardia* June 10, 1907, female (F. C. Bishopp).

MEGACHILE MEGAGYNA Cockerell.

Ardmore, Oklahoma, July 11, two females (C. R. Jones).

MEGACHILE VALLORUM Cockerell.

Dallas, Texas, August 23, 1905, female (J. C. Crawford).

MEGACHILE POLLICARIS PEREXIMIA Cockerell.

Devils River, Texas, May 8, a small (about 12½ mm. long) male (F. C. Bishopp); Devils River, May 6, 1907, at flowers of *Monarda citriodora*, two males, the abdomen strongly infested with mites (F. C. Pratt); Victoria, Texas, at flowers of *Helianthus*, April 26, 1904, two males (F. C. Bishopp); Paris, Texas, May, 1904 (Bishopp); Calvert, Texas, one male, April 6 (C. R. Jones); Kerrville, Texas, April 12, one male at *Marrubium vulgare* (F. C. Pratt).

MEGACHILE ALBITARSIS Cresson.

Chicato, Texas, September 6, 1904, two males (F. C. Bishopp);
Ladonia, Texas, May 25, at flowers of *Rudbeckia*, sp. (F. C. Bishopp).

MEGACHILE SAYI HETERODONTA Cockerell.

Cresson says of *M. sayi*, "legs brown-ferruginous or black," and adds, "the male specimens from Texas have the legs, except coxæ, entirely brown-ferruginous." The red-legged form may therefore be regarded as the type, and Texas the type-locality. A female from Illinois, received from Professor Robertson, is red-legged. *M. heterodonta* Cockerell is black-legged, but certainly represents nothing more than a race of *M. sayi*.

MEGACHILE SAYI PALUDICOLA, new subspecies.

Female.—Unusually large, about 16 to 18 mm. long; legs black or dark reddish; wings dark throughout, though darker in the costal region; ventral scopa light yellowish, black on last segment.

Habitat.—Hearne, Texas, July 23, 1906, nesting in bogs, twelve females (F. C. Bishopp).

The ventral scopa of *sayi* and *heterodonta* is creamy-white, that of *paludicola* decidedly yellow.

Type.—Cat. No. 13539, U.S.N.M.

MEGACHILE COMATA Cresson.

Seven males; Kerrville, Texas, three at *Salvia pitcheri*, four at *Marrubium vulgare*, April 10 to 12, 1907 (F. C. Pratt).

MEGACHILE PRUINA Smith.

Texan males bear the following data: Kerrville, at flowers of *Marrubium vulgare*, April 12, 1907 (F. C. Pratt); Kerrville, at flowers of *Tetragonotheca ludoviciana*, April 12, 1907 (F. C. Pratt); Kerrville, at flowers of *Tetranuris linearifolia*, April 11, 1907 (F. C. Pratt); Kerrville, at *Verbena*, April 11, 1907 (F. C. Pratt); Dallas, at *Helianthus*, September 30, 1906 (R. A. Cushman); Devils River, at *Gaillardia pulchella*, May 3, 1907 (F. C. Pratt).

CROCISA DECORA Smith.

Trong, Lower Siam, January–February, 1899 (W. L. Abbott). In the *Entomologist*, August, 1910, I recorded this species from several tropical localities, but suggested a possibility that the true *decora*, from north China, might be distinct. Mr. G. Meade-Waldo has now compared the species recorded by me with Smith's type, and kindly reports that they agree in all essential points. He returns to me a Singapore specimen as a reliable exponent of *decora*. The Siamese

specimen differs a little, in that the blue is deeply excavated at the sides of the first abdominal segment, and the abdominal bands are more widely interrupted than in the type, but this appears to be only a matter of individual variation.

OSMIA SUBFASCIATA Cresson.

This small blue species runs in both sexes in Robertson's tables to *Dicratosmia*, except for the absence of the frontal tubercles. The female has tridentate mandibles, and the ventral scopa white, varying to slightly yellowish. The following localities are represented in the material before me:

OKLAHOMA.

Hugo, at flowers of *Monarda citriodora*, females, June 20 (F. C. Bishopp).

Ardmore. Females collected by Bishopp, April 11 and 21, at *Rubus*; males by Bishopp, March 3 to April 21, at *Rubus* and wild plum.

TEXAS.

Dallas. Fifty-seven males, collected by Bishopp and Cushman, March 7 to April 26, common at *Rubus* and wild plum, but also at *Cercis canadensis* and *Amorpha fruticosa*. Twenty-one females, mostly collected by Bishopp, March 20 to June 26, at blackberry, *Monarda citriodora* and *Gaillardia pulchella*. Two are labeled as bred from heads of *Aphanostephus skirrobasis*, but Messrs. Pierce and Bishopp, in response to an inquiry, state that they think the bees were from the flowers, and whoever labeled them, accidentally omitted to erase the word "bred." Two collected by E. S. Tucker, March 13, 1908, are labeled "in nest mud wasp."

Ladonia. Females collected by Bishopp at *Achillea*, May 17, and at *Monarda*, June 1.

Pittsburg. One female, May 9 (Bishopp).

Kerrville. Twenty-one females, one collected by P. Durham, the rest by F. C. Pratt, April 12 and 13, at *Marrubium vulgare*.

Waco. Nine males, six at *Rubus*, three at yellow *Oxalis*, March 22 (R. A. Cushman).

Clarksville. March 30, 1908 (E. S. Tucker). Three males; "old stalks horseweed."

Victoria. One male, March 6 (J. C. Crawford); one female, on *Quercus*, March 26 (J. D. Mitchell).

Calvert. One male, April 5 (C. R. Jones).

Handley. One male, April 27 (J. C. Crawford).

Paris. Three males, April 10 (F. C. Bishopp; female, April 17 (Bishopp).

Falfurrias. Four males at *Helianthus*, May 18 (A. C. Morgan).

Devil's River. Seven females, one collected by Pratt, the others by Bishopp, May 3 to 6, at flowers of *Marilaunidium organifolium*, *Gaillardia pulchella*, and sumach.

Del Rio. One female, May 8 (Bishopp).

Weatherford. Three females, June 9, at *Monarda* (C. R. Jones).

Wolfe City. One female, at *Helenium tenuifolium*, May 31 (Bishopp).

Wichita Falls. Two females, at *Monarda*, June 11 (C. R. Jones).

Llano. One female, May 20 (W. D. Pierce).

Mineral W[ell?]. Two females, June 9, at *Monarda* (Jones).

Brownsville. Two females, at *Monarda citriodora*, March 23 (Jones and Pratt).

DASYPODA JAPONICA, new species.

Almost exactly like *D. plumipes* Panzer (*hirtipes* Latreille), but in the female the head is broader, with the eyes more diverging above, the black hair on dorsum of thorax is less abundant, the middle tibiæ and tarsi have purplish-sooty hair on outer side, and the hind tibiæ and tarsi are more or less ornamented in the same manner. The only male seen is headless, but it is like a rather small pale *plumipes*; the sixth ventral segment is broadly shallowly emarginate.

Habitat.—Japan (Mitsukuri), one female (type) in U. S. National Museum; Japan, 10 females, 1 male, in Berlin Museum. The Berlin Museum specimens appear to have been in some liquid, and the pubescence is matted.

The tibiæ and tarsi of the male (except for the hair) are black, whereas in *D. tibialis* Morawitz from Mongolia they are rufotestaceous.

Type.—Cat. No. 13540, U.S.N.M.

EUCERA SOCIABILIS Smith.

Female.—Length about 14 mm.; black, without light markings on face; hair of vertex and thorax above pale yellowish, not mixed with black; hair of face, sides of thorax, etc., paler, to yellowish white, but that of labrum distinctly ochreous; head broad, facial quadrangle a little broader than long; clypeus strongly and very densely punctured, but shining; antennæ entirely dark, third joint almost as long as 4+5; mesothorax closely punctured at sides, but in middle with strong, widely separated punctures on a shining ground; scutellum with dense small punctures, entirely contrasting with middle of mesothorax; tegulæ ferruginous; wings dusky; hair on inner side of hind basitarsus ferruginous; abdominal segments 3 to 5 with broad dark chocolate basal bands; 2 to 4 with broad white apical bands, that on 2 very broadly, that on 3 narrowly, interrupted; apex of fifth segment with pale brown hair.

Male.—The male varies greatly in size (length $11\frac{1}{2}$ –13 mm.) and in the color of the pubescence, which may be rich fox-red or pale gray on the vertex and thorax above. The abdomen is described by Smith as without bands, but in good specimens there are very distinct creamy-white to fulvous hair bands at the apices of segments 2 to 4, the abdomen looking like that of *E. cinerea* Lepeletier. The mandibles have no yellow spot.

Habitat.—Pekin, China, April 20, 21, May 11, 12, 14, 1901 (M. L. Robb).

I thought at first that this was a new species, but fortunately I have a pair of *E. sociabilis* cotypes from Hiogo, Japan, from F. Smith's collection, and upon close comparison they are evidently conspecific with the insect from Pekin. The cotype male is, indeed, without distinct abdominal bands, but they appear to have been worn off, as is the case with nearly all the hair on the mesothorax and scutellum. In consequence of the difference in condition, the Chinese and Japanese specimens seem on superficial examination to be quite different things. Smith himself stated that *E. sociabilis* occurred also in China and Siberia. The females seen by me are quite uniform, but the males vary much. It is just possible that these males represent more than one species, but I can not find any tangible structural differences, and similar variation is well known in other Eucerine bees.

In spite of the difference in venation, *Tetralonia* is much nearer to *Eucera* than to *Melissodes*. *Eucera*, with two submarginal cells, is abundantly developed in Europe, but becomes scarce in eastern Asia, and fails to occur in America.

TETRALONIA MITSUKURII, new species.

Male.—Body and antennæ each about 9 mm. long; black, the tarsi beyond the base ferruginous; clypeus, labrum, and large spot on base of mandibles yellow; apical part of mandibles with an orange patch; maxillary palpi pale, the third joint long, the three last minute; antennæ long, the flagellum slender, crenulated, ferruginous beneath, varying to black with the faintest red tinge; third antennal joint very short; hair of head and thorax pale to rather bright ochreous above, white below, no dark hair intermixed; mesothorax and scutellum strongly punctured, but smooth and shining on disk, the mesothoracic punctures here widely separated; tegulæ clear rufotestaceous; legs with pale hair; middle and hind tarsi slender; wings faintly dusky, nervures ferruginous; abdomen well punctured, especially the first two segments; hind margins of segments very narrowly dark rufous, the punctures coming almost to the margin; no apical hair-bands, but broad pale grayish-ochreous basal ones; sixth segment with the hair usually redder.

Female.—Length about $10\frac{1}{2}$ – $11\frac{1}{2}$ mm.; black, robust, the small joints of tarsi ferruginous, and the hind margins of the abdominal segments variably reddish; face all black; mandibles with a large apical orange patch; clypeus strongly and densely punctured; flagellum dark, at most faintly reddish beneath; hair of scutellum a lively yellowish-fulvous; hair on inner side of hind basitarsi ferruginous; abdomen well punctured as in the male; basal band on second segment very narrow in middle, those on third and fourth broad and pale, especially that on fourth, which is almost silvery white and covers the margin of the segment; hair on fifth segment and apex dark reddish chocolate, but that at sides of fifth broadly pale.

Habitat.—Type male and three others (1 male, 2 females) from Japan (Mitsukuri). Also two of each sex from Tokyo, Japan, September, 1892; one male is dated September 26.

Related to *T. nipponensis*, but uniformly smaller, with the abdomen more strongly punctured, and the third antennal joint of the female rather shorter in proportion.

Type.—Cat. No. 13541, U.S.N.M.

TETRALONIA NIPPONENSIS (Pérez).

Described by Pérez as a *Macrocera*. I believe my identification is correct, although the mandibles of the female have a subapical orange mark, whereas Pérez describes them as entirely black. In the female the dark red hair at bases of segments 2 to 4, and the fine orange-fulvous covering the fifth, are especially characteristic. The material consists of three males and two females, labeled Japan (Mitsukuri).

TETRALONIA CHINENSIS Smith.

Twenty-two males and eight females from Peking, China, April 20 to 30, 1901 (M. L. Robb). Smith described only the male; the female is much like that of *T. nipponensis*, but easily separated by the black hair at the bases of the abdominal segments. The fifth segment has the hair white at sides and dilute chocolate in the middle. The clypeus is densely and coarsely punctured. There are three white or greyish-white abdominal hair bands.

Knuth¹ records *T. chinensis* from Japan, and gives *floralia* Smith and *sociabilis* Smith as synonyms. *T. floralia* is quite distinct from *chinensis*, while *sociabilis* belongs to the genus *Eucera*.

The following key separates the above three species:

| | |
|--|----|
| Males..... | 1. |
| Females; hair on inner side of hind basitarsus bright ferruginous..... | 3. |

¹ The record appears in the last volume of Knuth's *Blütenbiologie*, edited by Dr. E. Loew. While Knuth collected the material on which the record was made, he was, I suppose, in no way responsible for the erroneous synonymy.

1. Small, length of body and antennæ each about 9 mm.; mandibles with a large yellow spot.....*mitsukurii* Cockerell.
Larger, mandibles without a yellow subbasal spot.....2.
2. Hair of abdomen above all pale.....*nipponensis* Pérez.
Hair of abdomen black or fuscous on bases of segments beyond the second.....
chinensis Smith.
3. Bases of abdominal segments with black feltlike hair.....*chinensis* Smith.
Bases of abdominal segments with brownish or reddish hair.....4.
4. Length 14-15 mm.....*nipponensis* Pérez.
Length 10½-11½ mm.....*mitsukurii* Cockerell.

Since the above was written, Friese has published two new species from Japan, *T. okinawæ* and *T. japonica*. There is some resemblance between *T. okinawæ* and *T. mitsukurii*, but the latter is smaller and evidently distinct. *T. okinawæ* does not come from Japan proper, but from the Riu Kiu Islands. *T. japonica* is recorded from "Jaku-shima, Südjapan," but this is evidently Yaku Shima, in the Riu Kiu group.

Genus ANTHOPHORA.

I have included in my account of the Asiatic species in the National Museum a small series of Asiatic forms from the Berlin Museum.

ANTHOPHORA SAVIGNYI Lepeletier.

Three females in the Berlin Museum, collected by Ehrenberg in Syria and the Arabian Desert. In Friese's tables they run to *A. albigena* Lepeletier, but they have the stature and general appearance of *A. circulata* Fabricius from Willowmore, S. Africa (*Brauns*). I am satisfied that they are separable from *albigena*, *circulata*, *quadri-fasciata*, etc., but they agree excellently with the description of *A. savignyi* Lepeletier, based on a specimen from Egypt of unknown history. The only difference I can find is that the hair of the legs is in the main pale, not black; should this prove constant in a series, it may indicate a separable subspecies. The fulvous hair of the head and thorax above is strongly mixed with fuscous, a point overlooked by Lepeletier. The insect is distinguished from *A. quadrifasciata* by the evident pale lateral face-marks (formed as in *albigena*) and the large patch of white hair on the outer side of the hind basitarsus. One of the Arabian specimens is paler than the others, the hair of the thorax being colored as in *A. confusa*. Dours thought *A. savignyi* was a variety of *A. rufipes* Lepeletier, a small (8 mm. long) South African species. I can not believe that this is at all the case; certainly, our insect is not a variety of *rufipes*.

ANTHOPHORA ZONATA WHITEHEADI Cockerell.

One male from the Island of Luzon, Philippine Islands, in the Berlin Museum. It was obtained from Rolle. The male, now first made known, differs from the female in the same manner as the rest

of the *zonata* group. It is about or slightly over 10 mm. long, the abdominal bands shining lilac-blue or purple, the hair on outer side of hind tibiæ wholly creamy white. The face markings are pale yellow, and the third antennal joint has a conspicuous ferruginous spot.

ANTHOPHORA ZONATA BURUENSIS, new subspecies.

Female.—Length about 13 mm.; like *zonata*, but abdominal bands entirely purple, as in *A. zonata whiteheadi*; face-markings whitish; scape with a pale stripe; fourth and fifth antennal joints ferruginous beneath; hair of thorax above pale fulvous; tegulæ ferruginous; hair on outer side of hind tibiæ and basal two-thirds of basitarsi clear orange-ferruginous (in the manner *A. zonata ternatensis*), the tibia with a whitish apical brush.

Habitat.—Buru (Moluccas), one female (*V. Martens*). Berlin Museum.

ANTHOPHORA CONFUSA Smith.

Two from the Berlin Museum, one labeled "Himalaya, Hoffm.," the other without locality. The colors of this insect are like those of the African *A. niveata* Friese, but the white abdominal bands are narrower than in *niveata*.

ANTHOPHORA EVERSA, new species.

Female.—Length 14 mm., anterior wing $9\frac{1}{2}$; black, with pale creamy or dull white hair, that on the head and thorax above mixed with black; tegument of face wholly black; labrum subquadrate, black, very coarsely rugose, with a smooth brownish spot near each upper corner; mandibles black; malar space exceedingly small, but not entirely obsolete; eyes pale red; head broad; face with greyish hair; clypeus shining, prominent, convex, with distinct rather sparse punctures and a median smooth line; disk of mesothorax shining, with scattered small punctures; tegulæ ferruginous, fuscous at base; wings dusky, b. n. meeting t. m. a little on the basad side; legs black, with white hair, that on inner side of tibiæ, and especially tarsi, ferruginous; small joints of tarsi clear red; spurs clear orange ferruginous; abdomen cordiform, black, the first segment covered with creamy-white hair, the following three with black hair, and broad apical white hair bands, but the disk of the fourth segment with largely pale hair in the middle; fifth segment with pale hair, but the median apical brush dark fuscous; apical plate very narrow; last ventral segment projecting; ventral hair white, with a slight creamy tinge; antennæ black, third joint longer than the three following united.

Habitat.—Lantschôu, China (W. Filchner). Berlin Museum.

Differs from *A. finitima* Morawitz by the clear red spurs, the apical brush on the hind basitarsus pale reddish instead of black, and the

larger size, but seems to be closely allied. Differs from *A. testaceipes* Morawitz by the smaller malar space, the redder tegulæ, the darker basitarsi, and the white (not ferruginous) hair of middle of abdomen beneath. Differs from *A. tedshenensis* Radoszkowski by the larger size, dusky wings, and the absence of hair on the disk of the clypeus. *A. connexa* (*Podalirius connexus* Nurse) is also related, but has piceous spurs, and other differences. There is quite a strong general resemblance to *A. blanda* Pérez, from Tunis, but the abdominal bands are greyish, slightly yellowish, not pure white as in *blanda*.

ANTHOPHORA HILGENDORFI, new species.

Female.—Length about 21 mm., expanse about 35, width of abdomen a little over 8; robust, black, without light face markings; malar space evident; labrum broader than long, very rugose, with the lower edge greatly thickened, and with a pair of small reddish spots near base; clypeus densely punctured, with a very obtuse median keel; scape red at apex, antennæ otherwise black with the third joint about as long as the next five together; hair of occiput, thorax above, upper part of pleura broadly, metathorax, and first two dorsal abdominal segments, all pale fulvous, not mixed with black; hair otherwise black except on outer side of hind tibiæ in front, where it is ferruginous; wings moderately dusky; tegulæ clear ferruginous; spurs dark ferruginous. Very close to *A. hispanica* Lepelletier, but less robust, the third and following abdominal segments with black hair, and without the lateral light hair so conspicuous in *hispanica*; the clypeus also is not so densely roughened. If the insect had been taken in Spain or Northwest Africa I should think it a variety of *hispanica*, but considering the remote locality, and the fact that it does not accord with any of the members of the *hispanica* group described from Central Asia, it is doubtless a distinct species.

Habitat.—Japan (Hilgendorf). Berlin Museum.

ANTHOPHORA FULVITARSIS Brullé.

One male, agreeing well with this species, though less robust than one from Algeria. Pekin, China, April 20, 1901 (M. L. Robb). Nurse found *A. fulvitaris* at Quetta, and Friese states that a male from China is in the Schulthess collection.

ANTHOPHORA VENERABILIS, new species.

Female.—Length 18 to 19½ mm.; black, including the face, densely covered with pale grey hair, but that on hind knees, outer side of hind tibiæ, and hind basitarsus except at apex, bright orange ferruginous. Malar space well developed; antennæ black, third joint about as long as the next four together; labrum with pale ferruginous hair; clypeus closely punctured; sides of vertex and anterior part of cheeks with some black hair; mesothorax with black hair mixed with the light;

tegulæ dark rufous; wings moderately dusky; b. n. just falling short of t. m.; anterior femora with very long greyish-white hair behind, but black below and in front; their tibiæ with black and pale mixed; their tarsi with black, rather reddish on inner side; middle femora with long sooty hair; their tibiæ and tarsi with ferruginous hair on outer side and black on inner; hind femora with black hair, but mostly white on upper side (white also on hind coxæ and trochanters beneath); their tibiæ and tarsi with black hair on inner side and red on outer, the basitarsal brush black or dark reddish; hind spurs ferruginous, with lateral dark lines; apex of abdomen, around the narrow apical plate, black haired; some black hair on basal part of third segment, almost hidden; apical ventral segments reddish haired in middle, with black hair before the red.

Habitat.—Japan (Hilgendorf). Five females in Berlin Museum.

Runs in Friese's table to *A. senilis* Eversmann, from Russia and Turkestan, but is larger, with the hair of the legs differently colored in part and the tarsi dark. If it came from the mainland I should think it probably a subspecies of *A. senilis*. Doctor Friese has marked one of the specimens "*canescens?*," i. e. *A. nigrocincta*, var. *canescens* Brullé, from Greece. It does accord very nearly with Brullé's short description, but considering the different locality, and the fact that Brullé's insect was very insufficiently described, I can not assume that the Japanese species is identical. It is perhaps just possible that Brullé had a Japanese specimen with the wrong locality; Friese places *canescens* as a variety of *nigrocincta* without seeing specimens, and if the two are really conspecific, the name *canescens* has priority and should stand for the species. In Dalla Torre's Catalogue *canescens* appears as a *Megachile*.

ANTHOPHORA ROBBI, new species.

Female.—Almost exactly like *A. atrolba* Lepeletier, but all the hair on outer side of hind basitarsus black, that on outer side of hind tibia silver white. It very likely deserves only subspecific rank, but the male may show more difference.

Habitat.—Pekin, China, May 7, 1901 (M. L. Robb). U. S. National Museum.

Type.—Cat. No. 13542, U.S.N.M.

ANTHOPHORA RETUSIFORMIS, new species.

Male.—Length about 15 mm., black, the occiput, thorax above, pleura, metathorax, and first two abdominal segments with bright orange-fulvous hair, not mixed with black; a little black hair on vertex; hair of face pale yellowish, of lower part of cheeks long and white; abdomen shining, feebly and sparsely punctured, the third and following segments with black hair, apical margins of second to

fourth with whitish hair much as in *A. atro-alba* female, but less distinct; extreme sides of fifth and sixth segments with white hair; sides of apical half of venter with much light hair; legs dark, including tarsi; outer side of tibæ with ferruginous hair; anterior tarsi with light hair, but middle and hind basitarsi with much black hair, especially behind, though they have light hair at apex, and the small joints have light hair, except a black tuft on each side of last joint of middle tarsi; the ornamentation of the middle tarsi is as in *A. retusa* (not as in *A. monacha*), except that the posterior black brush of the basitarsus is longer and more or less evidently pointed apically, and the apical black brush seems smaller; face-marks yellow, including clypeus (*with no basal spots*), lateral marks (filling space between clypeus and eye, and with an upward process ending a little away from orbit), narrow supraclypeal band, labrum (except the two basal spots) and the rather flattened scape in front; mandibles wholly black; eyes green; flagellum wholly dark; third antennal joint about as long as the next three united; tegulæ piceous; wings moderately dusky; third s. m. broader above than second; mesothorax with dense small punctures.

Habitat.—Pekin, China, April 20, 1901 (M. L. Robb). U. S. National Museum.

A. retusa Linnæus is wide spread and very variable, and I was at first inclined to consider the present insect a variety or subspecies.

Type.—Cat. No. 13543, U.S.N.M.

ANTHOPHORA MELANOGNATHA, new species.

Male.—Runs in Friese's table to *A. senescens* Lepelletier, except that it is about 16 mm. long, and has quite the aspect of *A. fulvitaris* Brullé. It differs from *A. fulvitaris* as follows: Mandibles wholly black; a black band down each side of clypeus; lateral face-marks widely separated from supraclypeal band; yellow area on scape smaller; apical abdominal segments with hair-bands like those on second and third (thus rather combining the features of *fulvitaris* and *senescens*); apical spines ferruginous. The legs are practically as in *fulvitaris*. From *A. senescens* (specimen from Cairo compared) it is easily known by the pale bands on the second and third abdominal segments, the whole ornamentation of the basal half of the abdomen being exactly as in *fulvitaris*. The face markings are practically as in *senescens*, but the third antennal joint is shorter.

Habitat.—Pekin, China, May 14, 1901 (M. L. Robb). U. S. National Museum.

Type.—Cat. No. 13543, U.S.N.M.

I give a table for the separation of the above species:

| | |
|---|----|
| Hind margins of abdominal segments with violet bands..... | 1. |
| Hind margins not so colored..... | 2. |

1. Hair on outer side of hind tibiæ creamy white *A. zonata whiteheadi* Cockerell.
 Hair on outer side of hind tibiæ red *A. zonata buruensis* Cockerell.
2. Very large robust species, 18-21 mm. long, abdomen very hairy, not banded or spotted 3.
 Not so large, abdomen not thus hairy, usually banded 4.
3. First two abdominal segments with pale fulvous hair, those beyond with dark.
A. hilgendorfi Cockerell.
 Abdomen covered with pale grey hair; tibial scopa bright fulvous.
A. venerabilis Cockerell.
4. Abdomen with lateral white spots of hair, or interrupted bands.
A. robbi Cockerell.
 Abdomen not so marked 5.
5. Hair of thorax above orange-fulvous, not mixed with black or fuscous.
A. retusifformis Cockerell.
 Hair of thorax above mixed with black or fuscous 6.
6. Hair of hind tibiæ red above and black below; of thorax above red; tegulæ red
 (Khow Sai Dow Mountain, 1,000 feet, Lower Siam, Feb. 1899, W. L. Abbott).
A. sp. (probably new, but condition too poor to describe).
 Hair of hind tibiæ above not red 7.
7. Second abdominal segment with much erect pale hair 8.
 Second abdominal segment without such hair 9.
8. Mandibles (male) with a large yellow spot *A. fulvitaris* Brullé.
 Mandibles (male) without a yellow spot *A. melanognatha* Cockerell.
9. Tuft of hair behind wings clear strong fulvous; flagellum red beneath.
A. savignyi Lepeletier.
 Tuft of hair behind wings pallid, not distinctly if at all fulvous 10.
10. First abdominal segment covered with pale hair; face without light markings.
A. eversa Cockerell.
 First abdominal segment not so covered; clypeus with light markings 11.
11. Larger; flagellum dark *A. confusa* Smith.
 Smaller; flagellum red beneath *A. savignyi* Lepeletier, variety.

THE HOFFMAN PHILIP ABYSSINIAN ETHNOLOGICAL COLLECTION.

By WALTER HOUGH,
Curator of Ethnology, U. S. National Museum.

INTRODUCTION.

The objects comprising this collection were gathered in Abyssinia in the year 1909 by the Honorable Hoffman Philip, minister and consul-general of the United States at Addis Abeba, the capital of Emperor Menelek. Material from Abyssinia is exceedingly rare, and the collection of Mr. Philip, probably the first that has been brought to this country, is interesting on account of the survivals which it exhibits from the ancient culture of northern Africa, the neighboring Asiatic continent, and eastern Europe.

J. Theodore Bent notes that the fly-flaps carried by the priests are of identical shape with those depicted on Egyptian frescoes, and observes:

Everything in Abyssinia connected with religion would seem to have its prototype in the ancient world; the sistrum, the fly-flap, the crutch, and many other things have doubtless been brought originally from the valley of the Nile, and, with the peculiar conservatism of primitive races, have been preserved even to our day.¹

The portion of Abyssinia inhabited by the ruling class, who have inherited the remains of the early civilization, is an elevated plateau terribly gashed by erosive agencies which render it almost inaccessible, and the country, though lying between the great trade routes of the world, the Nile and the Red Sea, has remained isolated. It has also been unaffected by great movements of peoples since the prehistoric wave of Himyarites from Arabia Felix became entangled in the vast recesses of the plateau.

Abyssinia received its first culture from southern Arabia (Arabia Felix, Yemen) when in the prehistoric period the Himyarites crossed the narrow strait of Bab-el Mandeb and secured a permanent location on the plateau. About the third and second centuries B. C. the Ptolemies sent expeditions to survey the Arabian and African sea-

¹J. Theodore Bent, *The Sacred City of the Ethiopians*, London, 1893, p. 65.

boards and to found trading stations on the coast of Ethiopia, and at that period Koloe and Ava, the cities of the Himyarites, were flourishing, later to be succeeded by the great Axumite empire whose city, Axum, shows Himyaritic culture developed under Græco-Roman influences.¹

CATALOGUE.

BASKETRY.

Embroidered hat.—Of palm midrib coiled, the whole surface, interior and exterior, laid over with green, yellow, red, white, and black floss silk. The work is called basket stitch and is one of the most ancient methods of couching. The hat is of European shape, and was made and embroidered by the Abyssinian women in the northern province of Waag.

Diameter, 14 inches; height, 4 inches.

Pl. 12, fig. 1, Cat. No. 261884, U.S.N.M.

Coiled basket.—Formed of small coils of straw held together with a loosely twined splint. The sewing is of purple, green, and yellow dyed straw over one and three coils alternately and interwoven with yellow straw, producing pleasing textile patterns. The interweave is an advance on the coil work of the Hopi Indians of Arizona, whose basketry alone of all the tribes is like that of northern Africa, but simpler in execution than the Abyssinian. The specimen has a lid like an embossed shield, a capacious body resting on a foot. The salient edges are bound in red morocco leather, and the lid has a loop in the apex for convenience in lifting.

This specimen was presented to Mr. Philip by Dedjaz Abatta, a high Abyssinian military official. These baskets are used as receptacles for crushed corn and millet, of which thick moist cakes of Abyssinian bread are made.

Diameter, 20 inches; height, 16 inches.

Pl. 12, fig. 2, Cat. No. 261880, U.S.N.M.

METAL WORK.

Embossed shield.—Of buffalo hide, formed, when damp, into a high boss, the edge raised and turned over with a neat finish. The exterior surface has near the edge a band of geometric pattern in low relief and is decorated with repoussé silver having crescentic and triangular openings, and these plates are applied with round-headed tacks. A cap, engraved on its upper surface, is set at the apex, and bosses hide the places where the handle passes through the structure of the shield. The interior is lined with red morocco leather bearing fine geometric design, and the lining is secured under the overturned edge of the shield. The handle is large, covered with fine leather, and looped

¹ See Keane's review of Ethiopian history in Stanford's Compendium of Geography and Travel, Africa, vol. 1, London, 1895, pp. 445-446.

over it is a strap secured at the ends with a packet knot. Two leather loops are secured to opposite edges of the shield on a line with the handle. This superb shield is used by the Abyssinian cavalry.

Diameter, $20\frac{1}{2}$ inches; height, $6\frac{1}{2}$ inches.

Pl. 13, Cat. No. 261883, U.S.N.M.

Ecclesiastical crown or miter.—Of silver *percé à jour* and engraved, consisting of a brow band, central band, and apex plate secured to 8 vertical curving strips leaving 8 spaces from each of which project slantingly curved prongs of engraved silver. From the apex rises a tubular structure, from the capping plate of which 10 little bells are suspended by chains. From the lower rim of the miter juts a small oval plate fringed with bells and chains, resembling the vizor of a cap. The designs on the silver are similar to those on the shield and consist of a series of self-involving loops, apparently from some cord or serpent motif.

These crowns, which are of very ancient design, are worn by the high priests on state occasions, and are very rare and difficult to obtain. The specimen described was originally in use in the church of St. George, Addis Abeba, Abyssinia.

Height, $10\frac{1}{2}$ inches; diameter, $8\frac{1}{2}$ inches.

Pl. 14, Cat. No. 261843, U.S.N.M.

The necklaces in the Philip collection illustrate very clearly a phase in the origin of such ornaments from the amulet, nearly all the specimens being made up of a series of charm boxes.

Necklace.—Consisting of small button-like beads of fine silver gilt filigree, 6 in number, strung on a coarse cotton string. Old Tigre or Godjam work.

Diameter of beads, $\frac{3}{8}$ inch.

Pl. 15, fig. 1, Cat. No. 261867, U.S.N.M.

Necklace.—Consisting of 8 silver filigree boxes like Asiatic amulet boxes, strung on a strip of cloth. The filigree work is simple rickrack and occurs on only one side of the boxes, which are provided with two loops for stringing.

Pl. 15, fig. 2, Cat. No. 261868, U.S.N.M.

Necklace.—Consisting of 4 boxes of silver filigree, spaced with 8 cylindrical beads. All of the boxes have fringes of conical tinklers suspended by chains and two of the boxes have sliding drawers. The filigree work is in simple patterns.

Pl. 15, fig. 3. Cat. No. 261871, U.S.N.M.

Necklace.—Consisting of 5 silver filigree boxes of crescentic, rectangular, and conical outline. The design is very good, and the work crude, but effective.

Pl. 15, fig. 4. Cat. No. 261869, U.S.N.M.

Necklace.—Consisting of 25 tubular beads terminating in a filigree charm box having tinklers and a drawer. These necklaces are worn by Abyssinian women and are usually from the northern provinces of Tigre or Godjam, most of the silverwork emanating from Abyssinia. The specimens are old, few being made to-day.

Pl. 16, fig. 1. Cat. No. 261872, U.S.N.M.

Necklace.—Consisting of groups of two or more silver beads alternating with tubular beads strung on fiber cord; the terminal cylinder is encrusted with small pearl-like ornaments.

Pl. 16, fig. 2. Cat. No. 261870, U.S.N.M.

Cross.—Of cast bronze, finished with a file. The form is that of the Greek cross, the triangular wings terminating in arrow-shaped projections. The surface is decorated with punch marks outlining the edges. This specimen, like the others, has a square, perforated base, from which projects an arrow-shaped spur. The specimen appears to be very old.

Length, 6 inches; width, $2\frac{1}{2}$ inches.

Pl. 17, fig. 1. Cat. No. 261858, U.S.N.M.

Cross.—Bronze, base perforated for suspension, stem rounded, cross plain Greek form, the faces ornamented with circles inclosing dots.

Length, 7 inches; width, $3\frac{1}{2}$ inches.

Pl. 17, fig. 2. Cat. No. 261857, U.S.N.M.

Cross.—Of pewter, cast; and finished by scraping. The form is a floreated Greek cross with the tree rising from a flat rectangular base terminating below with a cross. The surface decorations are circles and dots and bands of herring-bone pattern.

Length, $8\frac{3}{4}$ inches; width, $4\frac{3}{4}$ inches.

Pl. 17, fig. 3. Cat. No. 261860, U.S.N.M.

Cross.—Cast brass finished with the file and by scraping. The design, which appears to be the intertwined serpent motive, is based on the Greek cross, forming an elaborate and pleasing ornament. The work is pierced and engraved. The stem is terminated with a square frame, from the lower side of which extends an arrowhead.

Length, $8\frac{1}{2}$ inches; width, $3\frac{3}{8}$ inches.

Pl. 17, fig. 4. Cat. No. 261859, U.S.N.M.

Woman's bracelets.—Consisting of a band upon which is applied a strip of silver filigree in simple pattern. These bracelets open with hinge and pin, as in No. 261849, but are of older workmanship.

Diameter, 2 inches; width, $\frac{5}{8}$ inch.

Pl. 18, fig. 1. Cat. No. 261848, U.S.N.M.

Woman's bracelets.—A curved band of massive silver hinged and secured by pin and loops. The exterior is heavily worked with a chisel and punch in simple patterns. These are old specimens and display crude workmanship.

Diameter, $2\frac{1}{4}$ inches; width, $\frac{3}{4}$ inch.

Pl. 18, fig. 2. Cat. No. 261850, U.S.N.M.

Woman's bracelets.—Silver filigree, one section opening on hinges to admit the wrist. The bracelets are good specimens of modern filigree work.

Diameter, $2\frac{1}{4}$ inches; width, 1 inch.

Pl. 18, fig. 3. Cat. No. 261849, U.S.N.M.

Scabbard mounting.—Curved terminal metal sheath of a sword scabbard. The design is a combination of stamping with a punch and work with an engraving tool. The field is divided up into panels by bands of textile motive; most of the panels bear the St. Andrews cross while two have a lion and Greek cross. The Abyssinian sword was scimitar shape, the scabbard of leather covered with velvet, the grip of rhinoceros horn. North Abyssinia.

Length, 12 inches.

Pl. 19, fig. 1. Cat. No. 261882, U.S.N.M.

Scabbard mounting.—Consisting of the tip of a sword scabbard in silver gilt filigree. Made by forming the metal base for the two sides, piercing it with the design, soldering the two parts together and covering the line with twisted wire. The designs are outlined with wire soldered on, the ends terminating in small bosses simulating pearls, which are masses of silver, like small shot, soldered on. The work is crude, but strong. The designs, which are very pleasing, are unlike on the two sides.

Length, 14 inches.

Pl. 19, fig. 2. Cat. No. 261881, U.S.N.M.

Case for tweezers.—Of hammered silver ornamented with chasing and decorated with small bangles which produce an agreeable tinkling sound. In form the specimen is like that of an amphora. The tweezers are used for picking out thorns and when not in use are thrust into the opening at the neck of the case. It is suspended by two silver chains. The case is said to be of very old Abyssinian silverwork.

Length, $3\frac{3}{4}$ inches; diameter, 1 inch.

Pl. 19, fig. 3. Cat. No. 261879, U.S.N.M.

Ornamental bands.—Of silver gilt filigree. These resemble the bands on sword scabbards and the work is like that of No. 261881. They are said to be ornaments for a priest's staff or crutch.

Length, $1\frac{3}{4}$ inches; width, $\frac{5}{8}$ inch.

Pl. 19, fig. 4. Cat. No. 261856, U.S.N.M.

Food strainer.—Of beaten silver worked into saucer form and perforated by punching. The specimen is said to have been the property of the former King of Godjam and is of northern Abyssinian manufacture.

Diameter, $4\frac{1}{16}$ inches; height, $\frac{7}{8}$ inch.

Pl. 20, fig. 1. Cat. No. 261866, U.S.N.M.

Bell.—Of silver, cast and highly polished. The bell is of excellent shape and tone and is reputed to have belonged to the former King of Godjam. The handle is of red morocco leather.

Diameter, $1\frac{1}{2}$ inches; height, 2 inches.

Pl. 20, fig. 2. Cat. No. 261865, U.S.N.M.

UTENSILS OF WOOD AND HORN.

Drinking cup.—Turned from a single piece of rhinoceros horn. In this respect it differs from ordinary specimens, which have inserted bottoms. Such cups are usually presented to subjects who have met with his favor by the Emperor of Abyssinia.

Diameter, $3\frac{3}{4}$ inches; height, $3\frac{1}{2}$ inches.

Pl. 20, fig. 3. Cat. No. 261844, U.S.N.M.

Wooden cup.—Turned from hard yellow wood, polished; decorated with turning grooves which have been colored red and black and bands between the grooves relieved by small depressions. The foot has three perforations corresponding to similar perforations in the cover, designed for passage of the cords securing the parts together as well as forming a handle for carrying. Mr. Philip states that:

It is used for preserving the national Abyssinian hairdressing and perfume, which is oil derived from rancid butter.

Diameter, $3\frac{1}{2}$ inches; height, 5 inches.

Pl. 20, fig. 4. Cat. No. 261873, U.S.N.M.

PICTORIAL ART.

Triptych.—Folding triptych of wood covered with paper, the leaves closing into the frame on leather hinges like a Byzantine eikon. The central larger picture represents the Virgin and Child seated on a terraced throne, guarded at the upper right and left corners by the archangels Gabriel and Michael with drawn swords. On the upper left hand leaf is represented St. George mounted on a white horse slaying a dragon. On the opposite side stands Tekla Haimanout, patron saint of Abyssinia, a one-legged, winged man of patriarchal aspect. The lower figures represent groups, apparently of suppliants. The colorings are most vivid and crude, the backgrounds of yellow and the figures in purple, yellow, red, and green. The style of art is Byzantine.

Length, $20\frac{1}{4}$ inches; width, 15 inches.

Pl. 21. Cat. No. 261847, U.S.N.M.

Religious painting.—Executed in thick guache on coarse muslin. The colors are primitive red, blue, green, and yellow, the drawing and treatment archaic, suggesting Egyptian and Byzantine influences.

The subject is the coronation of Mary; to the right the Father grasping the world, to the left the Son carrying the cross, each

grasping and placing the crown, above which the Spirit in form of a dove rests, and back of which is represented the sun's rays. Below, two figures holding rosaries prostrate themselves and at the sides are Abyssinian worshippers, whose faces might have been drawn on an ancient Egyptian papyrus or mummy case.

The representation of the Father as an old man and the Son as a young man has the same naive element as is shown in Velasquez's painting of the same subject in the Madrid gallery.

The painting is singularly rich in color and decorative quality. The modeling is in sanguine, the outlines in very dark, rather heavy lines, the treatment of the neck and hands is formal like Assyrian, the result of ignorance of anatomy. The halo is circular and is molded like a picture frame and it appears to be solid, as it obscures one arm of the cross. The textiles are decorated with sporadic patterns; the lining of the Virgin's robe and the borders are in set patterns in squares which cover the surface. The worshippers are clad in lined fabrics like the Mandingan cloths. The crown is turban shape set with red and blue stones and terminated with a floreated Greek cross.

Length, 49 inches; width, 42 inches.

Pl. 22. Cat. No. 261846, U.S.N.M.

Painted scroll.—Representing on the right the Biblical story of the rich man and Lazarus, and on the left the stages in the life of a holy man. The groundwork represents a cross and in the circular field at the top of the cross are the three evangelists depicted in the cabalistic design called "The Seal of Solomon" within a circle. The painting is in crude colors and the execution is somewhat better than usual.

Length, 20 inches; width, 15 inches.

Pl. 23. Cat. No. 261886, U.S.N.M.

Painting.—In guache on thick paper, crudely drawn and painted in strong blues and reds on a chrome yellow ground. The subject is Menelek and his queen receiving the benediction and protection of heavenly beings, two of whom hold red umbrellas over the heads of the royal pair. In the upper left hand corner is St. George on a white horse.

Length, 22 inches; width, 21 inches.

Pl. 24. Cat. No. 261885, U.S.N.M.

Scroll painting.—The medium employed is oil upon muslin sized with lime. The background, as is usual with Abyssinian paintings, is in brilliant yellow. The picture is arranged in three horizontal bands and represents the Abyssinian and Italian troops at the battle of Adowa (1896). On the upper left hand side are represented Menelek on a white palfrey surrounded by his bodyguard. Below him are Queen Taitu, the priests and Abyssinian troops, and opposite them the Italian army. The Abyssinians are represented full face and the Italians are drawn in profile. The painting, though crude,

shows considerable skill in representing action and forms an interesting study of the costumes of the Abyssinian dignitaries and the army.

Length, 57 inches; width, 35 inches.

Pl. 25. Cat. No. 261845, U.S.N.M.

Picture on brass.—Somewhat irregular sheet of brass upon which is a representation of Tekla Haimanout, a saint who wears a curious headdress with crossed wings, has wings on his shoulders and but one leg. The outlines have been cut with a chisel and the figures thrown into the slight relief by hammering.

Length, $4\frac{3}{4}$ inches; width, 4 inches.

Pl. 26, fig. 1. Cat. No. 261861, U.S.N.M.

Picture on brass.—Representing a saint with a long beard and guarded by two lions. Upon his shoulder is a large bird like a raven, which appears to be pecking out his eye. The background is filled in with small crosses. The work has been done with a chisel-edge punch.

Length, $4\frac{3}{4}$ inches; width, $4\frac{1}{4}$ inches.

Pl. 26, fig. 2. Cat. No. 261862, U.S.N.M.

Picture on brass.—Representation of the Virgin and Child with the celestial guardians Michael and Gabriel. The work is extremely crude and has been accomplished with a chisel and figured punch. These brass plates bring to mind the Russian eikons. The work is said to be ancient.

Length, $5\frac{1}{4}$ inches; width, $4\frac{3}{4}$ inches.

Pl. 26, fig. 3. Cat. No. 261863, U.S.N.M.

WRITING.

Theological treatise on parchment in Amharic script.—The writing is in black and red ink and well executed. The inside of the cover and fly leaves are painted, the pictures being of the Virgin and Child, St. George and the Dragon and other saints. The backs are of wood covered with cotton cloth, to which is attached a band for withdrawing the book from the double leather case in which it is carried by priests and others.

Keane says that the liturgical language of the Abyssinian church is Gheez, a pure Himyaritic idiom, the most archaic member of the Semitic family, not excepting the Assyrian of the cuneiform writings. It is the vernacular of the kingdom of Tigre, but it also enters largely into the constitution of the Amharic (Amharna) current in the rest of Abyssinia proper, at least among the governing classes.¹

Case: Length, $5\frac{3}{4}$ inches; width, 4 inches.

Page of book: Length $4\frac{3}{4}$ inches; width, 3 inches.

Pl. 27. Cat. No. 261864, U.S.N.M.

¹ Stanford's Compendium, Africa, vol. 1, p. 448, 1895.

COSTUME.

Mantle.—Of tanned goatskin, slashed on the sleeve and skirt and ornamented on the outside with leather appliqué. It is made of a single skin folded on itself, the sleeve-like appendage and a portion of the fringe being sewn to the upper and lower edges respectively. Suspended from one edge of the mantle is a small bamboo bottle, apparently for holding oil. This garment is worn by the Arusi Galla people living in the mountain districts of Abyssinia.

Length, $41\frac{1}{2}$ inches.

Pl. 28, fig. 1. Cat. No. 261877, U.S.N.M.

Lion's mane headdress.—Strip of skin from lion's mane bound in red and green silk and edged with a band of copper gilt chain such as is used on European helmets and military headdress. The ends of the silk binding hang down at the rear of the headband. This headdress is worn by high officers of the Abyssinian army.

Length, 18 inches.

Pl. 28, fig. 2. Cat. No. 261875, U.S.N.M.

ORNAMENTS.

Necklet.—Consisting of a rod of brass looped at the ends and covered with a fine winding of brass wire, which has worn smooth. Southwestern Abyssinia.

Diameter, $4\frac{1}{2}$ inches.

Pl. 29, fig. 1. Cat. No. 261852, U.S.N.M.

Armlets.—Sections cut from elephant tusk polished and beautifully stained by long use. These armlets were worn by south Abyssinian elephant hunters.

Diameter, $3\frac{1}{2}$ inches to $4\frac{7}{8}$ inches.

Pl. 29, figs. 2, 3, and 5. Cat. No. 261874, U.S.N.M.

Anklet.—Of hammered brass beaten into a concave and strengthened with a middle rib, which is a feature of so much African metal work. The exterior is decorated with chiseled designs of simple pattern, but very effective. Worn by the Shangalla (Shankilla) negroes of the western slopes of the Abyssinian plateau.

Diameter, $3\frac{1}{2}$ inches; width, 1 inch.

Pl. 29, fig. 4. Cat. No. 261851, U.S.N.M.

Earring.—Consisting of a circlet of ivory to which is attached by perforation in the ivory a locking circlet of brass rod wound with brass wire. Worn by the elephant-hunters of the southwestern Abyssinian province. Since this object weighs 8 ounces, it no doubt stretches the lobe of the ear greatly.

Diameter of ivory, $4\frac{7}{8}$ inches.

Pl. 29, fig. 6. Cat. No. 261853, U.S.N.M.

RELIGION.

Mask.—Formed of clay mixed with fiber. The front represents a human face of not unpleasing appearance and having both lip and chin whiskers of black goat hair. The back of the mask bears in relief a strange animal figure (lizard?) whose body forms a handle by which the mask is suspended from a leather strap. This mask, as stated by the collector, was said to have been worshiped by the Gallas of Abyssinia. "The Gallas are not of a Semitic origin, as are the Abyssinians proper, nor are they Christians. They worship trees in many parts of the country and they also reverence various objects to which they make sacrifices. The specimen was the only one seen in Abyssinia, and its proper use and authenticity can not be vouched for."—(Information given by Mr. Philip.)

Length, $6\frac{3}{4}$ inches; width, 5 inches.

Pl. 30, fig. 1. Cat. No. 261887, U.S.N.M.

UTENSILS.

Spoon.—Cut from cow's horn; the bowl slightly shallow and spatulate. The end of the handle is ornamented with roundels. "Eating utensils of any kind, with the exception of the knife, are very rare among all inhabitants of Abyssinia and are practically unknown to the great mass of the population. Raw meat is the most favored article of food among the Abyssinians." The specimen is from the Gallas.—(Information given by Mr. Philip.)

Length, $8\frac{1}{2}$ inches.

Pl. 30, fig. 2. Cat. No. 261854, U.S.N.M.

Headrest.—Carved from a single piece of yellow wood. The decoration consists of scores cut into the surface, forming simple pattern. Previous to cutting the pattern the wood was blackened. On top and bottom the pillow is painted dark brown. Used by south Abyssinian natives.

Width, 7 inches; height, $6\frac{3}{4}$ inches.

Pl. 30, fig. 3. Cat. No. 261855, U.S.N.M.

ZOOTECHNY.

Lasso.—Of giraffe hide thong 1 inch wide, the throwing end consisting of two back and forward turns of the leather lashed just above the running loop. The inner member of these thongs slides like a slip noose through a slit cut in the end of the leather thong. The lasso appears to be for the capture of large and dangerous animals and is ingeniously designed to allow the quarry when caught by the foot or neck to pull and tear at the extra bands, each motion drawing the sliding noose tighter. Used by the Boranna, Abyssinian Gallo-Hamites, who inhabit the Boranna province adjoining British Somaliland (southeast Abyssinia).

Length, 22 feet.

Pl. 31. Cat. No. 261878, U.S.N.M.

Horse bell.—Worked from a strip or bar of iron, the method pursued being to beat out the metal into broad wings, leaving only a short portion of the bar at the middle in its original size. The two wings are then bent together until nearly in contact and curved over, forming a conical shell. Around the loop of the bell passes a heavily braided neck yoke of leather ornamented with spirals of iron wire wound around divided portions of the braiding. The clapper is a rod of iron fastened by a ring to the leather yoke. The bell is remarkably loud and sonorous. “It is made and used by Shangalla Abyssinians, and is important to some tribesmen in case of war and as an ordinary cattle bell to keep off wild animals.”—(Information given by Mr. Philip.) This form of bell is widespread in Africa.

“Shangalla (Shankilla) are negroes who live along all the western slopes of the Abyssinian plateau above the plains of Senaar.”¹

Diameter, $4\frac{1}{2}$ inches; height, 5 inches.

Pl. 32. Cat. No. 261876, U.S.N.M.

COINAGE.

The coinage of Abyssinia is based on the Austrian thaler of Maria Theresa, a large number of which, bearing the date of 1780, having been sent out as trade money and passing current in Abyssinia, became the model for the issues of Menelek.

The coins collected by Mr. Philip consist of:

One Maria Theresa thaler, 1780; diameter, 40.5 mm. (Fig. 6.)

One Menelek thaler, silver. (Fig. 3.)

Obverse: Portrait head of Menelek, crowned. Inscription, “Menelek II, King of Ethiopia.”

Reverse: Crowned lion carrying cross standard with pennants. Inscription: “The Lion of Judah Conquered.” (Apocalypse. 5.) On the edge is an inscription of which the word “Habesh.” meaning Abyssinia or Ethiopia can be made out. Date, 1875. Diameter, 39.5 mm. The coin is 1 mm. less in diameter than the Maria Theresa thaler, but, being slightly thicker, weighs the same. The series appears to have been coined in England.

One-half Menelek thaler, silver. This coin is uniform with the thaler in design and inscription. Date, 1889. Diameter, 30.5 mm. Milled edge. (Fig. 1.)

One-fourth Menelek thaler, silver. Date, 1889. Diameter, 25.5 mm. Milled edge. (Fig. 4.)

One-twentieth Menelek thaler. Date, 1871. Diameter, 16.0 mm. Milled edge. (Fig. 5.)

One one-hundredth Menelek thaler, brass.

Obverse: Portrait head of Menelek with same inscription as on the thaler. Beneath the head, in very small letters, is “Lagrange.”

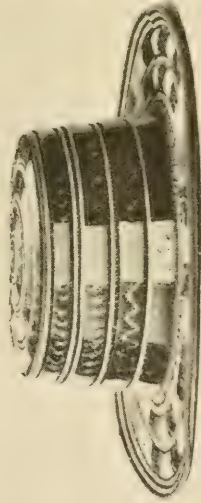
¹ Keane, *Stanford's Compendium, Africa*, Vol. 1, p. 484, 1895.

Reverse: Around border is the same inscription as on the thaler. On central disk, "Yaber Matowan," below which are mint marks consisting of a rose (?), the letter "A," and a torch. Date, 1889. Diameter, 25.0 mm. (Fig. 2.)

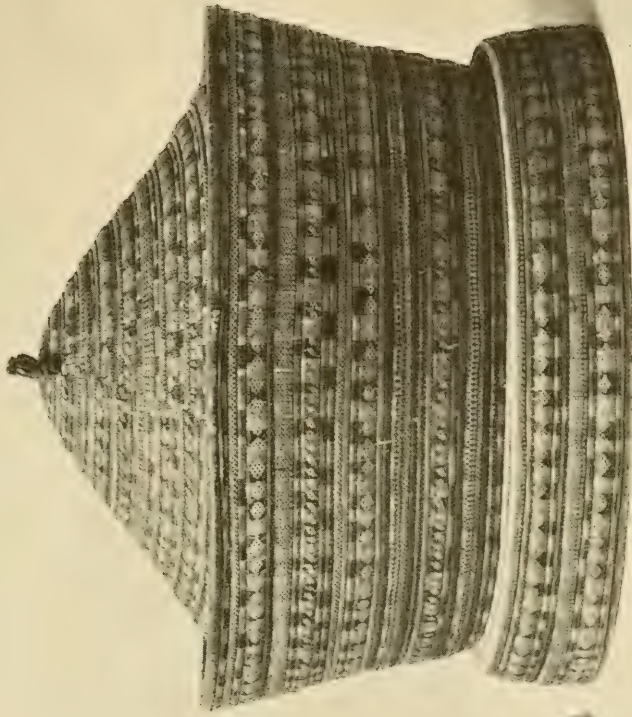
The inscriptions were translated by Dr. I. M. Casanowicz, of the U. S. National Museum.

Mr. Philip also collected a ring of Abyssinian gold (diameter, 25.0 mm., pl. 32, fig. 7) such as were used in Abyssinia and on the east coast of Africa and which are said to have been a form of money of the Fourth Egyptian Dynasty, but to the best of my knowledge no specimens have been found by investigators in the remains of the culture of ancient Egypt.

(Pls. 33, 34, Cat. No. 261889, U.S.N.M.)



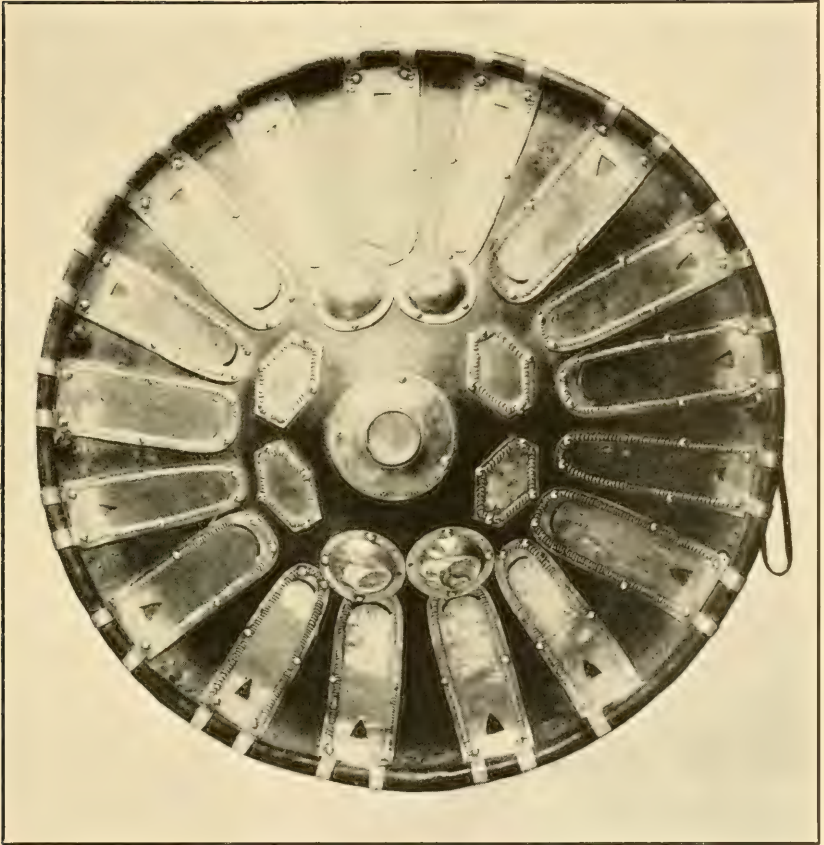
1



2

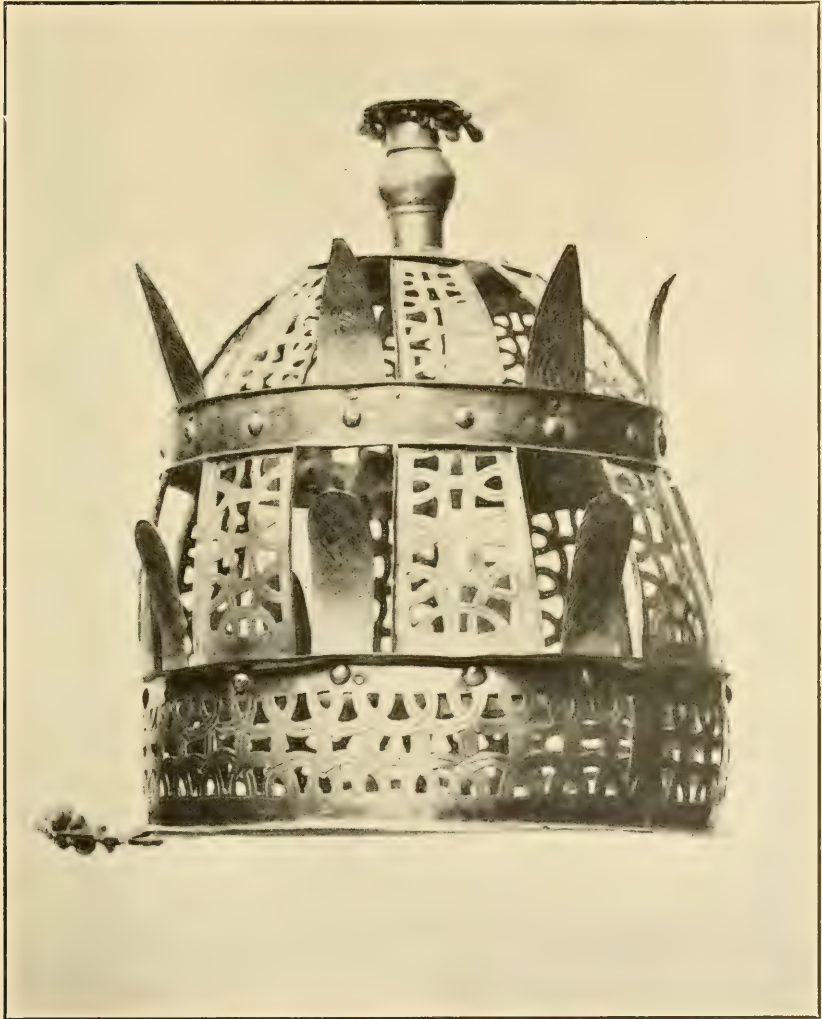
COILED HAT AND BASKET.

FOR REFERENCE TO PLATE SEE PAGE 266.



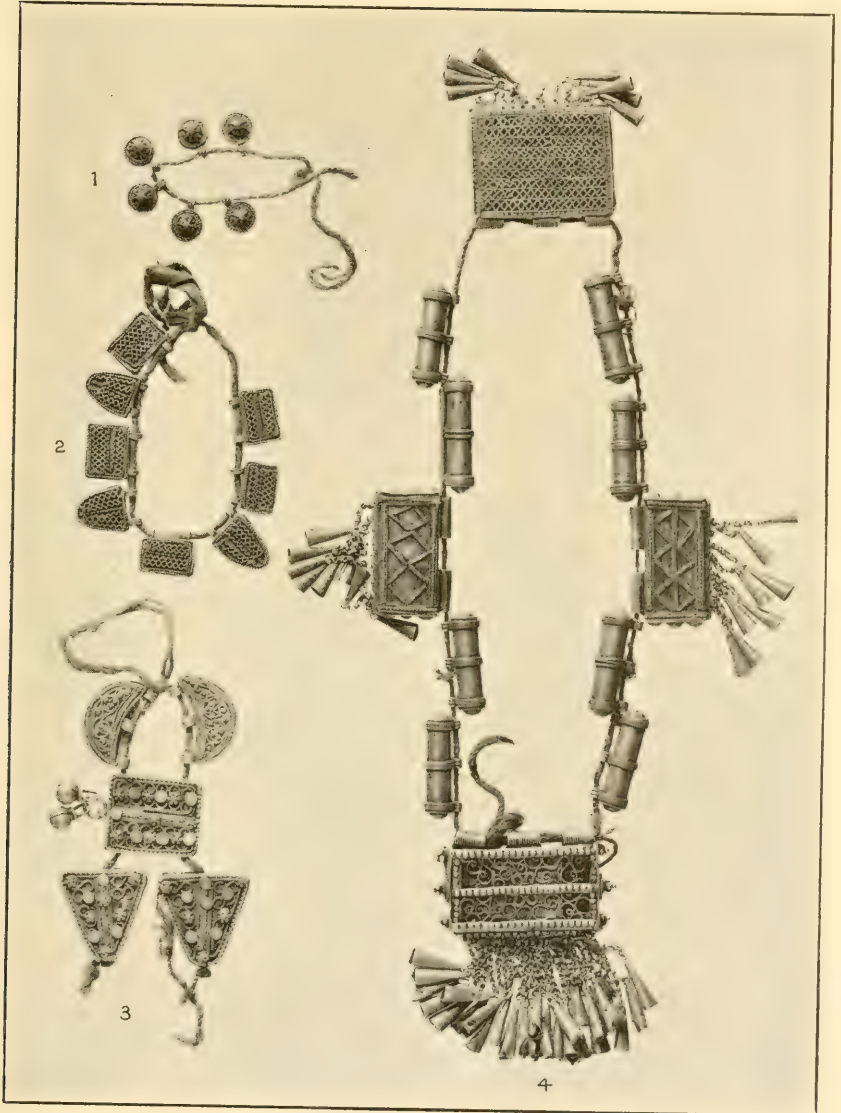
SILVER-MOUNTED SHIELD.

FOR REFERENCE TO PLATE SEE PAGE 267.



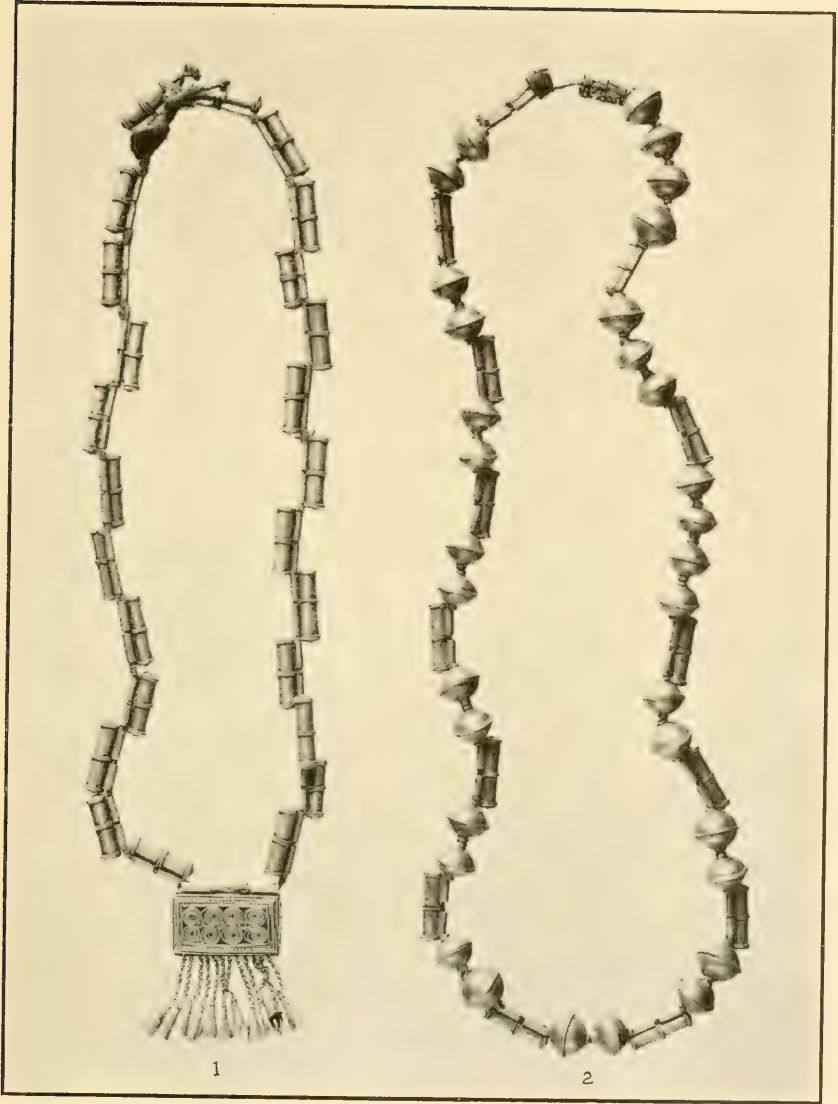
ECCLESIASTICAL CROWN OR MITER.

FOR REFERENCE TO PLATE SEE PAGE 267.



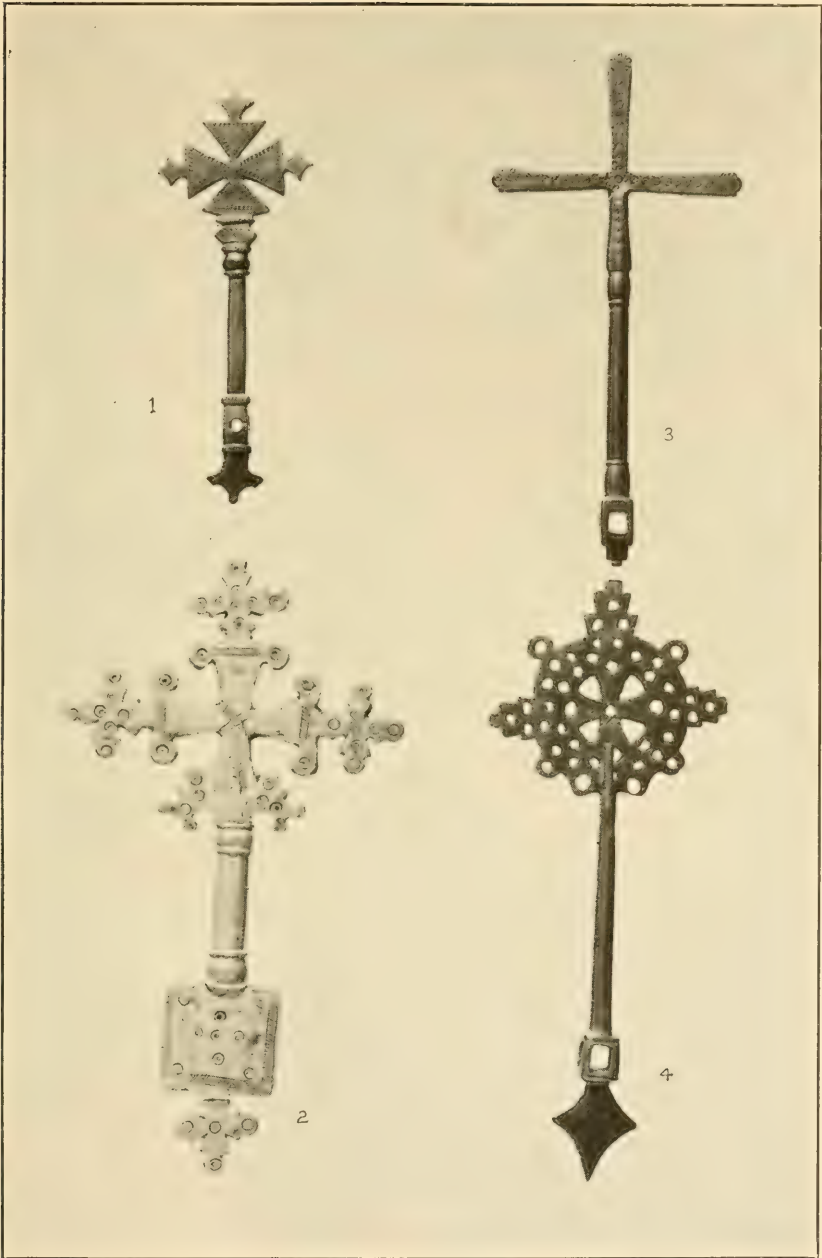
NECKLACES OF CHARM BOXES.

FOR REFERENCE TO PLATE SEE PAGE 267.



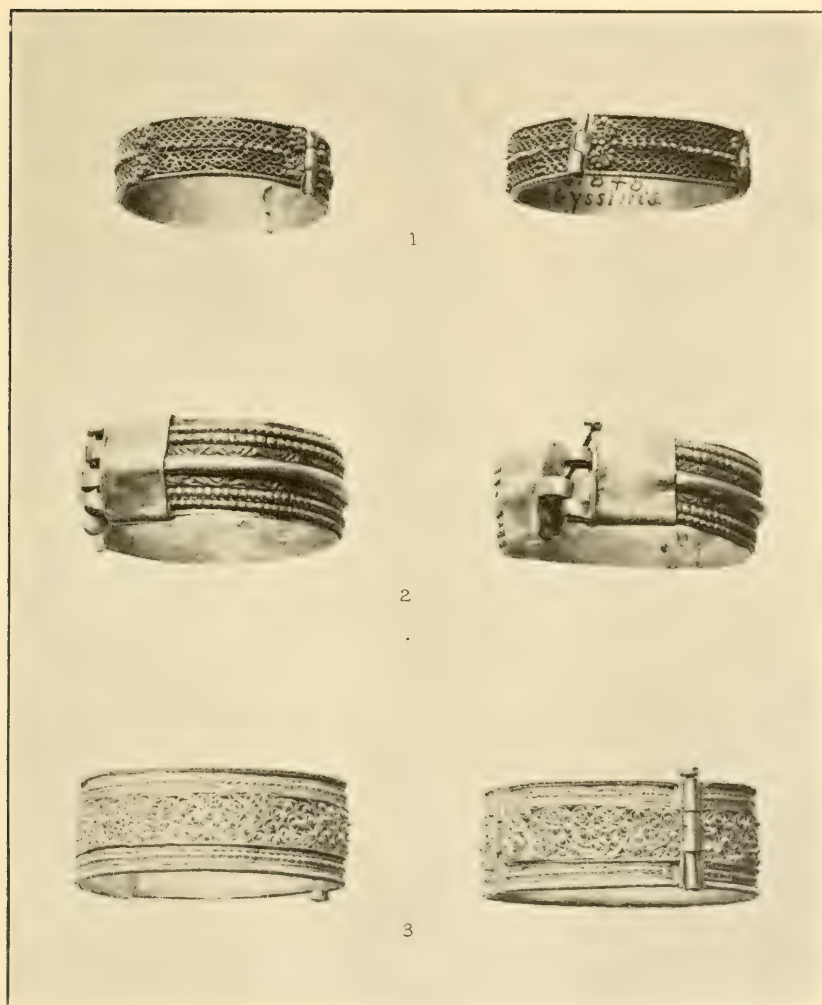
NECKLACES OF CHARM BOXES.

FOR REFERENCE TO PLATE SEE PAGE 268.



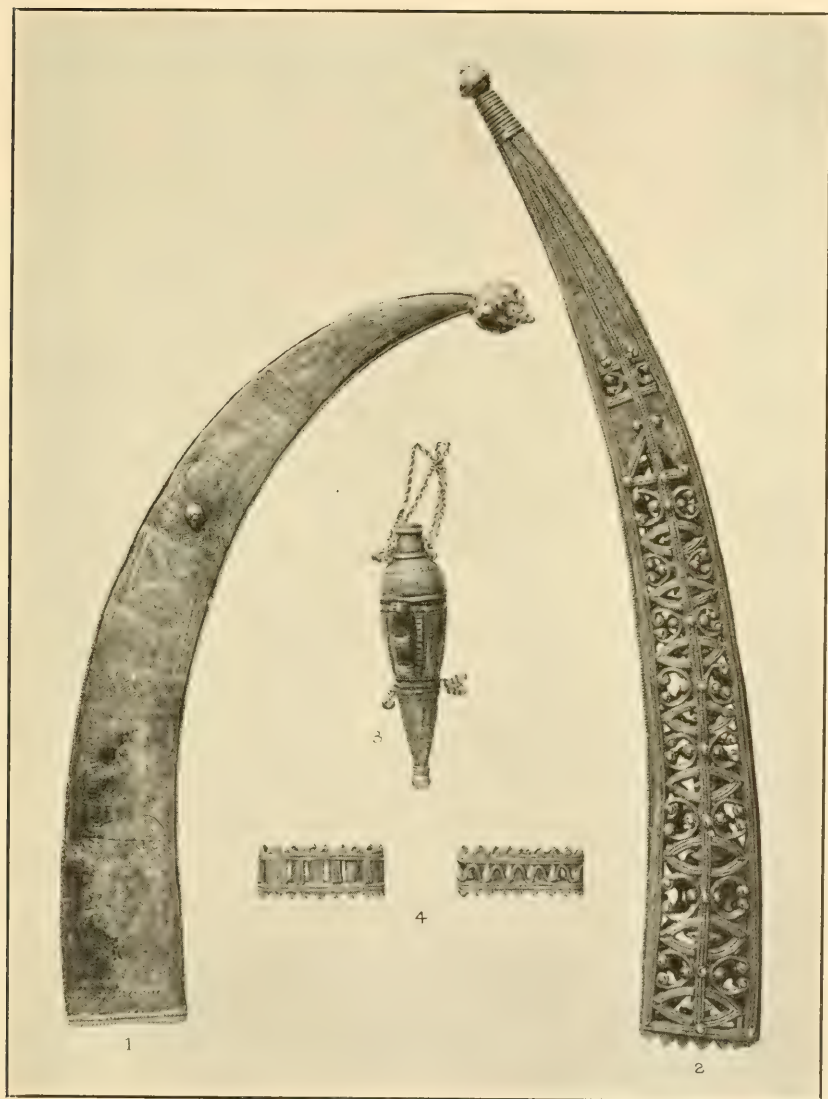
ORNAMENTED CROSSES.

FOR REFERENCE TO PLATE SEE PAGE 268.



SILVER BRACELETS.

FOR REFERENCE TO PLATE SEE PAGES 268 AND 269.



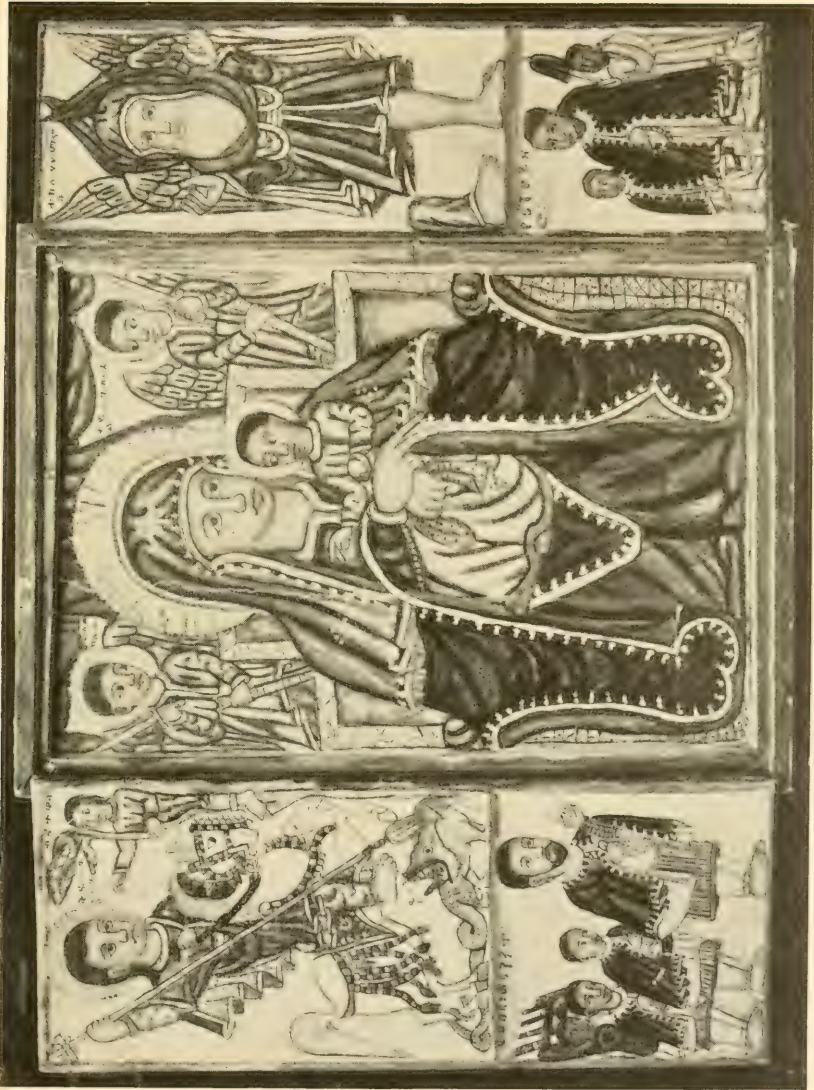
TWEezer CASE, SCABBARD MOUNTS, AND CRUTCH ORNAMENTS.

FOR REFERENCE TO PLATE SEE PAGE 269.



SILVER, HORN, AND WOOD VESSELS.

FOR REFERENCE TO PLATE SEE PAGES 269 AND 270.



TRIPTYCH.

FOR REFERENCE TO PLATE SEE PAGE 270.





PAINING ON CLOTH.

FOR REFERENCE TO PLATE SEE PAGE 271.



PAINTED SCROLL.

FOR REFERENCE TO PLATE SEE PAGE 271.



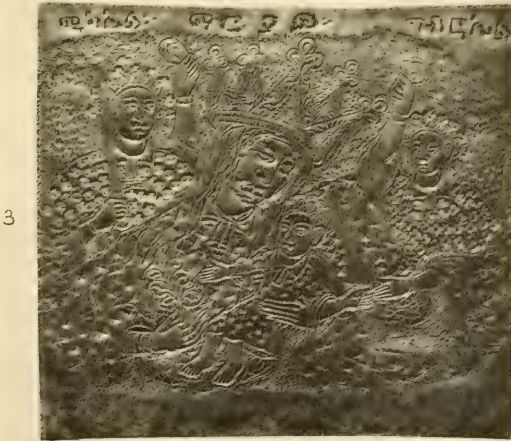
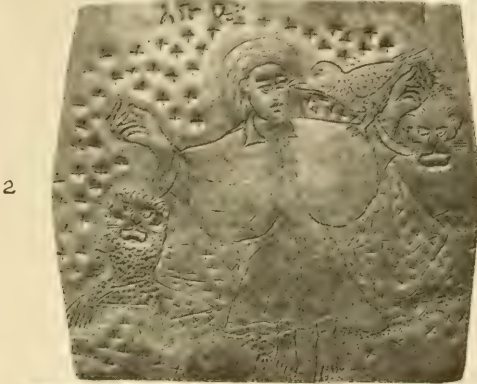
PORTRAIT OF MENELEK AND THE QUEEN.

FOR REFERENCE TO PLATE SEE PAGE 271.



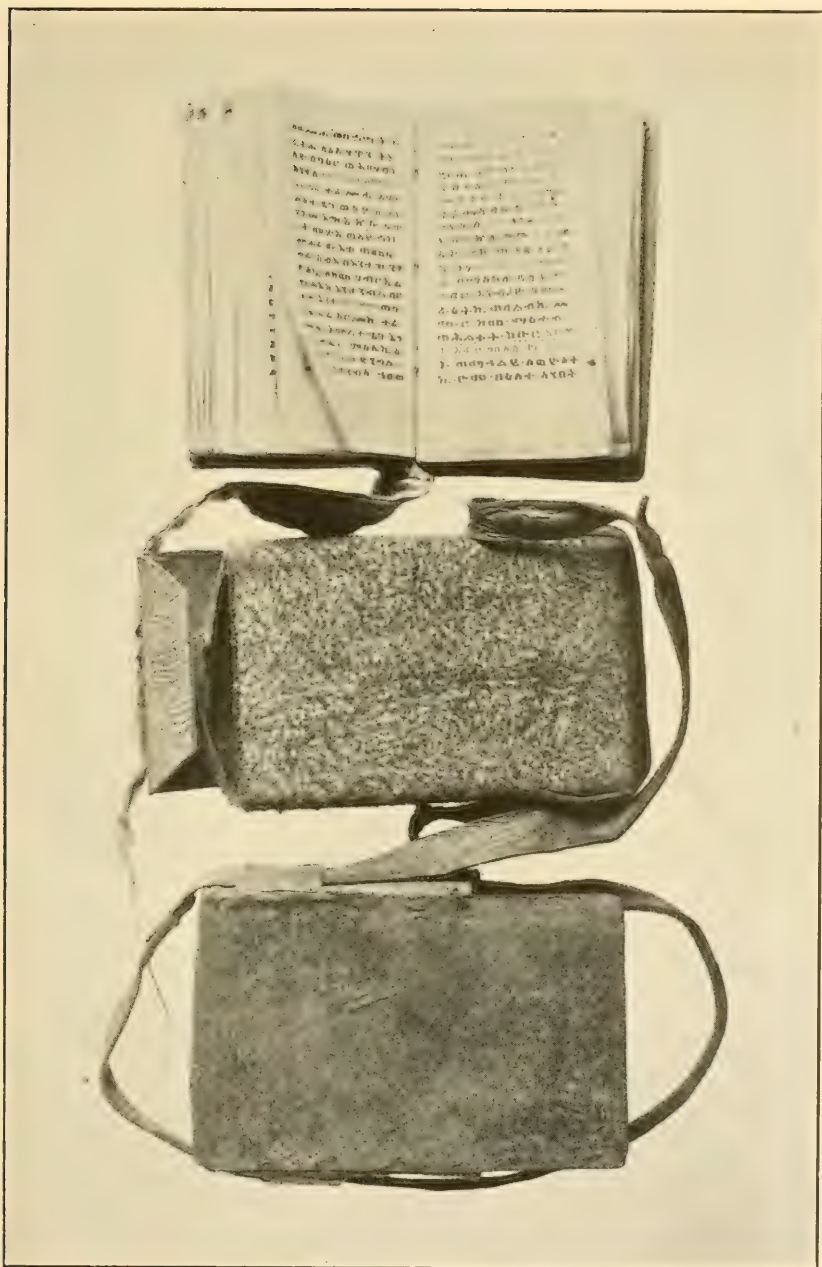
HISTORICAL PAINTING ON CLOTH.

FOR REFERENCE TO PLATE SEE PAGES 271 AND 272.



RELIGIOUS PICTURES ON BRASS.

FOR REFERENCE TO PLATE SEE PAGE 272.



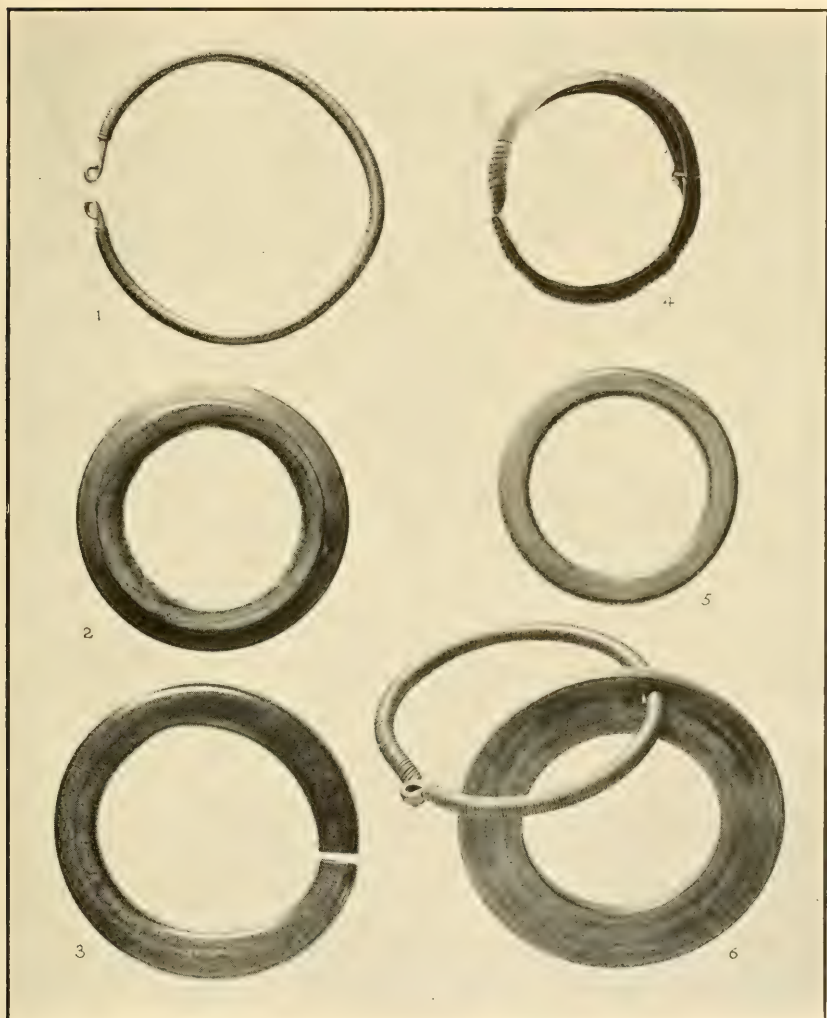
MANUSCRIPT BOOK WITH LEATHER CASE.

FOR REFERENCE TO PLATE SEE PAGE 272.



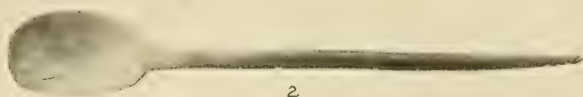
MANTLE AND HEADDRESS.

FOR REFERENCE TO PLATE SEE PAGE 273.



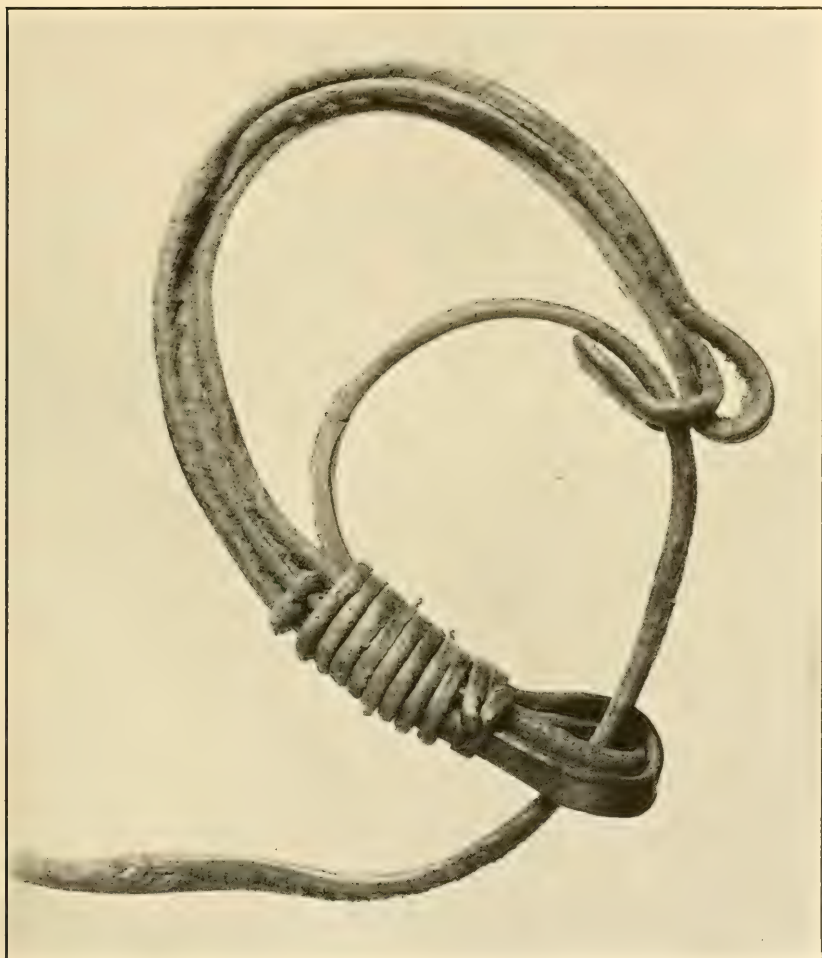
ORNAMENTS OF IVORY AND BRASS.

FOR REFERENCE TO PLATE SEE PAGE 273.



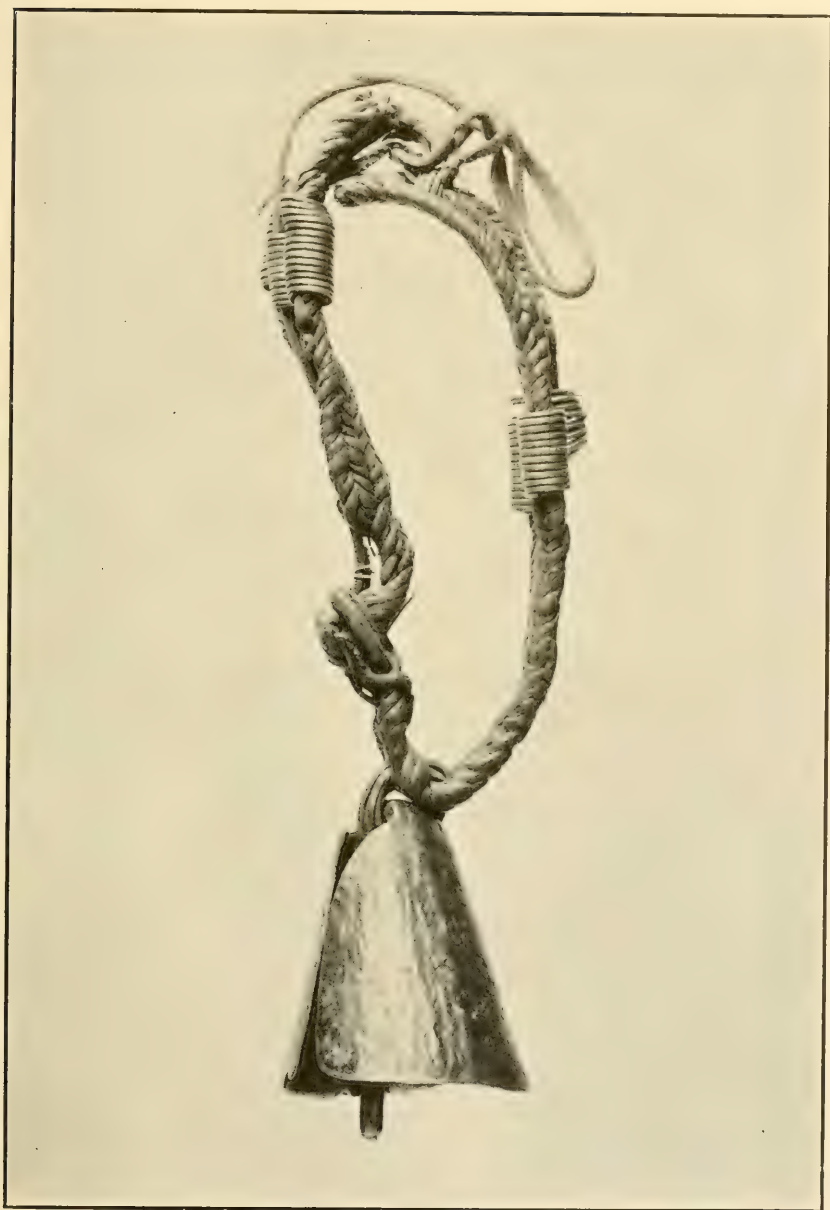
MASK, SPOON, AND HEADREST.

FOR REFERENCE TO PLATE SEE PAGE 274.



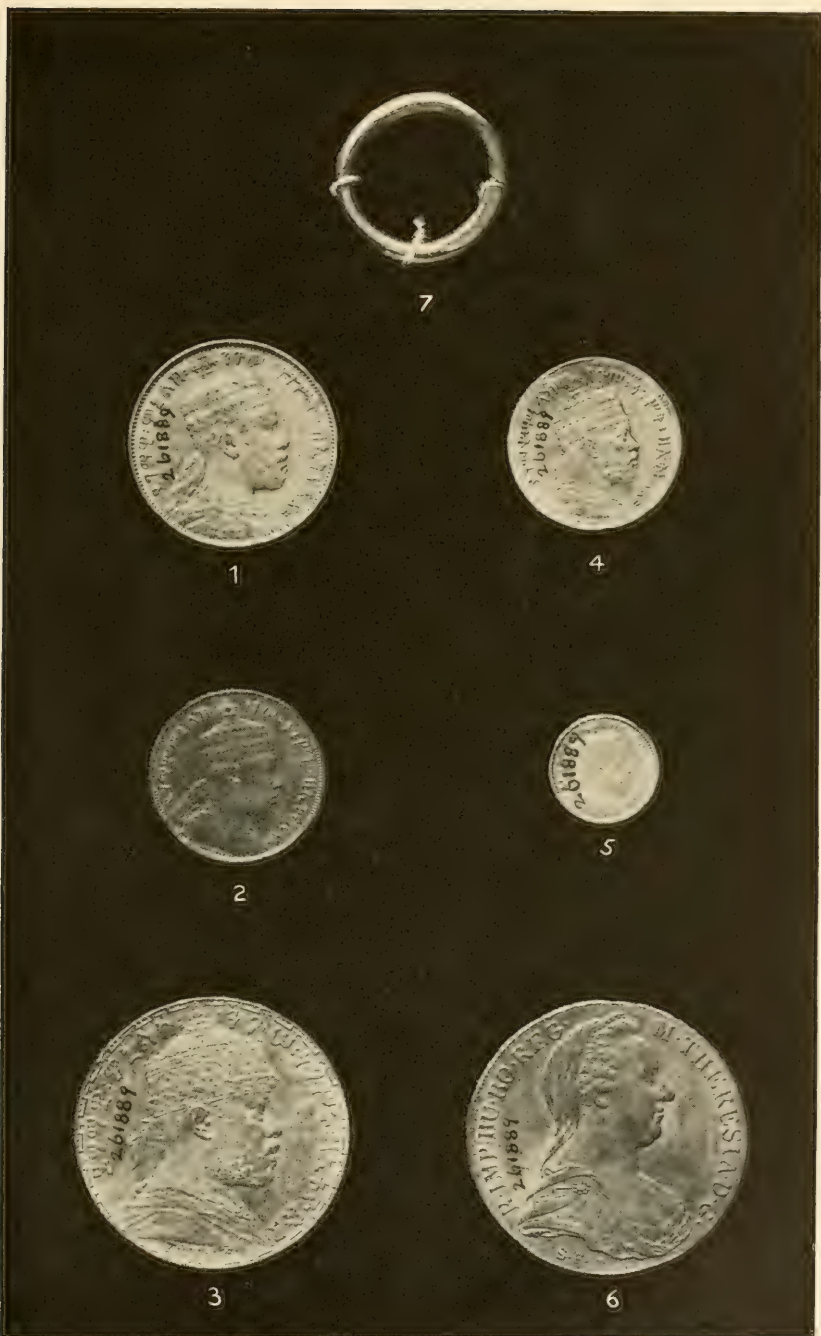
LASSO.

FOR REFERENCE TO PLATE SEE PAGE 274.



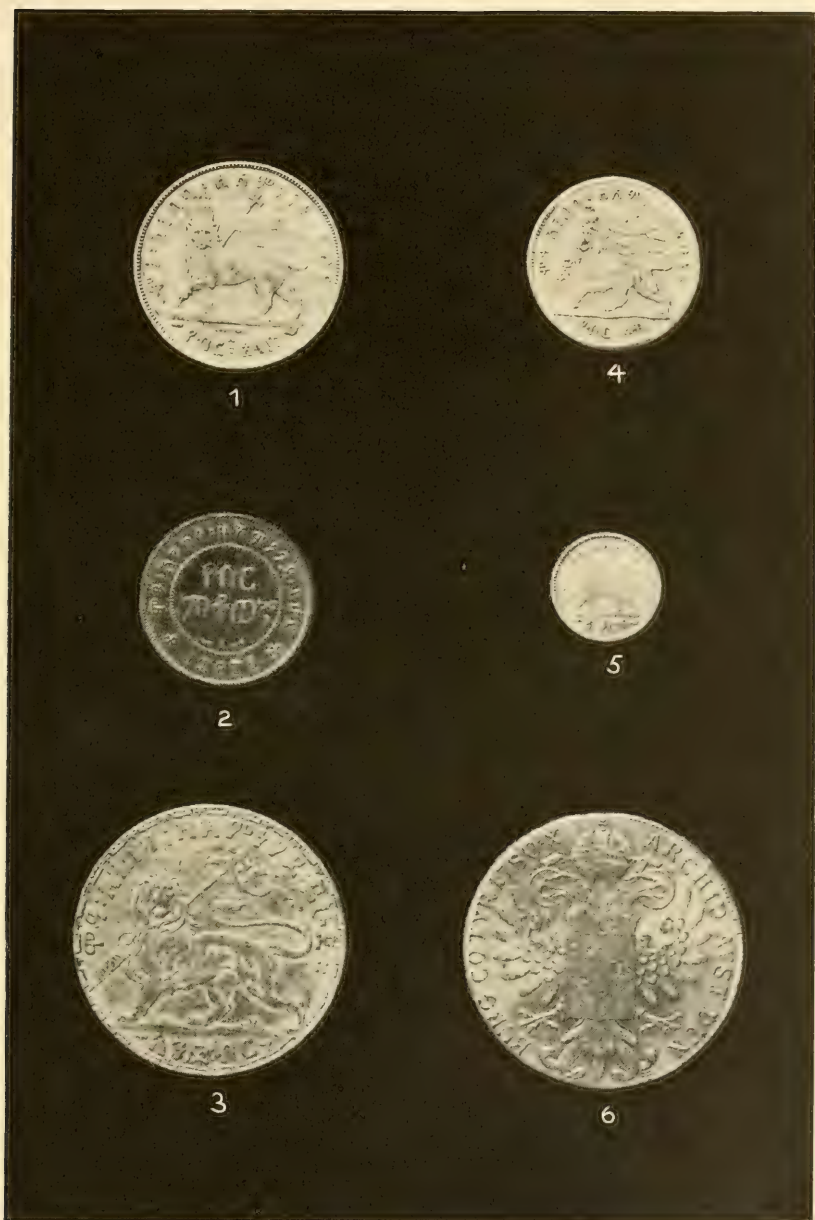
HORSE BELL.

FOR REFERENCE TO PLATE SEE PAGE 275.



ABYSSINIAN COINS. (OBSERVE).

FOR REFERENCE TO PLATE SEE PAGES 275 AND 276.



ABYSSINIAN COINS. (REVERSE).

FOR REFERENCE TO PLATE SEE PAGES 275 AND 276.

NEW SPECIES OF SHELLS FROM BERMUDA.

By WILLIAM HEALEY DALL and PAUL BARTSCH,
Of the Division of Mollusks, U. S. National Museum.

The senior author recently received from Mr. Arthur Haycock, of Bailey's Bay, Bermuda, a request to identify some undetermined species belonging to a series of Bermuda shells which Mr. Haycock is preparing as a donation to the museum at Hamilton, Bermuda.

On examination several of the species proved to be new and, with Mr. Haycock's permission, are described in the following paper. Quite a number are now first recorded from the islands, though previously known from the American mainland. One species, *Cantharus mas-sena* Risso, which is positively identified, is now for the first time reported from the western Atlantic, being previously known only from the Mediterranean. This distribution is parallel with that of another small species of *Cantharus*, *C. orbigny* Payraudeau, which is represented in the U. S. National Museum by specimens from Texas, Yucatan, and the West Indies, though originally described from Corsica.

The *Columbella somersiana* described in this paper is the largest species of the group of *C. mercatoria* to which it belongs; and it is much to be desired that full-grown specimens of this species may be obtained.

There are doubtless numerous other small species at Bermuda still to be obtained which have not yet been recorded, and it is to be hoped that Mr. Haycock's success in adding to the known fauna may stimulate others to continue exploration in the same line.

MITRA HAYCOCKI, new species.

Plate 35, fig. 7.

Shell small, stout, short-fusiform, white, flecked or clouded on the prominences of the sculpture with pale yellow-brown; whorls about five, nucleus white, blunt, polished; later whorls with, between the sutures, four subequal spiral nodulous cords with deep narrower inter-

spaces, the cord in front of the suture slightly more prominent than the others; on the last whorl there are about fifteen spiral cords which are crossed by about twenty axial, incised, equally spaced lines, the segments of the cords thus formed being convexly nodulous; toward the aperture the axial lines become feebler or obsolete; aperture short and rather narrow with about six spiral lirations inside the outer lip which is simple and not reflected and hardly thickened; on the pillar are two strong plaits, rather deep within the aperture; the canal is short and not very deep, with hardly any siphonal fasciole. Length of shell, 4.7; of last whorl, 3.5; of aperture, 2.5; maximum diameter of shell, 2.5 mm.

Cotypes.—In the Bermuda and U. S. National Museums, Cat. No. 221617.

Named for Mr. Arthur Haycock.

COLUMBELLA SOMERSIANA, new species.

Plate 35, fig. 2.

Shell of the general type of *C. mercatoria* Linnæus but larger and differently sculptured. Color translucent white with spiral lines articulated with opaque white and reddish brown, and with radiating brown flammules above the shoulder of the whorl, all covered by a very thin, smooth, yellowish, dehiscent periostracum. Whorls about seven, nucleus worn, the whorls between the rather deep sutures convex and on the upper part of the spire obscurely nodulous; last whorl with a rounded shoulder, with on the whorl in front of the shoulder about a dozen articulated lines of color, slightly elevated, separated by interspaces about twice as wide as the color lines; the surface of the whorl is sculptured axially by rather widely spaced incised lines visible only under a lens; the type being immature, the thickening of the lips about the aperture can not be described; the siphonal fasciole is distinct, with two obscure folds in the interior of the shell. Length of shell, 24; of last whorl, 19; of aperture, 17; maximum diameter, 14.6 mm.

Type.—In Bermuda Museum.

Ordinarily I should be unwilling to describe a species from a single immature specimen, but in the present case the large size, characteristic sculpture, and absence of any species nearer than *C. mercatoria* with which it could be prudently united, lead me to believe that it is best to put it on record.

ACLIS BERMUDENSIS, new species.

Plate 35, fig. 5.

Shell minute, elongate-conic, white, subdiaphanous. Nucleus composed of a single turn which is well rounded and smooth. Post-nuclear whorls strongly shouldered on the early turns, the shoulder

forming a prominent carina at the anterior termination of the posterior two-fifths of the space between the sutures. The surface of the shell between the anterior suture and the shoulder is marked by six equal and equally-spaced very slender spiral threads, while the space between the shoulder and the summit is smooth. Beginning with the fifth whorl the shoulder becomes less apparent and finally loses its angulation altogether. The posterior two-fifths between the sutures, however, remains smooth, while the anterior three-fifths retains the six raised threads. Entire surface of the shell marked by exceedingly fine incremental lines. Sutures strongly constricted. Periphery of the last whorl feebly angulated. Base short, moderately rounded. Aperture subquadrate, somewhat effuse anteriorly; posterior angle obtuse; outer lip very thin, showing the external markings within; columella almost straight and slightly revolute.

The type has seven post-nuclear whorls and measures: Length, 2.1 mm.; diameter, 0.6 mm. It was collected in Bermuda and is in the Bermuda Museum. The minute sculpture is not indicated on the figure.

TURBONILLA (CARELIOPSIS) BERMUDENSIS, new species.

Plate 35, fig. 4.

Shell very small, exceedingly slender, very elongate-conic, white. Nuclear whorls about one and one-half, planorboid, well rounded, having their axes at right angles to that of the succeeding turns, upon the first of which they rest without being immersed. Post-nuclear whorls high between the sutures, feebly shouldered at the summit, well rounded, marked by exceedingly fine incremental lines and about 19 somewhat sinuous, slender, depressed, rounded, spiral threads, which are a little wider than the incised lines that separate them. Sutures strongly constricted. Periphery of the last whorl well rounded. Base rather long, well rounded, marked like the spire. Aperture elongate-oval; posterior angle acute; outer lip thin, showing the external sculpture within. Inner lip slightly curved and slightly reflected over the base.

Three specimens of this species (Cat. No. 221614, U.S.N.M.) were collected by Mr. Haycock in Bermuda. The type has six post-nuclear whorls and measures: Length 2 mm., diameter 0.4 mm. This is the second species of *Careliopsis* known from the Atlantic coast of America. The first, *Turbonilla (Careliopsis) styliformis* Mörch, was described by Mörch¹ from material collected by A. H. Riis at St. Thomas, West Indies, the measurements of which are more than double the dimensions of the present form.

¹ Malakozoologische Blätter, 1874, p. 168.

TURBONILLA (STRIOTURBONILLA) PEILEI, new species.

Plate 35, figs. 9 and 9a.

Shell elongate-conic, light waxen yellow. Nuclear whorls small, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, and in the first of which they are about one-third immersed. Nuclear whorls two and one-half. Post-nuclear whorls feebly shouldered at the summit, marked by somewhat flexuous, well-developed, regular, axial ribs, of which 14 occur upon the first and second, 16 upon the third, 20 upon the fourth, 22 upon the fifth, 24 upon the sixth to eighth, 26 upon the ninth, 28 upon the tenth and the penultimate turn. Intercostal spaces about twice as wide as the ribs, well impressed, the depressed portion terminating in a deep pit at the periphery. A second series of pits occurs at the anterior termination of the posterior two-fifths of the space between the sutures. In addition to these two series of pits, the intercostal spaces are marked by fine, very regular, and regularly spaced, incised spiral lines, which are about half as wide as the flattened spaces between them. Of these lines, twenty occur between the two series of pits, while the space between the median series of pits and the summit is marked by fourteen. Periphery of the last whorl slightly angulated. Base moderately long, well rounded, crossed by the feeble continuations of the axial ribs which disappear before reaching the middle of the base, and about twenty irregular and irregularly spaced, sinuous, incised, spiral lines. Aperture somewhat effuse anteriorly posterior angle obtuse; outer lip thin, showing external sculpture within; columella oblique, slightly revolute.

Two specimens of this species were sent by Mr. Haycock from Bermuda. These may be considered cotypes. One of these (Cat. No. 221610, U.S.N.M.) has twelve post-nuclear whorls and measures: Length 6 mm., diameter 1.3 mm. The other is in the Bermuda Museum.

The species is named, at the request of Mr. Haycock, for Major Peile, Royal Artillery, of Bermuda, in recognition of kindly assistance rendered by him.

TURBONILLA (STRIOTURBONILLA) HAYCOCKI, new species.

Plate 35, figs. 6 and 6a.

Shell elongate-conic, white. Nuclear whorls two, forming a depressed, helicoid spire, the axis of which is at right angles to that of the succeeding turns, scarcely at all immersed, with the tilted edge projecting slightly beyond the post-nuclear spire on the left side. Post-nuclear whorls almost flattened, slightly shouldered at the summit, marked with strong, well rounded, slightly protractive, axial ribs, of which 12 occur upon the first, 14 upon the second, 16

upon the third and fourth, 18 upon the fifth, 20 upon the sixth, 22 upon the seventh to tenth, 24 upon the eleventh and the penultimate turn. Intercostal spaces about twice as wide as the ribs, well impressed, evenly concave, marked with two series of strongly impressed pits, of which one forms the anterior termination of the impressed intercostal spaces, while the other is a little posterior to the middle between the sutures. The remaining portions of the intercostal spaces are crossed by numerous, very fine, regular and regularly spaced, incised spiral lines, that leave the spaces between them as raised flattened spiral threads which are about twice as wide as the incised lines. Of these incised lines, twenty-six occur between the two pits on the last turn and twenty-five between the median series of pits and the summit of the whorls. Sutures moderately strongly impressed. Periphery of the last whorl well rounded. Base short, well rounded, marked by incremental lines and thirty-three somewhat wavy, slightly irregularly spaced, fine, incised, spiral lines. Aperture subquadrate; posterior angle acute; outer lip thin, showing the external markings within; columella almost straight and slightly revolute.

Four specimens, cotypes, of this species were dredged at Bermuda. One of these consists of the nucleus and five post-nuclear whorls, and has furnished the description of the nucleus. Another has lost the nuclear whorls and has twelve and one-half post-nuclear whorls remaining; this measures: Length 7 mm., diameter 1.8 mm.

Two of these are in the Bermuda Museum and two in the U. S. National Museum, where they are entered as Cat. No. 221611.

This species and the following are related to *Turbonilla (Strioturbonilla) puncta* C. D. Adams. Both differ from the latter in being uniformly larger and also in details of sculpture.

Named for Mr. Arthur Haycock.

CERITHIOPSIS MOVILLA, new species.

Plate 35, fig. 11.

Shell elongate-conic, brown, the tubercles a little lighter than the ground color. Nuclear whorls two, well rounded, smooth. Post-nuclear whorls well rounded, marked with three spiral cords, of which the first is at the summit, the third somewhat above the suture, while the second is half way between the two. The spaces between these spiral cords are a little wider than the cords. In addition to the spiral cords, the whorls are marked by somewhat retractive, well rounded, axial ribs, which are a little less strong than the spiral cords. Of these ribs, 14 occur upon the first, 16 upon the second and third, 18 upon the fourth, 20 upon the fifth, 22 upon the sixth, and 24 upon the penultimate turn. The junctions of the axial ribs and spiral cords form well developed small tubercles, of which those on the first spiral cord are well rounded, those on the median are slightly

truncated posteriorly, rounded abruptly anteriorly, while those on the third cord are decidedly truncated posteriorly, sloping gently anteriorly. The spaces inclosed between the axial ribs and spiral cords form well impressed, squarish pits. In addition to the above sculpture the entire surface of the spire is crossed by exceedingly fine incremental lines and spiral striations. Sutures strongly constricted. Periphery of the last whorl marked by a well developed spiral cord, which is separated from the first suprasutural cord by a space a little wider than that separating the suprasutural from the median cord. The axial ribs continue to and over the peripheral cord and render it feebly tuberculated. Base somewhat concave, marked with a single low broad cord at the insertion of the columella, the space between which and the peripheral cord appears as a broad, concave sulcus; the space limiting the basal cord anteriorly is a feebly impressed groove. Entire surface of the base marked by fine, incremental lines and exceedingly fine, spiral striations. Aperture subquadrate, effuse at the junction of the outer and basal lip, decidedly channeled anteriorly; posterior angle obtuse; inner lip slightly curved and reflected over the base; parietal wall covered with a thick callus.

The type has eight post-nuclear whorls and measures: Length 3.8 mm., diameter 1.6 mm. It and another specimen (Cat. No. 221613, U.S.N.M.) were collected by Mr. Haycock at Bermuda.

CERITHIOPSIS ARA, new species.

Plate 35, fig. 1.

Shell small, ovoid, dark brown, except the white band which extends over the posterior row of tubercles on the last three whorls. (Nuclear whorls decollated.) Post-nuclear whorls increasing very rapidly in size in the first three whorls, after that almost cylindrical, then again somewhat contracted on the last volution. The whorls are marked with two spiral rows of cords, of which the first, which is almost double the width of the other, is at the summit, while the second is immediately above the suture. The space separating the two is almost equal in width to the anterior row of tubercles. In addition to the spiral cords, the whorls are marked with axial ribs, of which 14 occur upon the first and second, 16 upon the third, 18 upon the fourth, and 20 upon the penultimate turn. The junctions of the axial ribs and spiral cords form strong tubercles, those on the posterior cord being elongate-oval, having their long axes coinciding with the axial ribs, while those on the anterior spiral cord are much smaller and truncated posteriorly, sloping gently anteriorly. The spaces inclosed between the axial ribs and spiral cords are well impressed oval pits. Sutures small, scarcely differentiated from the depressed sulcus of the spire. Periphery of the last whorl marked by a smooth spiral cord, which is separated from the suprasutural cord

by a sulcus as wide as that which separates the two spiral cords on the spire, and like that crossed by the continuations of the axial ribs, which extend to its posterior edge. Base moderately long, marked by a slender spiral thread at the insertion of the columella, the space between which and the peripheral cord appears as a broad, strongly impressed spiral groove. Anterior half of the base marked by exceedingly fine, incremental lines and spiral striations. Aperture irregular, subquadrate, very strongly channeled anteriorly and feebly so at the posterior angle, decidedly effuse at the junction of the outer and basal lip. Outer lip thin, showing the external sculpture and color markings within; inner lip slightly curved, reflected over the base; parietal wall covered with a thick callus which renders the peritreme complete.

Three specimens of this species (Cat. No. 221612, U.S.N.M.) were received from Mr. Haycock, collected at Bermuda. All are lacking the nucleus. The largest of these has six post-nuclear whorls and measures: Length 2.3 mm., diameter 1.2 mm. The smallest, which also has six post-nuclear whorls, measures: Length 2 mm., diameter 1 mm.

CERITHIOPSIS PESA, new species.

Plate 35, fig. 10.

Shell small, elongate-conic, banded as follows: Brown, excepting the median row of tubercles and the depressed spaces on either side of them, which are white. The dark tubercles on all the whorls are a little lighter than the main portion of that part of the shell. Nuclear whorls two and one-half, well rounded, smooth. Post-nuclear whorls well rounded, marked from the very beginning by three spiral cords, of which the first, which is at the summit, is a little weaker than the other two. The third is immediately above the periphery, while the second is a little nearer to the first than to the third. In addition to the spiral cords, the whorls are marked with almost vertical axial ribs, which are almost as strong as the spiral cords. Of these ribs, 16 occur upon the first to fourth, 18 upon the fifth, and 20 upon the penultimate turn. The junction of the axial ribs and spiral cords form strong tubercles, of which those at the summit are the smallest and well rounded; those on the median cord and basal cord are truncated posteriorly, sloping gently anteriorly. The spaces inclosed between the axial ribs and spiral cords are well impressed squarish pits on the last whorls, while on the early whorls they are rectangular pits having their long axes parallel to the spiral sculpture. Sutures strongly impressed. Periphery of the last whorl marked by a strong spiral keel, which is separated from the first suprasutural keel by a groove almost as wide as that which separates the suprasutural keel from its neighbor. The axial ribs extend partly upon the peripheral keel and render it feebly tuberculous. Base somewhat

irregular. A raised spiral cord of moderate strength marks the insertion of the columella; the space between this and the peripheral cord is a deep sulcus, which, like the rest of the base is crossed by fine incremental lines. The anterior half of the base, which is fairly rounded, is marked by six irregular wavy, fine, raised, spiral threads. Aperture irregularly rhomboid, very strongly channeled anteriorly, and feebly so at the posterior angle; outer lip moderately thick, showing the external sculpture and color markings within; inner lip reflected over the base; parietal wall covered with a thick callus which renders the peritreme complete.

The type has seven post-nuclear whorls and measures: Length 2.5 mm., diameter 1 mm. It and two specimens form Cat. No. 221616, U.S.N.M.

CERITHIOPSIS VICOLA, new species.

Plate 35, fig. 12.

Shell elongate-conic, white, with two bands of golden brown on each whorl. The first of these bands extends over the posterior row of tubercles, while the second covers the peripheral cord. Nuclear whorls two and one-half, well rounded, smooth. Post-nuclear whorls well rounded, marked from the very beginning with three strong spiral cords, which are about as wide as the spaces that separate them. The first of these cords, which is at the summit, is a trifle weaker than the rest; the third is at some little distance above the suture, while the second is half way between the two. In addition to these cords, the whorls are marked by well developed vertical axial ribs, which are about as strong as the spiral cords. Of these ribs, 18 occur upon the first and second, 20 upon the third, 22 upon the remaining whorls. The junctions of the axial ribs and the spiral cords form well developed tubercles, while the spaces inclosed between them are well impressed, squarish pits. The tubercles are well rounded on the first and second cords, while those on the third are truncated posteriorly, sloping gently anteriorly. Sutures strongly impressed, showing a portion of the peripheral cord on the last three whorls. Periphery of the last whorl marked by a strong spiral cord, which is separated from the suprasutural cord by a space almost double the width of that which separates the suprasutural from the median cord. The axial ribs extend to the posterior edge of the suprasutural cord, but do not cross it. Base moderately long, somewhat concave, marked by a low tumid area at the insertion of the columella, which somewhat suggests a very broad, low, weakly rounded cord. The entire surface of the base is marked with exceedingly fine spiral striations and incremental lines. Aperture very large, irregular, oval, decidedly effuse at the junction of the outer and basal lip, very strongly channeled anteriorly and slightly so at the posterior

angle. Outer lip thin, showing the external sculpture within; inner lip strongly curved, reflected over the base; parietal wall glazed with a moderately thick callus which renders the peritreme complete.

The unique type comes from Bermuda, and has seven post-nuclear whorls measuring: Length 2.9 mm., diameter 1 mm. It is in the collection of the Bermuda Museum.

CERITHIOPSIS IO, new species.

Plate 35, fig. 3.

Shell elongate-ovate, white, with three bands of very dark brown. The first of these bands extends over the posterior row of tubercles on each whorl, the second covers the cord at the periphery, while the third extends over the anterior half of the base. Nuclear whorls decollated in the two specimens before us. Post-nuclear whorls marked with three spiral cords, of which the first is at the summit, the third at the suture, while the second is a little nearer to the first than to the third. In addition to these spiral cords, the whorls are marked with somewhat retractive axial ribs, which are about as strong as the spiral cords, the intersections of the two forming well developed tubercles, while the spaces inclosed between them are strongly impressed, rounded pits. The tubercles of the cord at the summit are well rounded; those of the median cord slope abruptly anteriorly and more gently posteriorly, while those of the third cord are truncated posteriorly, sloping gently anteriorly. Sutures strongly impressed. Periphery of the last whorl marked by a spiral cord, which is less strong than those on the spire. Base moderately long, well rounded, the posterior half marked by the continuations of the axial ribs, which terminate somewhat abruptly at the insertion of the columella. These ribs render the peripheral spiral cord tuberculated, the tubercles being slightly truncated posteriorly, sloping gently anteriorly, where they disappear at the insertion of the columella. The insertion of the columella is marked by a moderately strongly impressed, spiral line. Anterior half of base marked by ten somewhat irregular, raised, spiral threads, which are about as wide as the spaces that separate them, the entire space being marked with exceedingly fine, raised, axial threads. Aperture irregularly rhomboid, decidedly channeled anteriorly, weakly channeled at the posterior angle; outer lip thick, showing the external sculpture and color markings within; inner lip reflected over the base; parietal wall covered with a thick callus which joins the columella and the posterior angle of the aperture and renders the peritreme complete.

Two specimens of this species were sent by Mr. Haycock, which may be considered cotypes. One of these is in the Bermuda Museum, the other is Cat. No. 221615, U.S.N.M. One of these has six post-nuclear whorls and measures: Length 2.3 mm., diameter 1.1 mm.

FISSURIDEA BERMUDENSIS, new species.

Plate 35, fig. 8.

Shell small, white, elevated, reticulately sculptured; apex a little in advance of the middle of the shell, rather pointed; the anal aperture long-oval, the margins excavated in the middle, internally with a thickened margin, subtruncate behind; sculpture of radiating threads with wider deep interspaces, crossed between the apex and the base by about a dozen concentric lines, representing old margins, nodulating the radials and forming deep pits between the intersections; interior of the shell white, the margin forming a regular oval, and often internally radially grooved in harmony with the external ribs. Length, 5; breadth, 3.5; height, 3 mm.

Cotypes.—In the Bermuda Museum and U. S. National Museum Cat. No. 221618.

This small species has been carefully compared with young specimens of the already known species with none of which could it, apparently, be prudently united.

ODOSTOMIA (CHRYSALLIDA) NIOBA, new species.

Shell broadly conic, milk-white. Nuclear whorls small, obliquely immersed in the first of the succeeding turns, above which only about half of the last volution projects. This is marked with three strong spiral threads which are almost as wide as the spaces that separate them. Post-nuclear whorls moderately rounded, marked with strong, slightly retractive ribs of which 16 occur upon the first, 18 upon the second, 20 upon the third, and 22 upon the penultimate whorl. These ribs are about as wide as the spaces that separate them. In addition to the axial ribs, the whorls are marked with four spiral cords which are much wider than the spaces that separate them. The intersections of the axial ribs and spiral cords form well rounded, low tubercles. Sutures strongly channeled. Periphery of the last whorl and base well rounded, marked with four equal and equally spaced spiral cords. Aperture oval, posterior angle acute, outer lip thin, showing the external sculpture within; inner lip oblique and reflected partly over the base; parietal wall covered with a thin callus.

The type and six specimens of this species were collected by Mr. A. Haycock, at Bermuda. They form Cat. No. 223284, U.S.N.M. The type has five post-nuclear whorls and measures: Length 2.6 mm., diameter 1.3 mm.

The specimens of this and the next species arrived after the plate for this paper had been prepared. Hence, no figure of it is included in this report.

ISCHNOCHITON (STENOPLAX) BERMUDENSIS, new species.

Animal narrow, elongate, with an evenly rounded back, prominent mucro, narrow yellowish girdle articulated with reddish blotches, the girdle scales very minute, imbricate, oval, radiately strongly striated; the surface of the girdle has a dusty look to the naked eye and required high magnification to bring out the characters. Color dark crimson, minutely and feebly mottled with small whitish blotches, interior dark crimson, except the sutural plates which are whitish; eaves solid, smooth; median plates with one lateral slit; anterior valve with 11, posterior with 7-8 slits; jugum wide; lateral areas rounded, passing without interruption into the median areas; anterior and posterior valves and lateral areas sharply concentrically grooved; the median areas appear smooth, but under high magnification are seen to be longitudinally sculptured with very narrow sharp grooves articulated by little partitions; the lateral portions of the valves are minutely granulose. The mucro is somewhat posterior to the center of the tail valve and rather prominent. Length 11 mm., width 4 mm.

This species belongs to the group of *I. limaciformis* from which it differs by its minute sculpture, granulation, more prominent mucro, and inconspicuous lateral areas; apparently also in color, though this is quite variable in the *limaciformis*. The type is Cat. No. 223354.

LIST OF SPECIES IDENTIFIED FROM BERMUDA.

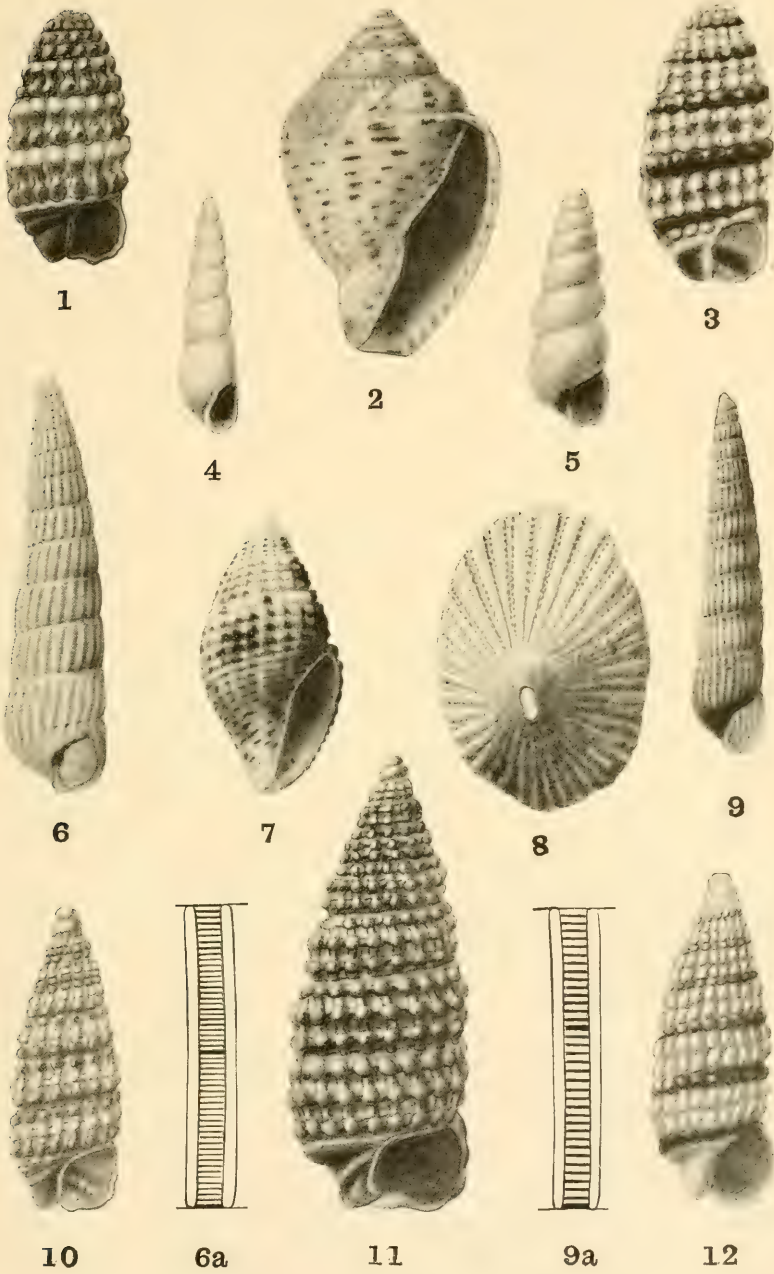
- Haminea succinea* Conrad, very young.
Pleurobranchus, sp. ind.
Mitra haycocki Dall and Bartsch.
Mitra chelonia Reeve. ? (fragment).
Mitra hanleyi Dohrn.
Mitromorpha buplicata Dall, young.
Cantharus massena Risso.
Colubraria swiftii Tryon.
Columbella somersiana Dall and Bartsch.
Aelis bermudensis Dall and Bartsch.
Turbonilla (Careliopsis) bermudensis Dall and Bartsch.
Turbonilla (Strioturbonilla) peilei Dall and Bartsch.
Turbonilla (Strioturbonilla) haycocki Dall and Bartsch.
Odostomia (Chrysallida) nioba Dall and Bartsch.
Cymatium chlorostoma Lamarck.
Cerithiopsis movilla Dall and Bartsch.
Cerithiopsis ara Dall and Bartsch.
Cerithiopsis pesa Dall and Bartsch.
Cerithiopsis vicola Dall and Bartsch.
Cerithiopsis io Dall and Bartsch.
Alabina cerithioides Dall.
Alaba incerta Orbigny.
Alaba tervaricosa C. B. Adams.
Rissoa caribaea Orbigny.
Solarium krebsi Mörch, young.
Crepidula conveza Say, young.

- Cyclostrema granulum* Dall, var.?
Vitrinella helicoides C. B. Adams.
Fissuridea bermudensis Dall and Bartsch.
Ischnochiton (Stenoplax) bermudensis Dall and Bartsch.
Pododesmus rudis Broderip.
Pecten ornatus Lamarck., very young.
Melina lamarckiana Orbigny, very young.
Crassinella parva C. B. Adams.
Erycina linella Dall, young.
Coralliophaga dactylus Bruguière.
Chione mazyckii Dall, young.
Chione cancellata Linnæus.
Macrocallista maculata Linnæus.
Macoma mitchelli Dall.
Ervilia subcancellata E. A. Smith.
Semele proficua Pulteney.
Lyonsia beana Orbigny, young.
Gastrochaena rostrata Spengler.

EXPLANATION OF PLATE 35.

The measurement given after each species represents the actual length of the specimen.

- FIG. 1. *Cerithiopsis ara*; 2.3 mm.; p. 282.
 2. *Columbella somersiana*; 24 mm.; p. 278.
 3. *Cerithiopsis io*; 2.3 mm.; p. 285.
 4. *Turbonilla (Careliopsis) bermudensis*; 2 mm. The fine spiral sculpture has been omitted in our figure; p. 279.
 5. *Aclis bermudensis*; 2.1 mm.; p. 278.
 6. *Turbonilla (Strioturbonilla) haycocki*; 7 mm.; p. 280.
 6a. *Turbonilla (Strioturbonilla) haycocki*; detail of intercostal sculpture; p. 280.
 7. *Mitra haycocki*; 4.7 mm.; p. 277.
 8. *Fissuridea bermudensis*; 5.0 mm.; p. 286.
 9. *Turbonilla (Strioturbonilla) peilei*; 6 mm.; p. 280.
 9a. *Turbonilla (Strioturbonilla) peilei*; detail of intercostal sculpture; p. 280.
 10. *Cerithiopsis pesa*; 2.5 mm.; p. 283.
 11. *Cerithiopsis movilla*; 3.8 mm.; p. 281.
 12. *Cerithiopsis vicola*; 2.9 mm.; p. 284.



NEW SPECIES OF SHELLS FROM BERMUDA.

FOR EXPLANATION OF PLATE SEE PAGE 288.

A REVISION OF SEVERAL GENERA OF GYMNOSPERMOUS PLANTS FROM THE POTOMAC GROUP IN MARYLAND AND VIRGINIA.

By EDWARD W. BERRY,
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The present paper is the third of a series of revisions of the more important genera of fossil plants from the Potomac group in Maryland and Virginia. The first dealt with the genus *Nageiopsis* and formed No. 1738 of Volume 38¹ of the Proceedings. The second treated the genera *Acrostichopteris*, *Taeniopteris*, *Nilsonia*, and *Sapindopsis* and constituted No. 1769 of the same Volume 38.²

The present contribution is devoted to a consideration of the genera *Sphenolepis*, *Arthrotaxopsis*, *Cephalotaxopsis*, *Widdringtonites*, *Brachyphyllum*, *Sequoia*, *Abietites*, and *Pinus*. These are all gymnospermous genera, some of which are of disputed botanical affinity. The majority offer exceptional difficulties to their correct interpretation by reason of the convergence in foliar characters of the Mesozoic Coniferales. This is more marked than in the existing species because of the greater number of species in the Mesozoic, a period which has more than once been termed the "Era of Gymnosperms."

The genera *Arthrotaxopsis* and *Cephalotaxopsis* were originally described from the Potomac group. All of the other genera, however, are well known and for the most part widespread Mesozoic types, two, *Sequoia* and *Pinus*, surviving to the present time.

In the previous treatment of these types in the area under discussion there existed the utmost confusion and it has been necessary to check each cited occurrence by referring back to the original material in the U. S. National Museum collections. This has resulted in a most intricate splitting and combining of the named forms or parts of the named forms as they occurred in the literature, some idea of the extent and labor of which can be imagined from the following synonymy.

Forty-three species and three varieties which were formerly recognized are here replaced by 18 species. Instead of 9 species and 1 variety of *Sequoia* four are retained; 6 species and 1 variety of *Sphenolepidium*

¹ Pp. 185-195.

² Pp. 625-644.

are represented by 2 species of *Sphenolepis*; five species and one variety of *Glyptostrobus* disappear altogether as does also a species of *Williamsonia* and one of *Araucarites*.

While the lack of certainty pertaining to the correct recognition of coniferous foliage as ordinarily preserved in the fossil state is fully recognized it is believed that the previous segregation of these Potomac forms was entirely unwarranted and that the present conception instead of being ultra-conservative as might be deduced from the synonymy still leans in the direction of recognizing too many species. However, it approximates at least the actual status of these genera in this area during the Lower Cretaceous.

THE GENUS SPHENOLEPIS.

The genus *Sphenolepis* was proposed by Schenk in 1871.¹ In 1881 Heer proposed the generic name *Sphenolepidium* as a substitute for *Sphenolepis* on the ground that the latter had been previously used in the animal kingdom. In his treatment of these plants in Zittel's Handbuch Schenk adopts Heer's generic name which had meanwhile come into general use. As, however, all modern nomenclatorial codes both botanical and zoological do not regard the use of a name in one kingdom as prohibiting its use in the other, Schenk's original name must stand.

Sphenolepis may be defined as follows: Branches and twigs alternate. Phyllotaxy spiral. Leaves decurrent, more or less imbricated, acute, more or less appressed, especially on the older branches. Cones small, oblong or spherical, borne on short lateral branches. Conescales persistent, leathery, somewhat divergent at maturity, in habit suggesting *Sequoia*. The number and position of the seeds is altogether uncertain.

Although Solms-Laubach considers² that these forms can not be precisely located in any of the existing subfamilies of conifers most authors refer them to the Taxodiæ comparing them with the existing species of *Sequoia* and *Arthrotaxis*, especially the latter, with which as regards the cones, the leaf form and arrangement, and the general habit there is the closest similarity, amounting almost to an actual demonstration of relationship.

The genus appears in beds of Rhætic age both in Europe and South America. In North America one species has been recorded from the Oregon Jurassic, and Saporta has described a species from the Upper Jurassic of Portugal. Species of this genus are widespread and characteristic of the Wealden and Lower Cretaceous and constitute a very abundant element in the flora of the Potomac group, where they are represented by remains of both foliage and cones. As has been frequently pointed out, the genus may be composite.

¹ Schenk, Palæontographica, vol. 19, 1871, p. 243.

² Solms-Laubach, Fossil Botany, 1891, p. 71.

SPHENOLEPIS KURRIANA (Dunker) Schenk.¹

- Thuites* (*Cupressites*?) *kurrianus* DUNKER, Monogr. Norddeutsch. Weald.-bild., 1846, p. 20, pl. 7, fig. 8.
- ? *Thuites germari* DUNKER, Monogr. Norddeutsch. Weald.-bild., 1846, p. 19, pl. 9, fig. 10.
- Widdringtonites kurrianus* ENDLICHER, Synop., 1847, p. 272.—GÖPPERT, Foss. Conif., 1850, p. 176.
- Brachyphyllum kurrianum* BRONGNIART, Tableau, 1849, p. 107.
- Brachyphyllum germari* BRONGNIART, Tableau, 1849, p. 107.
- Widdringtonites haidingeri* ETTINGSHAUSEN Abhandl. k. k. geol. Reichs., vol. 1, 1851, p. 26, pl. 2, fig. 1.
- Araucarites dunkeri* ETTINGSHAUSEN (part) Abhandl. k. k. geol. Reichs., vol. 1, p. 27, pl. 2, figs. 2-10.
- Sphenolepis kurriana* SCHENK, Palaeont., vol. 19, 1871, p. 243, pl. 37, figs. 5-8; pl. 38, fig. 1 (not fig. 2, which is an *Onychiopsis*).—SCHIMPER, Pal. Végét., Atlas, 1874, pl. 110, fig. 26.—HOSIUS and v. d. MARCK, Palaeont., vol. 26, 1885, p. 216, pl. 44, fig. 209.
- Sphenolepidium kurrianum* HEER, Contrib. Flora foss. Port., 1881, p. 19, pl. 12, fig. 1b; pl. 13, figs. 1b, 8b; pl. 18, figs. 1-8.—SCHENK in Zittel, Handbuch, 1884, p. 304, fig. 210.—FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 260, pl. 126, figs. 1, 5, 6; pl. 128, figs. 1, 7; pl. 129, figs. 1, 4, 6, 8; pl. 130, fig. 11; pl. 131, fig. 4; pl. 167, fig. 2.—SAPORTA, Flora foss. Port., 1894, pp. 115, 139, pl. 22, figs. 3-5; pl. 27, fig. 15.—SEWARD, Wealden Flora, Pt. 2, 1895, p. 200, pl. 17, figs. 7, 8; pl. 18, fig. 1.—FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., pt. 2, 1899, p. 681, pl. 166, figs. 12, 13.—KERNER, Jahrb. k. k. geol. Reichs., vol. 45, Heft 1, 1896, p. 51, pl. 4, fig. 2.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 484, 489, 519, 538, 543.
- Sphenolepidium parceramosum* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 257, pl. 129, fig. 7; pl. 130, fig. 8; pl. 131, fig. 2.—FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., Pt. 2, 1899, p. 682, pl. 163, fig. 11b; pl. 167, figs. 1-3.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 484, 538, 548.
- Arthrotaxopsis grandis* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 240 (part).
- Sphenolepidium virginicum* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 259, pl. 125, fig. 4; pl. 166, fig. 6.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 481, 484, 517.
- Arthrotaxopsis expansa* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 241 (part), pl. 135, figs. 15, 18, 22.
- Taxodium* (*Glyptostrobus*) *expansum* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 252, pl. 123, fig. 1.
- Glyptostrobus expansus* WARD, Fontaine, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 543.
- Taxodium* (*Glyptostrobus*) *denticulatum* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 253, pl. 124, fig. 1.
- Taxodium* (*Glyptostrobus*) *fastigiatum* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 253, pl. 125, figs. 1, 3.
- Glyptostrobus fastigiatus* WARD, 15th Ann. Rept. U. S. Geol. Surv., 1895, p. 380.
- Glyptostrobus brookensis* FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., Pt. 2, 1899, p. 682, pl. 165, fig. 4; pl. 168, fig. 4.

¹The following are included in the synonymy of this species by Seward (Wealden Flora): *Muscites imbricatus* Roemer, Verstein., 1839, p. 9, pl. 17, fig. 1c (this is doubtful and would change the specific name if recognized); *Araucarites hamatus* Trautschold, Nouv. Mém. Soc. Nat. Moscou, vol. 13, 1870, p. 225, pl. 21, fig. 3; and *Thuites choffati* Heer, Contrib. Flora foss. Port., 1881, p. 11, pl. 10, fig. 8.

Description.—Twigs alternate, branching copiously and more or less crowded, with a tendency toward a fastigiate arrangement in numerous specimens. Leaves thick, keeled dorsally, ovate in outline, often broadly so, acuminate, often slightly recurved, rather crowded and more or less appressed, but larger and much more divergent than those of the genera *Arthrotaxopsis* or the Lower Cretaceous species of *Widdringtonites*. Phyllotaxy spiral. Cones small, globose or oblate spheroidal, scales few in number, short and thick, truncate distally, becoming more or less divergent with age.

This species is very common at a large number of Lower Cretaceous horizons in both Europe and America, and it has also been recorded from the Cenomanian in Portugal, Saxony, and Austria (Lesina). It is present in the Neocomian of Portugal and Westphalia and doubtfully in beds of this age in Russia. It is present in the Wealden of England and Germany, the latter being the type area. It is also recorded from the Urgonian of Portugal and is probably present in the Kome beds of Greenland. In this country it is recorded from the Kootanic of Montana and the Fuson formation of the Black Hills. It is a very abundant form in the Potomac group, and occurs at numerous localities ranging in age from the oldest or Patuxent beds to the youngest or Patapasco beds, a range similar to but somewhat less in time than that ascribed to it in Portugal, where Saporta recognizes it from the Neocomian to the Cenomanian. Some of the numerous specimens from the Kome beds of Greenland, which Heer described first as *Widdringtonites gracilis*¹ and afterwards as *Cyparissidium gracile*,² are probably identical with *Sphenolepis kurriana* (Dunker) Schenk, although the cones ascribed to the former differ from those of the latter. Heer notes the resemblance between the remains of foliage of *Cyparissidium*, *Widdringtonites*, *Glyptostrobus*, *Arthrotaxis*, and *Sequoia*.

Araucarites hamatus Trautschold, which Seward³ doubtfully includes in the synonymy, is here excluded. There is some suggestion of *Sphenolepis* in Trautschold's figures, but not enough for certainty. These figures are, however, almost identical with the coniferous twigs from Glen Rose, Texas, which Fontaine describes as *Sequoia pagiophylloides* new species.

The species may be a composite one; its wide geographical and geological range offers some basis for such a suspicion, but the materials available for study do not furnish reliable data for its segregation.

Occurrence.—PATUXENT FORMATION: New Reservoir, Ivy City, District of Columbia; Fredericksburg, Potomac Run, Trents Reach, Dutch Gap, Telegraph Station (Lorton), Cockpit Point, Kankeys,

¹ Heer, *Flora foss. Arct.*, vol. 1, 1868, p. 83, pl. 43, figs. 1e, f, g, 3c.

² Heer, *Contrib. Flora foss. Port.*, vol. 3, pt. 2, 1874, p. 74, pl. 17, fig. 5b, c; pl. 19; pl. 20, fig. 1c; pl. 21, figs. 9b, 10d.

³ Wealden Flora.

Virginia. ARUNDEL FORMATION: Bay View, Arlington, Maryland. PATAPSCO FORMATION: Federal Hill (Baltimore), Vinegar Hill, Maryland; near Brooke, 72 milepost, Mount Vernon, Hell Hole, Virginia.

Collections.—U. S. National Museum, Johns Hopkins University.

SPHENOLEPIS STERNBERGIANA (Dunker) Schenk.

Muscites sternbergianus DUNKER, Monogr. Norddeutsch Weald.-bild., 1846, p. 20, pl. 7, fig. 10.

Juniperites sternbergianus BRONGNIART, Tableau, 1849, p. 108.

Araucarites dunkeri ETTINGSHAUSEN (part), Abhandl. k. k. geol. Reichs. vol. 1, 1851, p. 27, pl. 2, figs. 2, 3, 7, 8.

Araucarites curvifolius ETTINGSHAUSEN, Abhandl. k. k. geol. Reichs., vol. 1, 1851, p. 28, pl. 2, figs. 11, 13, 14, 17-21.

Widdringtonites dunkeri SCHIMPER, Pal. Végét., vol. 2, 1870, p. 329.

Widdringtonites curvifolius SCHIMPER, Pal. Végét., vol. 2, 1870, p. 329.

Sphenolepis sternbergiana SCHENK, Paleont. vol. 19, 1871, p. 243, pl. 37, figs. 3, 4; pl. 38, figs. 3-13.—SCHIMPER, Pal. Végét., vol. 3, 1874, p. 575, Atlas, pl. 110, fig. 27.—HOSIUS and v. d. MARCK, Paleont., vol. 26, 1885, p. 215, pl. 44, figs. 206-208.

Sphenolepidium sternbergianum HEER, Contrib. Flora foss. Port., 1881, p. 19, pl. 13, figs. 1a, 2-8; pl. 14.—FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 261, pl. 121, figs. 8, 10, 11; pl. 130, fig. 9.—SAPORTA, Flora foss. Port., 1894, pp. 114, 139, 193, pl. 22, figs. 1, 2; pl. 27, fig. 14; pl. 33, fig. 13.—SEWARD, Wealden Fl., pt. 2, 1895, p. 205, pl. 16, figs. 4-6.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 264, pl. 169, fig. 7.—KNOWLTON in Diller, Bull. Geol. Soc. Amer., vol. 19, 1908, p. 386.—WARD, 15th Ann. Rept. U. S. Geol. Surv., 1895, p. 359, pl. 3, fig. 1.

Sphenolepidium sternbergianum densifolium FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 261, pl. 118, fig. 7; pl. 121, figs. 5, 7, 9; pl. 125, fig. 2; pl. 129, fig. 3; pl. 130, fig. 1; pl. 131, figs. 1, 3; pl. 132, fig. 4.—FONTAINE, Proc. U. S. Nat. Mus., vol. 16, 1893, p. 268, pl. 36, fig. 10.—FONTAINE in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 480, 481, 484, 486, 491, 507, 511, 515, 524, 528, 544, 545, 555, 573, pl. 109, figs. 8, 9; pl. 112, figs. 1, 10 (not fig. 11); pl. 115, fig. 1.

Sequoia gracilis HEER, Flora foss. Arct., vol. 3, pt. 2, 1873, p. 80, pl. 18, fig. 1c; pl. 22, figs. 1-10.—FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890 (not 1899), p. 247, pl. 126; figs. 3, 4.—KNOWLTON, Smiths. Misc. Coll., vol. 4, pt. 1, 1907, p. 126.—? HOLLICK, Monogr. U. S. Geol. Surv., vol. 50, 1907, p. 43, pl. 3, fig. 14.

Description.—Branches somewhat more remote than in *Sphenolepis kurriana*, with relatively shorter twigs. Leaves ovate, decurrent, keeled, with a broad base and acuminate apex, often divergent and falcate; in other specimens appressed. In general the leaves are much more crowded and divergent than in the preceding species. Cones not collected in connection with the American material except in the case of some poorly preserved specimens from Mount Vernon figured by Ward¹ which may be immature, although they suggest the preceding species rather than this one. Cones are described by Schenk from the German Wealden and are also figured by Seward from the English Wealden. The cones are small, oblate spheroidal in shape,

¹ Ward, 15th Ann. Rept. U. S. Geol. Surv., 1895, p. 359, pl. 3, fig. 1.

with few stout truncated scales, which become more or less divergent with maturity. Ward¹ reports specimens of the foliage of this species with attached staminate catkins similar to those described by Fontaine as "Male aments" from various Virginia localities, where they were not attached to recognizable twigs.

This species was described by Dunker in 1846 as a species of *Muscites*, Brongniart in 1849 substituting *Juniperites* as a more appropriate generic name, one subsequently changed to *Araucarites* by Ettingshausen. Schimper referred this species to *Widdringtonites*, but since 1871 it has been rather consistently referred to as *Sphenolepsis* or *Sphenolepidium sternbergianum*, although the difficulty of dealing satisfactorily with various detached coniferous twigs of similar habit is no small one, not only from their similar appearance in various unallied species, but also because of their resistance of decay and retention of their leaves when reduced to fragments, so that they are often the most abundant remains in coarse sediments.

Sphenolepis sternbergiana has an equally wide range, both geographic and geologic, as has the preceding species. It is common in the Wealden of England and Germany, and is recorded by Saporta from the Neocomian, Urgonian, and Albian of Portugal, a range similar to that which it shows in the Maryland-Virginia area. It is probably represented in the Kome beds of Greenland by *Sequoia gracilis* Heer, while the latter author's *Glyptostrobus groenlandicus*² and *Sequoia fastigiata* from these beds also suggest this species. It is recorded from the Glen Rose (Trinity) beds of Texas and from the Shasta (Horsetown beds) of the Pacific coast. The form from the Upper Cretaceous of Marthas Vineyard which Hollick has identified as *Sequoia gracilis* Heer is also similar enough to be suggestive. The present species is very abundant in the Potomac Group ranging from the bottom to the top.

The specimens of *Sphenolepis sternbergiana* from the Wealden of Ecclesbourne, in possession of the writer, are much stouter than the American conifer usually identified as this species, and resemble rather closely what in America goes by the name of *Sequoia ambigua* Heer, a resemblance already commented on by Seward³. Since, however, the preservation is poor, too much importance can not be attached to a resemblance which may be purely superficial, although in the opinion of the writer it seems probable that some at least of the Wealden twigs identified as *Sphenolepis sternbergiana* may really be those of *Sequoia ambigua*, which in this country we have no difficulty in distinguishing from *Sphenolepis*.

Occurrence.—PATUXENT FORMATION: Fredericksburg, Telegraph Station (Lorton), Potomac Run, Alum Rock, Cockpit Point, Wood-

¹ 15th Ann. Rept. U. S. Geol. Surv., 1895, p. 359.

² Heer, Flora Foss. Arct., vol. 3, pt. 2, p. 76, pl. 17, fig. 9; pl. 20, figs. 9, 10.

³ Wealden Flora, pt. 2, 1895, p. 206.

bridge, Virginia. ARUNDEL FORMATION: Langdon, District of Columbia; Hanover, Tip Top, Soper Hall, Maryland. PATAPSCO FORMATION: Grays Hill, Fort Foote, Stump Neck, Maryland; Mount Vernon, White House Bluff, Hell Hole, Chinkapin Hollow, 72-mile post, Dumfries Landing, near Widewater, Aquia Creek, Virginia.

Collections.—U. S. National Museum, Johns Hopkins University.

THE GENUS *ARTHROTAXOPSIS* OF FONTAINE.

The genus *Arthrotaxopsis* was named from its resemblance to the modern genus *Arthrotaxis* Don, of the subfamily Taxodiæ, which has three species confined to Tasmania.

Arthrotaxopsis is characterized in the following terms by its describer:¹

Trees or shrubs, copiously branching, with principal stems or branches proportionally strong, cylindrical, rigid, sending off thickly placed, long, slender, cord-like, ultimate twigs, all in the same plane and spreading widely; the ultimate twigs leave the penultimate ones under a very acute angle and show a tendency to a fastigiate grouping; cones mostly broadly oblong, rarely globular, obtuse and rounded at base and apex, average dimensions 10 mm. by 14 mm., attached singly on the summit of short lateral branches and placed on the lower portions of the leafy stems and branches, the twig with its cone representing the branching leafy twigs which occur higher up; scales of the cones woody, thick, wedge-shaped in the basal portions, expanded at the free ends, and probably shield-shaped, numerous, spirally placed, attached at a large angle, the middle ones being nearly or quite at a right angle with the axis, close appressed, opening with age; seed under each scale one, elliptical in shape, smooth and bony in texture, average dimensions 1 mm. by 2.5 mm.; leafy branches ending abruptly in an ultimate-twig similar to those sent off pinnately and alternately lower down; leaves very thin and scale-like, elliptical, rhombic, or oblong, with varying age changing their shape, the rhombic forms representing the oldest and most crowded leaves, slightly keeled on the back, spirally arranged.

The only qualification that it is necessary to make in the foregoing description is that referring to a single, smooth, bony seed under each cone-scale. The present writer has been entirely unable to verify this feature in any of the material. The cones are of small size and comparable to the cones usually referred to *Sequoia*—i. e., with wedge-shaped, peltate scales. The material is all poorly preserved and the leafy twigs have evidently suffered greatly from decay before fossilization.

The genus may be distinguished from *Arthrotaxites* Unger,² *Echinostrobus* Schimper,³ and *Cyparissidium* Heer,⁴ all of which have very similar leafy twigs, by the characters of the cone, which are quite different. The first two are Jurassic, while the last extends from the Rhætic to the Upper Cretaceous. As a rule the twigs of *Arthrotaxopsis* are more elongated and slender than those of these other genera, indicating in all probability a pendulous habit.

¹ Fontaine, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 239.

² Unger, Bot. Zeit., 1849, No. 19.

³ Schimper, Pal. Végét., vol. 2, 1870, p. 330.

⁴ Heer, Flora Foss. Arct., vol. 3, pt. 2, 1874, p. 74.

As originally described *Arthrotaxopsis* contained four species. Two of these prove to be identical with the species described below, while the third was composite and included specimens of both *Sphenolepis kurriana* (Dunker) Schenk and *Sequoia ambigua* Heer.

ARTHROTAXOPSIS GRANDIS Fontaine.

Arthrotaxopsis grandis FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 240 (part), pl. 114, figs. 1-3; pl. 116, figs. 1-4; pl. 135, fig. 10.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 546.

Arthrotaxopsis tenuicaulis FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 241, pl. 114, figs. 4, 5; pl. 115, fig. 4; pl. 116, fig. 6; pl. 117, fig. 2.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 516, 520, 538, 546, 571; 19th Ann. Rept. U. S. Geol. Surv., pt. 2, 1899, p. 674, pl. 164.

Arthrotaxopsis pachyphylla FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 242, pl. 115, figs. 1, 3; pl. 117, figs. 1, 3-5.

Description.—Leafy twigs elongate and slender, especially the distal ones, which are extremely attenuated and unbranched or sometimes dichotomously branched. Main branches alternate, much branched, apparently in a single plane. Distal twigs crowded, somewhat fastigate. Leaves usually thin, closely appressed, elliptical to rhombic in shape, slightly keeled, acute. Phyllotaxy spiral. Cones, small, ovoid, 5 mm. to 10 mm. in diameter and 1 cm. to 1.5 cm. in length, made up of a small number of relatively thick, wedge-shaped, peltate scales, becoming somewhat spreading with age.

This species may be distinguished from *Sphenolepis kurriana* (Dunker) Schenk, with which it was confused by Professor Fontaine by the method of branching and by its longer and more slender twigs as well as by the usually more spreading leaves of *Sphenolepis*. The material which constituted the species *tenuicaulis* and *pachyphylla* of Fontaine is not separable from that of the type. It comes from the same beds and differs merely in the condition of preservation and relative positions of the twigs upon the branch. Under *Arthrotaxopsis grandis* was also included originally certain material from near Brooke, Virginia, which is referable to *Sphenolepis*. Both the foliage and the cones are common in the Patuxent and Arundel formations, and, so far as known, they do not extend above the top of the latter. Very ambiguous material from the Hay Creek beds of the Fuson formation in Wyoming are referred to this species by Fontaine.

Occurrence.—PATUXENT FORMATION. Dutch Gap and Fredericksburg, Virginia; Sixteenth street, District of Columbia; Springfield, Fort Worthington,? Maryland. ARUNDEL FORMATION Tip Top (2 sp. ?), Arlington (1 sp.), Bay View (cones and foliage common), Maryland, Langdon, District of Columbia.

Collections.—U. S. National Museum, Johns Hopkins University.

ARTHROTAXOPSIS EXPANSA Fontaine.

Arthrotaxopsis expansa FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 241, pl. 113, figs. 5, 6; pl. 115, fig. 2; pl. 117, fig. 6 (not pl. 135, figs. 15, 18, 22, which are referred to *Sphenolepis kurriana* (Dunker) Schenk).—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 504, 520, 546, 571 (not pp. 533, 535, 538, 555, 573, pl. 109, figs. 12, 13, which are referred to *Sequoia ambigua* Heer, and p. 547, which is referred to *Widdringtonites ramosus* (Fontaine) Berry.

Taxodium (Glyptostrobus) expansum FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 252, pl. 123, fig. 1.

Glyptostrobus expansus WARD, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 543.

Sphenolepidium sternbergianum densifolium FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 524 (part), pl. 112, fig. 11 (not figs. 1, 10).

Glyptostrobus brookensis FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 483, 486, 520 (not the other citations).

Description.—Branches and twigs elongated and extremely slender, widely spreading and sparingly branched, showing a tendency as preserved to be in a single plane, although it can not be determined to what extent this reflects the original habit of the plant. Leaves spirally arranged, thick, keeled, acute, showing a tendency to become obtuse and less appressed, especially on the older twigs.

As here delimited this species is confined to the older Potomac, although it is very similar to those forms from the Patapsco formation, which are described as *Widdringtonites ramosus* (Fontaine) Berry, the latter being more copiously branched, less spreading, and with more acute leaves which frequently become more or less elongated. These differences may or may not be of specific value. As preserved, the two plants differ decidedly in aspect, but this is due largely to the spreading habit of the present species and is approached in some of the coniferous twigs from Mount Vernon which are referred to *Widdringtonites*.

The relation to *Arthrotaxis* implied by the name is not certain and the present species is retained in the genus to which it was referred by Professor Fontaine more from a desire to avoid changes which do not appear to be justified by the meager evidence at hand than from any conviction of relationship. For the same reason it was not transferred to *Widdringtonites*, although it seemed desirable in the case of *Widdringtonites ramosus* to make such a change and bring the latter in association with the Upper Cretaceous species of that genus, with which there is such a close agreement.

Following Seward's suggestion,¹ the cones which Professor Fontaine referred to this species are considered to belong to *Sphenolepis kurriana* (Dunker) Schenk, as are also some of the leafy twigs which Fontaine identified as *Arthrotaxopsis*, and a number of the recorded

¹ Seward, Wealden Flora, pt. 2, 1895, p. 201.

occurrences of the latter have also been found to belong to *Sequoia ambigua* Heer.

The present is another of the several species which may be compared with the foliage from the Lower Cretaceous of Greenland which Professor Heer referred to *Cyparissidium*.

Occurrence.—PATUXENT FORMATION: Roadside near Potomac Run, Telegraph station (Lorton), Trents Reach, Dutch Gap, Cockpit Point, Virginia; Springfield (?), Maryland. ARUNDEL FORMATION: Langdon, District of Columbia, Bay View, Tip Top (?), Maryland.

Collections.—U. S. National Museum.

THE GENUS CEPHALOTAXOPSIS OF FONTAINE.¹

The utility of a new generic designation for the Potomac forms included in this genus is not altogether obvious with *Cephalotaxites* and *Taxites* already in use, but as it is in the literature and differentiates an abundant type, which is at least specifically distinct from the species usually referred to the two genera just mentioned, it is retained in the present publication. It may be characterized as follows:

Description.—Much branched, limbs stout, apparently in a single plane, although it is impossible to determine to what extent this is due to pressure during fossilization. Leaves flat, linear-lanceolate, coriaceous and persistent, rather variable in size, mucronate tipped; base slightly decurrent and twisted; midrib broad and flat, bordered on either side below by a stomatal groove. The leaves are distichous in habit, but the phyllotaxy was undoubtedly spiral, as it is in so many other gymnosperms with the distichous habit, and is attested by the twisted leaf bases. No fruits have been found upon any of the abundant foliage specimens, although certain associated species of *Carpolithus*² are mentioned by Professor Fontaine as the probable fruits of this genus, which are assumed to have been drupe-like with a bony seed after the manner of the existing species of *Podocarpus* and *Cephalotaxus*. This may well have been the case. The fact that no fruiting specimens occur in the abundant sterile material lends some support to this interpretation, since such fruits would stand far less chance of successful transportation by water and subsequent fossilization than would the woody buoyant cones of the majority of the conifers.

With the genus *Tumion* probably present in the Virginia Potomac and with *Nageiopsis* representing the subfamily Podocarpeæ, the family Taxaceæ is abundantly represented in the Lower Cretaceous, and when the individual abundance is considered rather than the specific differentiation, it must be admitted that this family furnishes an important element in the Potomac flora.

¹ Fontaine, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 235.

² *C. fasciculatus*, *C. mucronatus*, *C. sessilis*, *C. ternatus*.

Heer¹ has described a leafy twig from the Patoot beds of Greenland (Senonian) bearing a large solitary drupe-like fruit which he calls *Cephalotaxites insignis*, an identification which Solms-Laubach² seems to consider probable. Bertrand³ has described structural material of fruits allied to *Cephalotaxus* under the name of *Vesquia tournaissii* from the Aachenian of Belgium, and the present writer has described⁴ similar fruits which are common in the Upper Cretaceous of the southern Atlantic Coastal Plain.

The existing genus *Cephalotaxus* Siebold and Zuccarini, contains four species confined to the Chinese-Japanese region. It was evidently much more widespread in former geologic times, and to it should possibly be referred some of the leafy twigs included in the genus *Taxites* Brongniart. Fruit of three species of *Cephalotaxus*, apparently identified correctly, are described by Kinkelin⁵ from the Pliocene deposits of Germany.

CEPHALOTAXOPSIS MAGNIFOLIA Fontaine.

Cephalotaxopsis magnifolia FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 236, pl. 104, figs. 4, 5; pl. 105, figs. 1, 2, 4; pl. 106, figs. 1, 3; pl. 107, figs. 1, 2, 4; pl. 108, figs. 1, 3, 4.—FONTAINE, in Diller and Stanton, Bull. Geol. Soc. Amer., vol. 5, 1894, p. 450.—FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., Pt. 2, 1899, p. 686, pl. 162, fig. 1b; pl. 169, figs. 3, 4.

Cephalotaxopsis ramosa FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 237, pl. 104, figs. 2, 3; pl. 106, figs. 2, 4; pl. 107, fig. 3; pl. 108, fig. 2.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 258(?), pl. 68, figs. 5-7(?) (not p. 311, pl. 73, fig. 8, which is referred to *Oleandra*, or p. 547, which is referred to *Nageiopsis angustifolia*).

(?) *Cephalotaxopsis* ? *rhytidodes* WARD, Fontaine, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 258, pl. 68, fig. 8.

(?) *Cephalotaxopsis*, *species* FONTAINE, in Diller and Stanton, Bull. Geol. Soc. Amer., vol. 5, 1894, p. 450.

Description.—Branches very stout, more or less branched, in some instances apparently in whorls through the suppression of the terminal bud and the development of lateral shoots. Leaves distichous in habit, but probably with a spiral phyllotaxis, strikingly similar to those of the modern species of *Cephalotaxus*, linear-lanceolate in outline, rather abruptly rounded at the base and tapering gradually upward. Apex with a mucronate point. Length 2 cm. to 6 cm., averaging 4 cm. or 5 cm. and becoming regularly smaller distally and also smaller at the base of the new shoots. Width 3 mm. to 4 mm. Texture coriaceous. The midrib is broad and flat, occupying about one-seventeenth of the diameter of the leaf. The epidermal cells are arranged in rows; they are small in size and thick-walled, quadrangular or slightly hexagonal in outline, ranging from proportions but

¹ Heer, Flora Foss. Arct., vol. 7, 1883, p. 10, pl. 53, fig. 12.

² Solms-Laubach, Fossil Botany, 1891, p. 61.

³ Bertrand Bull. soc. bot. France, vol. 30, 1883, p. 293.

⁴ Berry, Bull. Torrey Club, vol. 37, 1910, p. 187.

⁵ Engelhardt and Kinkelin, Abh. Senckenb. Naturf. Gesell. vol. 39, Heft 3, 1908, p. 194, pl. 23, figs. 9, 13.

slightly longer than wide to those in which the length is about three times the width. On the lower surface of the leaf on either side of the midrib, commencing one-fifth of the distance to the margin and occupying a width of one-fourth the distance to the margin, are the stomatal grooves. They are deeply sunken and appear to have been floored with thin-walled cells not well preserved. There is some evidence of the occurrence of a woolly scurf in these grooves, but the preservation is such that this can not be positively asserted. The stomata were comparatively large and irregularly scattered in the floor of the groove. They are without definite arrangement or orientation. The guard cells are two in number, long, much curved, and slender.

This species is exceedingly common in the Patuxent formation of Virginia, to which it appears to be confined in the Atlantic coastal plain province. Although it has not yet been reported from the Kootanie formation of the Montana area, it is present in both the Lakota and Fuson formations of the Black Hills Rim and in the Shasta beds of California. At no localities, however, is it as abundant as in the lowest Potomac of Virginia. It is strikingly like the modern *Cephalotaxus* in appearance and may also be compared with various fossil species of *Taxites*.

Occurrence.—PATUXENT FORMATION: Fredericksburg, near Dutch Gap, and near Potomac Run, Virginia.

Collections.—U. S. National Museum.

CEPHALOTAXOPSIS BREVIFOLIA Fontaine.

Cephalotaxopsis brevifolia FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, p. 238, pl. 105, fig. 3; pl. 106, fig. 5; pl. 107, fig. 5.

Cephalotaxopsis microphylla FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 238, pl. 108, fig. 5; pl. 109, fig. 9.

Description.—Ultimate branches alternate and rather slender. Leaves distichous in habit, narrowly lanceolate, 7 mm. to 21 mm. in length, averaging 10 mm. to 12 mm. Width 1 mm. to 3 mm., averaging about 2 mm. Apex and base almost equally acute, the base slightly less so. Texture coriaceous. Fontaine says of this species: "Midnerve slender." It is, on the contrary, extremely broad, but flat and not prominent. In the specimen which is Fontaine's, plate 106, figure 5, the midrib occupies one-fifth of the maximum width of the leaf. This specimen exposes the upper surfaces of the leaves, in consequence of which the midrib and stomatal bands are obscured.

This species, which may simply represent certain terminal or abortive shoots of the preceding, is not at all common and is confined to the Patuxent formation of Virginia. It may be profitably compared with some of the Mesozoic species of *Taxites*.

Occurrence.—PATUXENT FORMATION: Fredericksburg, near Dutch Gap, and near Potomac Run, Virginia.

Collections.—U. S. National Museum.

THE GENUS WIDDRINGTONITES.

The genus *Widdringtonites* was established by Endlicher in 1847¹ with *Thuites gramineus* Sternberg² from the Tertiary of Perutz, Bohemia as the type. This he named *Widdringtonites ungeri*, including in its synonymy *Juniperites baccifera* Unger, *Thuia graminca* Brongniart, and *Muscites stolzii* Sternberg. Three additional species were listed, one from the Cretaceous, one from the Wealden, and one from the Lias. His characterization of the genus was as follows: "Folia spiraliter inserta, pleraque squamaformia adpressa. Strobilus globosus, valvatus."

There are perhaps a score of species ranging in age from the Triassic to the Miocene referred to this genus at the present time. It has been commonly used for foliar specimens which resembled the living forms, but which lacked the certainty furnished by associated cones. These are known, however, in a large number of species, many of which, especially those of Tertiary age, being now referred to the still existing genus *Widdringtonia*.

Although fruiting specimens of *Widdringtonites ramosus* are unknown, its immediate successor *Widdringtonites rieckii* (Ettingshausen) Heer of the Raritan and Magothy formations has, in the European material, furnished abundant four-valved cones which induce Velenovsky and Krasser to advocate its reference to *Widdringtonia*. *Widdringtonites subtilis* Heer, which is common in the later Cretaceous of the Atlantic Coastal Plain, has also furnished somewhat poorly preserved cones of this generic type in material collected by the writer in South Carolina and well preserved attached cones in material from the Tuscaloosa formation in Alabama.

There can be but little doubt of the actual genetic relationship between a number of these Mesozoic conifers and the existing species of *Callitris*, *Widdringtonia*, and *Frenela*, which Eichler lumps into the single genus *Callitris* Vent. At the present time they constitute a restricted group confined to the Australian region on the one hand (*Frenela*) and to northern Africa (*Eucallitris*) and southern Africa and Madagascar (*Widdringtonia*) on the other. In former geological periods they were much more abundant. *Frenelopsis* is recorded in America from Greenland to Texas and *Widdringtonites* from Greenland to South Carolina. Abroad both types occur abundantly in central and western Europe. Like so many other types of plants which were widespread in Mesozoic times they became during the Tertiary more and more restricted in their range until today they are not found at all in the Western Hemisphere.

¹ Endlicher, Synop. Conif., 1847, p. 271.

² Sternberg, Flora Vorwelt, Tentamen, 1825, p. 38, pl. 35, fig. 4.

Referring only to Cretaceous species of *Widdringtonites* we find four in the Neocomian, one in the Urgonian, one in the Albian, three in the Cenomanian, and one in the Senonian.

WIDDRINGTONITES RAMOSUS (Fontaine).

- Taxodium (Glyptostrobus) ramosum* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 251, pl. 123, figs. 2, 3; pl. 124, fig. 2; pl. 127, fig. 1; pl. 166, fig. 1.
- Glyptostrobus ramosum* WARD, Fontaine, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 281 (?), 489, 544.
- Taxodium (Glyptostrobus) brookense* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 254, pl. 122, fig. 1; pl. 124, figs. 3-9; pl. 131, fig. 5; pl. 165, figs. 1-3; pl. 166, figs. 4, 7; pl. 167, fig. 3.
- Glyptostrobus brookensis* WARD, 15th Ann. Rept. U. S. Geol. Surv., 1895, p. 359.—FONTAINE in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 481, 483, 486, 489, 495, pl. 110, fig. 1 (not pp. 483, 486, 520, which are referred to *Arthrotaxopsis expansa* Fontaine).
- Taxodium (Glyptostrobus) brookense angustifolium* FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 256, pl. 167, fig. 1.
- Glyptostrobus brookensis angustifolium* KNOWLTON, Bull. U. S. Geol. Surv., vol. 152, 1898, p. 112.—FONTAINE in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 489, pl. 108, fig. 4.
- Arthrotaxopsis expansa* FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 547 (not balance of the original citation).

Description.—Fontaine's original description in 1890 was as follows:

The principal stems seen are moderately stout and very rigid, the secondary ones mostly slender and rigid, the ultimate ones usually very long, slender, and unbranched, wide-spreading, often very delicate and thread-like, going off at an angle of about 45°, but from distortion due to pressure frequently appearing fastigate and irregularly grouped; leaves on the oldest stems elongate-linear, acute, close appressed, on the younger stems all very narrowly oblong, or narrowly elliptical, acute to obtuse, very closely appressed, not distinctly visible without help of a lens in many cases, all spirally arranged; the facial leaves usually acute, the lateral ones usually more obtuse and sometimes slightly divergent at the tips and incurved; midnerves slender and thread-like.

Since nowhere in the Potomac group are cones or scales found which indicate the presence of *Glyptostrobus*, it seems desirable to refer these species and variety of Professor Fontaine's to the genus *Widdringtonites* because of their extremely close resemblance to *Widdringtonites reichii* (Ettingshausen) Heer which is so widespread and characteristic a form in the Cenomanian of both the Old and New World. In fact it may be eventually desirable to reduce this Patapsco species to the synonymy of the latter, to which it is at least very closely allied. The variety *angustifolium* Fontaine is not distinguishable from the type and is based on specimens slightly more slender than the average, but readily matched in the material which that author refers to the type-species. *Glyptostrobus ramosum* (Fontaine) Ward is clearly identical with the other forms which are included by Fontaine in this species and comes from the same outcrops with the exception of certain material from the Kootanie at

Great Falls, Montana, which Professor Fontaine has identified as *Glyptostrobus ramosum*, but which is in all probability *Glyptostrobus groenlandicus* Heer and not identical with the Potomac species, although detached twigs of the two may and do show considerable similarity.

The material from the Fuson formation of eastern Wyoming which Fontaine referred to his *Glyptostrobus brookensis*, a synonym of *Widdringtonites ramosus*, is clearly identical with *Sphenolepis kurriana* (Dunker) Schenk, which occurs in the same beds with it, and quite different from the species under discussion.

Widdringtonites ramosus is a characteristic species of the Patapsee formation both in Maryland and Virginia and occurs in considerable abundance at numerous localities. It is undoubtedly the ancestor of *Widdringtonites reichii* (Ettingshausen) Heer of the Raritan and Magothy formations.

Occurrence.—PATAPSCO FORMATION: Vinegar Hill, Fort Foote Overlook Inn Road, Stump Neck, near Wellhams, Maryland; Mount Vernon, Hell Hole, White House Bluff, near Brooke, 72 milepost, Virginia.

Collections.—U. S. National Museum.

THE GENUS BRACHYPHYLLUM.

The genus *Brachyphyllum* was proposed by Brongniart in 1828¹ for conifers with short, fleshy, spirally arranged leaves attached by their broad rhomboidal bases. The type-species, *Brachyphyllum mamillare* from the Lower Oolite, was described, but not figured, and was placed under the heading *confère doutense*. In 1849 the same author² compared this genus with the existing genera *Arthrotaxis*, *Widdringtonia*, and *Glyptostrobus*. Schimper³ in 1872 somewhat restricted the genus and also extended Brongniart's diagnosis. Saporta⁴ also gives a rather well-illustrated account of *Brachyphyllum* figuring Brongniart's type and pointing out its doubtful botanical affinity. Seward⁵ regards *Brachyphyllum* as a purely provisional genus, the actual botanical position of which is very uncertain, and further states that it is quite probable that more than one family of conifers are included under this name. Comparisons have been made at various times with the modern subfamilies Araucariæ, Taxodiæ, and Cupressæ, especially with the Tasmanian genus *Arthrotaxus* of Don and the Araucarian species *Araucaria imbricata*.

Brachyphyllum may be defined as a genus of arborescent conifers the twigs of which are thick and club-shaped, irregularly distichous

¹ Brongniart, *Prodrome*, 1828, p. 109.

² Brongniart, *Tableau*, 1849, p. 69.

³ Schimper, *Traité*, vol. 2, 1872, p. 334.

⁴ Saporta, *Pal. franc.*, 1883, vol. 3, p. 310.

⁵ Seward, *Cat. Wealden Flora*, pt. 2, 1895, p. 214.

in their mode of branching. The leaves are squamate, very short, thick, appressed, and densely crowded. Phyllotaxis spiral. In life the leaves must have been more or less fleshy, mutual pressure causing them to assume a pentagonal or hexagonal outline, with a dorsal, slightly projecting carina or boss becoming more or less obliterated with age. Leaf surface more or less striated, the striæ converging to the obtuse apical point (at least this is true of our American Cretaceous species). The leaf-scars on old branches are said to be rhomboidal and continuous, remotely suggestive of *Lepidodendron*.

A variety of cones have been referred to this genus usually upon the unreliable evidence of association in the same stratum. Even when cones are found in actual connection with the leafy twigs their preservation is such that positive evidence of botanical relationship is not available. Newberry describes¹ a large cylindrical cone with a length of 20 centimeters and a diameter of 4 centimeters and having spatulate scales, which he is quite positive is the cone of the *Brachyphyllum* so common in the upper part of the Raritan clays of New Jersey. As against these cones described by Newberry most cones referred to *Brachyphyllum* have been small and somewhat spheroidal in shape. Thus Zeiller described branches of *Brachyphyllum* from the Lias of Madagascar which bore small ovoid cones with rhomboidal scales very suggestive of *Scquoia* and he seems to think it probable that some of the forms of *Brachyphyllum* are referable to the Taxodiæ while others have an affinity with the Araucariæ. Saporta² figures elliptical Walchia-like cones which he found associated with *Brachyphyllum jauberti*, *gracile*, and *moreauanum* in the French Jurassic while Heer describes³ and figures spherical cones with polygonal scales attached to twigs of his *Brachyphyllum insigne* from the Lower Oolite of Siberia, and other records of a very similar nature might be mentioned. Fontaine has recorded three obscure varieties of small cones from the Patuxent beds along the James River in Virginia which he refers to *Brachyphyllum*.⁴ They are very indefinite and poorly preserved but may be correctly identified. Finally Hollick and Jeffrey have rendered it extremely probable⁵ that the widespread coniferous scales of the mid-Cretaceous referred to *Dammara* are related to *Brachyphyllum* and these authors have proved, at least in the species formerly known as *Dammara microlepis* Heer from Staten Island, a relation to twigs of the *Brachyphyllum* type, which relationship would seem to effectually disprove the identity of the cones described by Newberry.

¹ Newberry, *Flora Amboy Clays*, 1896, p. 51, pl. 7, figs. 3, 4, 6.

² Saporta, *Plantes Jurassiques*, vol. 3, 1884, pp. 341, 349, 365, pl. 165, figs. 1, 2; pl. 167, fig. 2; pl. 171; figs. 5-9.

³ Heer, *Flora Foss. Arct.*, vol. 4, pt. 2, 1876, p. 75, pl. 13, fig. 9.

⁴ Fontaine, *Monogr. U. S. Geol. Surv.*, vol. 15, 1890, pp. 223, 224, pl. 135, figs. 8, 9; pl. 168, fig. 2.

⁵ Hollick and Jeffrey, *Amer. Nat.*, vol. 40, 1906, p. 200.

Leafy branches and twigs very similar in appearance to those of *Brachyphyllum* in which, however, the leaves are less thick and more free and pointed are often referred to the genus *Echinostrobus* which was founded by Schimper in 1872 for four or five Jurassic species of conifers, and it is to this Jurassic genus that Velenovsky refers two species from the Cenomanian of Bohemia,¹ although these latter are both practically identical with *Brachyphyllum macrocarpum* Newberry from the nearly homotaxial American horizons.

The geological range of *Brachyphyllum* like its geographical range is very great. The earliest recorded occurrence is that of a very doubtful species described by Feistmantel² from the Permo-Carboniferous of New South Wales (Newcastle beds). The genus reappears in the upper Triassic becoming prominent during the Jurassic and Lower Cretaceous and dies out during the first half of the Upper Cretaceous.

Recently discovered structural material has enabled Hollick and Jeffrey³ to settle in a measure the botanical affinity of at least one species, *Brachyphyllum macrocarpum*. The leaves are shown to be attached by practically the whole ventral surface, only the margins being free and these sometimes overlap. They refer this species to the subfamily Araucariæ on the evidence of the branched leaf trace, the mucilaginous contents of the resin canals, the Araucarioxylon type of flattened and alternating bordered pits, the lateral pits of the ray cells and the absence in the phloem of regularly alternating rows of hard bast fibers.

Brachyphyllum is not a prominent type in the Potomac flora although it is by no means as rare as it was thought to be some years ago. *Brachyphyllum parceramosum*, the Patuxent species, has been met with rather infrequently, but *Brachyphyllum crassicaule* is not uncommon at a relatively large number of Patuxent outcrops.

BRACHYPHYLLUM CRASSICAULE Fontaine.

Brachyphyllum crassicaule FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 221, pl. 100, fig. 4; pl. 109, figs. 1-7; pl. 110, figs. 1-3; pl. 111, figs. 6, 7; pl. 112, figs. 6-8; pl. 168, fig. 9.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 529, 557, pl. 113, fig. 6.

Description.—In 1890 Fontaine described this species as follows:

Trees with large branches, irregularly pinnate; on the penultimate twigs the ultimate branches lower and next to the main branch subdivide pinnately into branches; those higher are unbranched and simple; ultimate branches vary in numbers and closeness, sometimes few and remote, and again crowded, contiguous, almost touching toward the summit of the penultimate branches the ultimate ones become much crowded and grow gradually shorter, are cylindrical, and taper grad-

¹ Velenovsky, Gym. böhm. Kreidef., 1885, p. 16, pl. 6, figs. 3, 6-8; Květena českého cenomanu, 1889, p. 9, pl. 1, figs. 11-19; pl. 2, figs. 1, 2.

² Feistmantel, Palaeont., Suppl. 3, 1878, p. 97, pl. 7, figs. 3-6; pl. 17.

³ Hollick and Jeffrey, Amer. Nat., vol. 40, 1906, p. 200.

ually to an obtuse point; leaf-scars of young leaves elliptical in shape, slightly prolonged in the direction of the axes of the stems, and such leaves seem to have been fleshy, slightly convex, and with a free tip slightly keeled in the upper half; with age the leaves become broader and more convex, being broadly elliptical, almost circular, and they leave similar scars after their fall; when crowded and dilated with age the leaves and leaf-scars are subrhombic or rhombic in shape; the surface of the leaves, which is very rarely preserved, shows fine tubercles or dots, arranged in curving lines parallel to their margins and converging toward their tips; cones small, globular, or subelliptical in shape, attached laterally to the penultimate twigs, taking the place of ultimate branches; scales numerous, spirally arranged, touching, shape not made out, but probably with age rhombic and polygonal.

This species is fairly common in Virginia in beds of both Patuxent and Patapsco age, while in Maryland it occurs exclusively, as far as known, in deposits referred to the Patapsco formation.

Brachyphyllum crassicaule is very similar to the European *Brachyphyllum obesum* Heer¹ with which Seward² unites it tentatively. This latter species is found in the English Wealden and in the Urganian and Aptian of Portugal. While these European and American forms are very similar, it should be remembered that this similarity runs through all the members of this genus, and these two species are so widely removed geographically it has seemed best to maintain their distinctness. *Brachyphyllum obesiforme* Saporta³ from beds of Albian age in Portugal is also very similar to the forms under discussion. Finally the Patapsco species is very similar to the single Upper Cretaceous species of America, *Brachyphyllum macrocarpum* Newberry, and is undoubtedly its ancestral form.

Occurrence.—PATUXENT FORMATION: Trents Reach and Dutch Gap, Virginia; PATAPSCO FORMATION: Near Brooke, near Widewater, Dumfries Landing, Virginia; Fort Foote, Federal Hill (Baltimore), near Glymont, Stump Neck, Maryland.

Collections.—U. S. National Museum, Johns Hopkins University, Maryland Academy of Sciences, Goucher College of Baltimore.

BRACHYPHYLLUM PARCERAMOSUM Fontaine.

Brachyphyllum parceramosum FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 223, pl. 110, fig. 4.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 517, 538.

Brachyphyllum texense FONTAINE, Proc. U. S. Nat. Mus., vol. 16, 1893, p. 269, pl. 38, figs. 3-5; pl. 39, figs. 1, 1a.

Description.—Fontaine's original description was as follows:

Twigs branching sparingly and dichotomously; leaves and leaf-scars elliptical to subrhombic, with the longer dimensions in the direction of the length of the twigs; leaves convex, spirally arranged, showing a keel in their upper portions, closely appressed, contiguous, prolonged very slightly at the tips, branches cylindrical, of the same thickness throughout; so far as can be seen about 4 mm. in diameter.

¹ Heer, Contr. Flora Foss. Port., 1881, p. 20, pl. 17, figs. 1-4.

² Seward, Wealden Flora, pt. 2, 1895, p. 218, pl. 17, fig. 9; pl. 20, figs. 1.

³ Saporta, Flora foss. Port., 1894, p. 176, pl. 31, figs. 12, 13; pl. 33, fig. 4; pl. 34, fig. 8.

This form, which is of rare occurrence, is possibly not specifically distinct from *Brachyphyllum crassicaule* Fontaine, which in turn is very closely allied to various European forms. It may be distinguished, however, from the preceding species by its slender branches, which rarely fork, and then in an apparently dichotomous manner (this is only apparent, however, and not real dichotomy), and by its more regular, pointed, slightly keeled leaves. The specimens from Glen Rose, Texas, described as new by Professor Fontaine, are not distinguishable from the Maryland and Virginia specimens of *Brachyphyllum parceramosum*.

Brachyphyllum parceramosum is retained as a distinct species because of the inconclusive nature of the material and because it occurs in beds of somewhat greater age than *Brachyphyllum crassicaule* and because in habit it more nearly resembles the less branched Jurassic types rather than the more regularly and pinnately branched Cretaceous types, the latter type culminating in *Brachyphyllum macrocarpum* of the Upper Cretaceous. The great similarity among all of the species in this genus when studied as poorly preserved impressions tends to enforce caution on the student who would unite under one name forms which appear to be similar, but which are widely removed either geologically or geographically. The European representative of *Brachyphyllum parceramosum* is *Brachyphyllum obesiforme elongatum* Saporta, which occurs in the Albian of Portugal.

Occurrence.—PATUXENT FORMATION: Telegraph Station (Lorton), Virginia; New Reservoir, District of Columbia. ARUNDEL FORMATION: Arlington, Maryland.

Collections.—U. S. National Museum.

THE GENUS SEQUOIA.

The genus *Sequoia* was proposed by Endlicher in 1847,¹ being based upon the still existing species of the Pacific coast of North America. What appears to be the earliest authentic record of a fossil *Sequoia* is furnished by the cones collected in the Portlandian of France.²

Ranging through the succeeding Lower Cretaceous deposits about a dozen species are known. The localities include Maryland, Virginia, California, Montana, Wyoming, and Texas, and outside the United States British Columbia, Greenland, Mexico, Spitzbergen, Portugal, Belgium, Germany, Switzerland, England, and Russia. Wood of the *Sequoia* type of structure is also known from the Lower Cretaceous of this country and Europe. In the Upper Cretaceous species of *Sequoia* become still more abundant and they apparently extend their range and specific differentiation throughout the greater portion of the succeeding Tertiary period, some of the forms, repre-

¹ Endlicher, *Synop. Conif.*, 1847, p. 197.

² Fliche and Zeiller, *Bull. soc. géol. France* (4), vol. 4, 1904, p. 798, pl. 19, figs. 4, 5.

sented by foliage, cones, and wood, being almost identical with the modern redwood *Sequoia sempervirens* (Lambert) Endlicher, while others appear to be ancestral to the modern big tree of California *Sequoia washingtoniana* (Winslow) Sudworth. The climatic changes of the Pleistocene seem to have inaugurated the extinction of this type which had previously become restricted in America by the extensive development of the plains type of country, which was too arid for their continued existence. Both the *sempervirens* and the *washingtoniana* type are present in the Pliocene of Europe at a large number of localities, as well as three or four additional species represented by twigs, cones, seeds, and wood.

In the present flora the redwood is common in the Coast Range from Oregon southward to Monterey County, California, while the "big tree" is confined to the west slopes of the Sierras from southern Placer County to Tulare County, California.

SEQUOIA REICHENBACHI (Geinitz) Heer.¹

Araucarites reichenbachi GEINITZ, Charak. Schichten u. Petref. sach-bohm Kreide, pt. 3, 1842, p. 98, pl. 24, fig. 4.

Araucaria reichenbachi DEBEY, Ent. Geogn. Darst. Gegend von Aachen (Nachtrage, 1849.

Sequoia reichenbachi HEER, Flora Foss. Arct., vol. 1, 1868, p. 83, pl. 43, figs. 1d, 2b, 5a.—FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 243, pl. 118, figs. 1, 4; pl. 119, figs. 1-5; pl. 120, figs. 7, 8; pl. 122, fig. 2; pl. 167, fig. 5.—NATHORST, in Felix and Lenk, Beitr. Geol. u. Pal. Mexico, 1893, p. 52, figs. 4, 5.—FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., Pt. 2, 1899, p. 674, pl. 165, figs. 1, 2; pl. 166, fig. 1.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 177, 263, 281, 544, pl. 55, figs. 7, 8; pl. 69, figs. 4, 5.

Sequoia reichenbachi longifolia FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 244, pl. 117, fig. 8.

Sequoia densifolia FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 246, pl. 121, fig. 4.

Sequoia (?), species FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 248, pl. 116, fig. 7; pl. 132, figs. 2, 5, 6.

Sequoia, species FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 248, pl. 132, fig. 10.

Sequoia (?) *inferna* WARD, Fontaine, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 507.

Sequoia couttsix (not Heer) HOLLICK, Trans. N. Y. Acad. Sci., vol. 12, 1892, p. 30, pl. 1, fig. 5.

Description.—This is one of the most wide-ranging fossil plants, both geologically and geographically, that is known, and it seems very probable that it is of a composite character, the well-known difficulty of distinguishing between coniferous twigs of this character prohibiting any satisfactory segregation. Described originally as a species of *Araucarites*, certain of these remains from the Staten Island Cretaceous have shown by their vascular structure that they are allied to the *Araucariæ*, while, on the other hand, a large number of

¹ Only such citations as have some bearing on the Potomac occurrence of this species are mentioned in the synonymy.

exactly similar remains of leaf-bearing twigs bore cones which are unquestionably those of a *Sequoia*. Twigs of this sort are abundant throughout the Potomac group, occurring also in the Fuson formation of the Black Hills, the Kootanie of Montana, the Shasta of California, the Kome beds of Greenland, and the Neocomian of central Mexico. Abroad they have been reported from the Upper Jurassic (?) of Portugal, the Neocomian of Belgium, the Urganian of Silesia, and the Gault of Switzerland. Similar remains have also been described from a large number of horizons in the Upper Cretaceous, both in this country and abroad.

The slight variations from specimen to specimen and the varying conditions of preservation in the twigs of this species throughout the Potomac deposits, together with the detached and more or less macerated cones, furnished the basis for six species and varieties of Fontaine and Ward, but these are obviously not specifically distinct from one another.

Occurrence.—PATUXENT FORMATION: Fredericksburg, Lorton (Telegraph Station), and Dutch Gap, Virginia; Springfield, Maryland. ARUNDEL FORMATION: Reynolds Ore Pit, Maryland. PATAPSCO FORMATION: Near Brooke, Virginia.

Collections.—U. S. National Museum.

SEQUOIA RIGIDA Heer.

Sequoia rigida HEER, Flora Foss. Arct., vol. 3, pt. 2, 1873, pp. 80, 91, 102, 128, pl. 22, figs. 5g, 11a; pl. 25, fig. 6; pl. 27, figs. 8-14; pl. 38, figs. 9a, 10.—SCHENK, Palaeontographica, vol. 23, 1875, p. 168, pl. 29, figs. 8, 9.—HEER, Flora Foss. Arct., vol. 6, pt. 2, 1882, p. 52, pl. 7, figs. 10-12; pl. 8, fig. 7; pl. 11, fig. 1c; pl. 24, fig. 3b; vol. 7, 1883, p. 13, pl. 53, figs. 5-7.—FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 246, pl. 118, fig. 3; pl. 121, fig. 2; pl. 126, fig. 3; pl. 130, fig. 3.—KNOWLTON, in Stanton and Martin, Bull. Geol. Soc. Amer., vol. 16, 1905, p. 408.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 219.

Sequoia subulata FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, 245, pl. 117, fig. 7; pl. 118, figs. 5, 6 (not Heer).—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 486, 571 (not Heer).

Description.—This species was described by Heer from the Kome beds of Greenland, although he subsequently pointed out that it was more abundant in the Atane beds. He compares it with *Sequoia woodwardii* (Carruthers) Schimper of the upper Greensand of England and with *Sequoia pectinata* Heer of the Senonian of Germany. It is also recorded from the Gosau beds of Europe and from the Upper Cretaceous of Alaska as well as from the Potomac of Virginia, the Kootanie of Montana, and the Shasta of California. The specific identity of these Upper and Lower Cretaceous forms may well be doubted, but no clear line of demarcation can be drawn between them at the present time. It is quite possible that the Potomac forms are merely variants of the abundant *Sequoia reichenbachii*, since they fail to show the transverse rugosity (a feature of the preservation merely)

described by Heer. They also appear to be somewhat less decurrent and less finely pointed than the type material. A variety described by Saporta from the Albian of Portugal as var. *lusitanica*¹ is scarcely to be distinguished from the Potomac specimens.

Occurrence.—PATUXENT FORMATION: Near Potomac Run, near Telegraph Station (Lorton), Virginia; Springfield, Maryland.

Collections.—U. S. National Museum.

SEQUOIA DELICATULA Fontaine.

Sequoia delicatula FONTAINE, Monogr. U. S. Geol. Survey, vol. 15, 1890, p. 247, pl. 121, fig. 3.

Description.—In 1890 Fontaine furnished the following description of this species:

Principal twigs slender, penultimate and ultimate ones all in one plane, minute, short, closely placed, alternate and pinnate in arrangement; leaves very small, narrowly linear, acute or acuminate, widest at base, decurrent, and mostly crowded; midnerve slender but distinct.

Professor Fontaine says of this species:

This plant is a good deal like *Sequoia subulata*, but the leaves are proportionally wider and not so falcate, while the ultimate branches are placed at more uniform intervals.

It may be doubted whether it is really distinct from the abundant *Sequoia reichenbachii*, since it was extremely rare at the single Virginia locality from which it was originally collected and it has not been met with in any of the subsequent collections. It is not especially well marked and is of little significance, although it has seemed best to keep it distinct at the present time.

Occurrence.—PATUXENT FORMATION: Near Dutch Gap, Virginia.

Collections.—U. S. National Museum.

SEQUOIA AMBIGUA Heer.

Sequoia ambigua HEER, Flora Foss. Arct., vol. 3, pt. 2, 1874, pp. 78, 91, pl. 21, figs. 1-11; pl. 25, fig. 5; vol. 6, pt. 2, 1882, pp. 17, 52, pl. 1, fig. 3.—FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 245, pl. 118, fig. 2; pl. 120, figs. 1-6; pl. 127, fig. 5; pl. 132, fig. 3.—NATHORST, in Felix and Lenk, Beitr. Geol. and Pal. Mexico, 1893, p. 51, figs. 1-3.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 272, 281, 538, 555, pl. 69, fig. 6; pl. 110, fig. 13.

Sphenolepidium recurvifolium FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 258, pl. 127, fig. 2; pl. 130, figs. 2, 7.

Sphenolepidium dentifolium FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 258, pl. 128, figs. 2-6; pl. 129, fig. 5; pl. 130, figs. 4-6, 10.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 484, 528, 538, 546, 555.

Sequoia gracilis FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., pt. 2, 1899, p. 675, pl. 166, fig. 2 (not Heer).

Arthrotaxopsis expansa FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 533, 535, 538, 555, 573, pl. 109, figs. 12, 13 (not pp. 504, 520, 546, 547, 571),

¹ Saporta, Flora foss. Portugal, 1894, p. 177, pl. 33, figs. 7-12.

Description.—Remains of the foliage of this species are distinguishable from those of contemporaneous conifers which occur in the beds with them by the relatively short and very stout, acuminate, falcate, or recurved, decurrent leaves.

The cones are spherical and consist of relatively few short scales with longitudinally striated peduncles and suddenly expanded, quadrangular, peltate, umbilicate tips. These cones are abundant in the lower Cretaceous of Maryland, occurring usually as detached ferruginized mud casts. They vary considerably in size, and this has resulted in their having been referred to two species and genera, the smaller having been identified by Professor Fontaine as *Arthrotaxopsis expansa*, while the larger were referred to *Sequoia ambigua*. As Professor Ward pointed out in his monograph,¹ they show no differences except in size, and even this feature has rather narrow limits of variation with every gradation present. The writer has carefully compared a large suite of specimens and many wax casts of the scales and finds them absolutely identical in every respect, the relative proportions of the scales from the smallest and the largest cones giving the same ratios of length, width, and height.

As recorded in the literature cited above, *Sequoia ambigua* is widely distributed geographically and it has an equally great geological range. Described originally from the Kome beds (Urgonian) of Greenland by Professor Heer, this author soon afterwards recorded it from the Upper Cretaceous Atane beds of that country. It has been recorded by Nathorst from the Neocomian of Mexico and it is present in the Kootanie formation of Montana. It is a member of the Shasta flora of the Pacific coast (Horsetown beds) and is probably represented in the Fuson formation of eastern Wyoming by what Professor Fontaine calls *Sequoia gracilis*. In the Upper Cretaceous, remains in every way identical with these Lower Cretaceous occurrences are present in the Magothy formation at Gay Head and at a number of localities in Maryland as well as in the Tuscaloosa formation of Alabama.

In the Potomac group this species ranges from the base of the Patuxent, through the Arundel to the top of the Patapsco often in considerable abundance. Seward² comments on the resemblance between *Sequoia ambigua* Heer and the widespread remains of *Sphenolepis sternbergiana* (Dunker) Schenk, a resemblance strikingly shown in some Wealden specimens of the latter from Ecclesbourne recently received by the writer. However, their preservation is not of the best, and the English specimens seem to show slight differences from the type of this species in the direction of what in America is identified as *Sequoia ambigua*. No changes in nomenclature are proposed, however, since it seems probable that *Sphenolepis sternberg-*

¹ Monogr. U. S. Geol. Surv., vol. 48, 1906.

² Wealden Flora, pt. 2, 1895, p. 206.

iana in North America is properly identified and distinct from *Sequoia ambigua*, which is more open and stouter and which may be present in the English Wealden in some at least of the coniferous twigs identified as *Sphenolepis sternbergiana*.

Occurrence.—PATUXENT FORMATION: Fredericksburg, Dutch Gap, Cockpit Point, Potomac Run, Telegraph Station, Virginia; ARUNDEL FORMATION: Soper Hall, Riverdale, Arlington, Muirkirk, Schoolhouse Hill (Hanover), Maryland; PATAPSCO FORMATION: Federal Hill (Baltimore), Locust (Poplar) Point, Fort Foote, Maryland.

Collections.—U. S. National Museum, Johns Hopkins University.

THE GENUS ABIETITES.

Since its establishment by Hisinger¹ in 1837 this genus has been a convenient and perhaps useful repository for fossils whose real or fancied affinities were thought to suggest the modern genus *Abies*. They have ranged in age from the Keuper to the Pliocene, the bulk coming from the Cretaceous, and consisting of obscure impressions of foliage and cones, none of which have any real biological value or present any definite clue to their true relationship. Professor Fontaine has included in this genus fossils from the Triassic of North Carolina and various indefinite remains from the Trinity group of Texas, the Shasta group of California, the Lakota formation of the Black Hills, and the Potomac group of Maryland and Virginia. The latter he segregates into four species, all of which are based upon obscure cone impressions and none of which possess much specific value. When it is remembered what diverse appearances may be assumed by a single species of cone irrespective of individual variation and due merely to different stages of maceration before preservation, to differences in the matrix, and to differences in the direction and force of compression, it seems very probable that we are dealing with a single species of cone, or at least not more than two, instead of the four which are in the literature relating to the Potomac.

Similar forms from the English Wealden are described by Caruthers, Gardner, and Seward, and referred to the comprehensive genus *Pinites* of Endlicher (1847). They are in all probability congeneric if not specifically identical with *Abietites macrocarpus* Fontaine, whose generic and specific name is here retained in order to avoid unnecessary changes and because Endlicher's *Pinites* is antedated by *Pinites* Witham (1833), something altogether different. In the French Neocomian also, cones of this character are abundant, Cornuel² describing five species and referring them to *Pinus*. His *Pinus submarginata* is especially suggestive of *Abietites macrocarpus*

¹ Hisinger, *Lethæa suecica*, 1837, p. 110.

² Cornuel, *Bull. soc. géol. France* (n), vol. 23, 1866, pp. 658-673, pl. 12.

Fontaine, as are also some of the species described by Coemans¹ from the Lower Cretaceous of Belgium and by Carruthers² from the Gault of England. Finally the foliage from the Potomac beds which has been referred to *Leptostrobus* and *Laricopsis* is neither *Leptostrobus* nor related to the modern *Larix*, and since such foliage in the English Wealden is in organic union with cones of the *Abietites macrocarpus* type,³ it seems eminently proper in the treatment of the American material to associate this type of foliage with the corresponding type of cone.

ABIETITES MACROCARPUS Fontaine.

Abietites macrocarpus FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 262, pl. 132, fig. 7.—FONTAINE, in Ward., Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 261, 547, pl. 68, figs. 15, 16; pl. 115, figs. 2, 3.

Abietites ellipticus FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 263, pl. 132, figs. 8, 9; pl. 133, figs. 2-4; pl. 168, fig. 8.

Abietites angusticarpus FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 263, pl. 133, fig. 1.—FONTAINE, 19th Ann. Rept. U. S. Geol. Surv., Pt. 2, 1899, p. 671, pl. 163, fig. 14.—FONTAINE, in Ward., Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 528, 538, 556, 572, pl. 114, fig. 10.

Williamsonia? bibbinsi WARD, Fontaine, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 554, pl. 115, fig. 11.

Abietites californicus FONTAINE, in Diller and Stanton, Bull. Geol. Soc. Amer., vol. 5, 1894, p. 450 (*nomen nudum*).

Description.—Large, stout cones, with a stout axis and numerous, long, thin, imbricated, appressed scales. The various specimens vary considerably in length and appearance, all being much macerated and poorly preserved.

The author is unable to find good characters for the separation of the forms included in the foregoing synonymy. The supposed *Williamsonia* is nothing but a cone fragment vertically compressed as Professor Ward surmised. Described originally from the Patuxent formation of Virginia they have since been identified in the Shasta group (Horsetown beds) of California and the Lakota formation of the Black Hills, while a very similar cone fragment has been described from the Trinity group of Texas as *Abietites linkii* (Roemer) Dunker.

These cones are comparable with a number of previously described species, and they are especially close to *Pinites solmsi* Seward from the English Wealden, as the latter author has already pointed out. From the foliage preserved with the English cones, which is identical with what Professor Fontaine referred to *Leptostrobus*, it is possible that the latter type of foliage was borne by the tree which furnished the cones just described.

¹ Coemans, Mém. Acad. Roy. Belg., vol. 36, 1867.

² Carruthers, Geol. Mag., vol. 3, 1866, pp. 534-546, pl. 20, 21.

³ Seward, Wealden Flora, pt. 2, 1895, p. 197, pl. 18, figs. 2, 3; pl. 19. See especially pl. 18, fig. 2.

Occurrence.—PATUXENT FORMATION: Fredericksburg, Dutch Gap, Virginia, Broad Creek, Maryland; ARUNDEL FORMATION: Arlington, near Lansdowne, Maryland; PATAPSCO FORMATION, Vinegar Hill, Fort Foote, Maryland.

Collections.—U. S. National Museum.

ABIETITES MARYLANDICUS Fontaine.

Abietites marylandicus FONTAINE, in Ward., Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 549, pl. 115, figs. 4, 5.

Description.—Obscure impression of a narrowly oblong cone about 15 mm. wide and about 4 cm. long, covered with closely placed, rhomboidal scars, transversely elongated. The very stout peduncle might be taken to indicate a stout cone with thin scales of which only the basal portions were retained in the fossil. The relation of this cone to the preceding species is altogether doubtful, it is retained in this genus since the preservation is so vague that any effort to determine its true affinity would be futile.

In some respects it suggests the staminate cone of a cycad and it may also be compared with cones of the coniferous genus *Geinitzia* which are characteristic forms in the Albian, Cenomanian, and Senonian.

Occurrence.—PATAPSCO FORMATION: Vinegar Hill, Maryland.

Collection.—U. S. National Museum.

ABIETITES FOLIOSUS (Fontaine).

Leptostrobus foliosus FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 230, pl. 101, fig. 4; pl. 103, fig. 5; pl. 104, fig. 1; in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 482.

Laricopsis longifolia FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 233, pl. 102, figs. 7, 8; pl. 103, figs. 2, 3; pl. 165, fig. 4; pl. 168, figs. 5, 6.—FONTAINE, Proc. U. S. Nat. Mus., vol. 16, 1893, p. 268, pl. 36, fig. 9 (?).—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 312, pl. 73, figs. 11, 14.

Description.—Leaves long and slender, 0.5 to 1.0 mm. in width, full length not seen, at least several centimeters, much crowded, seemingly in bundles where the preservation is fairly good.

This is clearly distinct from the preceding species and less common. It is not fully characterized because of the poorness of preservation, as evinced by the fact that the leaves are detached in a majority of the specimens collected. The forms which were the basis for *Laricopsis longifolia* Fontaine have been united with this species since they are indistinguishable and probably identical in character.

This species occurs at the oldest and youngest horizons in the Virginia Potomac and it has also been recorded from the Kootanie formation of Montana. The fragment from the Trinity beds of Texas which Professor Fontaine identifies with such certainty is, in the writer's judgment, absolutely untrustworthy.

Occurrence.—PATUXENT FORMATION: Dutch Gap and immediate vicinity, Virginia; PATAPSCO FORMATION: Brooke, Virginia.

Collections.—U. S. National Museum.

ABIETITES LONGIFOLIUS (Fontaine) New Combination.

Leptostrobus longifolius FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 228, pl. 101, figs. 2, 3; pl. 102, figs. 1-4; pl. 103, figs. 6-12; pl. 104, fig. 6.—FONTAINE, in Ward, 19th Ann. Rept. U. S. Geol. Surv., Pt. 2, 1899, p. 671, pl. 163, fig. 15; pl. 165, fig. 3.—FONTAINE, in Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, pp. 281, 481, 482, 491, 506, 528, 551, 557, pl. 110, fig. 11; pl. 116, fig. 1.

Description.—Leaves long and narrow, needlelike, 10 to 15 cm. in length, aggregated in bundles. Bundles apparently borne on short shoots, with many leaves in each bundle. No satisfactory venation can be made out. Fontaine describes a various number of veins in these forms, but as nearly as can be determined these are simply folds due to compression or simply the angles of the leaf.

This species has a considerable geologic as well as geographic range, having been recorded from the Kootanic formation of British Columbia and the Fuson formation of the Black Hills. In the Potomac group it is of frequent occurrence and individually common, being found in the oldest as well as the youngest beds. The remains are always poorly preserved and were evidently much macerated before fossilization. They are closely comparable with *Pinites solmsi* Seward of the Wealden and with *Pinus peterseni* Heer from the Kome beds of Greenland. They may also be compared with the genus *Prepinus* proposed by Professor Jeffrey for certain structural material from the Upper Cretaceous.

The genus *Leptostrobus* was proposed by Heer¹ in 1876 for certain Siberian Jurassic cones, although in 1880 remains of foliage were also correlated with these cones.² Five species in all were described. The age of the containing beds is Oolitic. Subsequently this generic name was utilized by Ward and Fontaine for a considerable number of American Jurassic and Cretaceous species, based on an assortment of probably unrelated vegetative twigs, supposed cones, and seeds or fruits.

Occurrence.—PATUXENT FORMATION: Fredericksburg, Potomac Run, and Dutch Gap, Virginia; PATAPSCO FORMATION: Brooke, 72-mile post, Mount Vernon and Hell Hole, Virginia; Fort Foote, Vinegar Hill (very common), and Federal Hill (Baltimore), Maryland.

Collection.—U. S. National Museum.

THE GENUS PINUS.

Modern members of this genus are the dominant conifers of the northern hemisphere with about 70 species, usually forming vast forest

¹ Heer, *Flora Foss. Arct.*, vol. 4, Abth. 2, 1876, p. 72.

² Heer, *Idem.*, vol. 6, Abth. 1, 1880, p. 23

areas. There are considerable differences of opinion at the present time among morphologists as to the relative antiquity of the various members of the order Coniferales, the older view that the Abietineae were a highly specialized and relatively modern type being questioned by Jeffrey and others. It would seem, however, that the old view not only has the fossil record exclusively in its favor but many morphological arguments to substantiate it.

A very large number, perhaps as many as 200, of fossil species have been described, ranging in age from the Jurassic upward. The Jurassic has furnished pine-like leaves as well as the remains of cones which have formed the foundation of several species. While these records are for the most part not entirely unequivocal, Fliche and Zeiller¹ in a recent communication are positive of the identity of the cone which they describe from the French Portlandian. From horizons homotaxial with the Potomac group, a number of forms have been recorded. These include six species described by Heer from leaves in the Kome beds, three species from the Kootanie, one from the Lakota of the Black Hills, and one from the Trinity of Texas. Strata of Lower Cretaceous age in Europe are remarkable for the number, variety, and excellent preservation of cones of *Pinus*, about a dozen species being known from England, Belgium, and France. The Upper Cretaceous records are frequent and conclusive, including the evidence of wood with structure preserved, and the genus becomes thoroughly cosmopolitan during the Tertiary period. The definite remains of *Pinus* in the Potomac group are those of both cones and seeds constituting the following single species, the cones of which sometimes crowd the strata of the Patapsco formation.

PINUS VERNONENSIS Ward emend.

Pinus vernonensis WARD, in Fontaine, in Ward., Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 497, pl. 109, figs. 4-6.

Pinus schista WARD, Monogr. U. S. Geol. Surv., vol. 48, 1905, p. 531, pl. 112, figs. 13-15.

Araucarites virginicus FONTAINE, in Ward., Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 572, pl. 119, fig. 8 (not Fontaine, 1890).

Seed of Pinus?, species FONTAINE, Monogr. U. S. Geol. Surv., vol. 15, 1890, p. 272, pl. 170, fig. 4.

Description.—Cones elongate, conical, somewhat variable in size, averaging about 7 cm. in length by 1.8 cm. in diameter. Axis stout, 2 mm. to 3 mm. in diameter. Cone scales triangular, relatively thin, thickened apically to form a rhomboidal boss with an elevated transverse ridge. A central umbilicus may represent the area of attachment of a short spine which has been worn away before fossilization. Length about 1.5 cm., greatest width about 0.8 to 1 cm., thickness 1 to 2 mm.

¹ Fliche and Zeiller, Bull. Soc. geol. France (4), vol. 4, 1904, p. 804.

The arrangement of the scales is a close spiral, and in all of the cones collected or seen, numbering several score, none were found expanded, all having the scales closely appressed. This may indicate fossilization before maturity, since also numbers of the cones retain their seeds, which is remarkable if the cones were shed in a ripe state. The seeds seem to be mature, however, and it is probable that the cones in this species had reached nearly or quite their full size when they were blown into some Lower Cretaceous stream and carried out and buried in the Patapsco estuaries. Each cone scale subtends two seeds which are typically those of *Pinus*. The seeds are elliptical, 3–5 mm. long with straight wings 5–15 mm. high and not over 7 mm. wide, sides rather straight though somewhat curved on the outside, obtusely rounded apically.

The single seed from Federal Hill represents the maximum of size as given above and is also rather more pointed than the specimens from the other localities. It was doubtfully described by Fontaine in his first monograph. More recently Professor Ward discovered seeds of *Pinus* at Mount Vernon, Virginia, and at Fort Foote, Maryland. The former were described as *Pinus vernonensis*, which now becomes the name of all the *Pinus* like remains from the Patapsco formation. The latter specimens were described as a distinct species, *Pinus schista*, because the wings are somewhat split. As the latter are identical with the more complete remains from the other bank of the Potomac, and as the different specimens are split to a varying degree and one specimen is not split at all, it is quite obvious that the splitting is due entirely to trituration before fossilization.

Recently the writer discovered abundant lignitized cones associated with these seeds near Widewater, Virginia, and these cones were found in a number of instances to still contain some of their seeds which proved to be identical in every respect with the seeds previously described from the Patapsco formation. Having become familiar with the cones which bore the pine seeds it was found that the single cone described by Fontaine¹ from Cecil County, Maryland, as identical with *Araucarites virginicus* was in reality a pine cone identical in every respect with the cones from near Widewater, Virginia.

The seeds of *Pinus vernonensis* may be compared with those figured by Seward² from the Wealden of Bernissart, Belgium as *Pinites* cf. *Solmsi*. In the U. S. National Museum collections a number of specimens of *Widdringtonites brookense* are labeled *Pinus vernonensis* in Professor Fontaine's handwriting, but there is no record in print of supposed foliage of this species, although it is possible that some of the foliage specimens referred to *Abietites* in the present paper may have had such a relationship.

¹ In Ward, Monogr. U. S. Geol. Surv., vol. 48, 1906, p. 572, pl. 119, fig. 8.

² Seward, La Flora Wealden de Bernissart, Mém. Musée roy. d'hist. nat. de Belgique, Année 1900, p. 28, pl. 4, fig. 77.

Occurrence.—PATAPSCO FORMATION: Mount Vernon (seeds) and near Widewater, Virginia (cones and seeds): Federal Hill (Baltimore) (seed) and Fort Foote (seeds); Muddy Creek, Cecil County (cone), near Wellhams, Anne Arundel County (seeds), Maryland.

Collections.—U. S. National Museum, Johns Hopkins University.

DESCRIPTIONS OF THREE NEW FISHES OF THE FAMILY
CHÆTODONTIDÆ FROM THE PHILIPPINE ISLANDS.

By HUGH M. SMITH and LEWIS RADCLIFFE,
Of the U. S. Bureau of Fisheries, Washington.

The species referred to in this paper represent hitherto undescribed forms of the family Chætodontidæ obtained in the Philippine Archipelago by the *Albatross* expedition.

The measurements herein used represent the ratio between length of part described and the standard length from tip of snout to end of last caudal vertebra, with the exception of eye, snout, maxillary, interorbital, fins, and least depth of caudal peduncle, which are expressed in ratio to head measured from tip of snout to posterior edge of opercle (not including opercular flap). The length of caudal peduncle is measured between the verticals drawn at base of last anal ray and at end of last vertebra. Even when the last dorsal and anal rays are cleft to base they are still counted as single rays. The scale formula indicates the number of scales in a transverse row from insertion of dorsal downward and backward to and including lateral line and from origin of anal upward and forward to lateral line and the number of transverse rows above the lateral line, between upper angle of opercle and end of last caudal vertebra.

CHÆTODON ARGENTATUS, new species.

Dorsal XIV, 22; anal III, 16; scales 4 + 10 - 33.

General form subrhomboidal, strongly compressed; head 3.12, deeper than long, upper profile nearly straight; depth of body 1.63; caudal peduncle shorter than deep, slender, depth 3.00; eye 3.00;

snout 2.64, conical; mouth moderate; maxillary 3.42, barely reaching vertical from anterior nostril; nostrils close to eye, anterior nostril larger, circular, provided with a flap posteriorly, posterior nostril elongate, slit-like; interorbital 3.33, very slightly rounded; preopercular border smooth except for a few weak denticulations near upper angle and on horizontal margin; teeth in bands, long, slender, with a slight constriction near tip; peritoneum silvery, with scattered dusky spots.

Scales unequal, those on middle of trunk larger than the others, arranged in rows which are very distinct both upward and backward and downward and backward; 22 transverse rows of scales between opercle and end of last vertebra; head, belly, and vertical

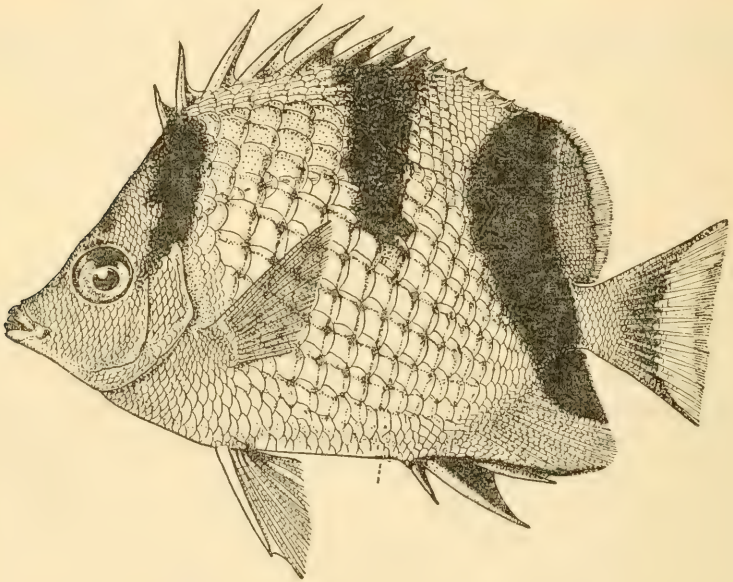


FIG. 1.—*CILETODON ARGENTATUS*. (From the type. Natural size.)

fins finely scaled. Scales subcircular, truncate at base; circuli regular in arrangement, those in nuclear area enlarged or absent; radial folds on basal portion of scale well developed, about 8 to 14 in number; a moderately narrow area along apical margin of scale with short radially arranged lines, each composed of a series of cones or cone-like structures, slightly hastate in outline, truncate at tip, appearing as if the apex of one had pierced the base of the one immediately in front of it; the terminal cone in each row entire, forming the series of spine-like structures along apical margin.

Dorsal spines long and slender, fourth spine longest, 1.26 in head, spines following this graduated backward; membranes of anterior spines deeply incised; soft dorsal moderately low, evenly rounded; caudal short, obliquely truncate; anal bluntly right-angled, second

and third spines subequal, the second slightly stronger than the third; ventrals 1.14, short, tips not reaching vent; pectorals 1.10.

Color in alcohol: Silvery, tinged with a very pale lemon yellow; a narrow black saddle across upper part of interorbital, not reaching eye; a small black area on upper part of eye and adjacent interorbital region; an irregular black saddle from in front of origin of dorsal downward across upper part of opercle, duskiness extending across upper part of preopercle to posterior margin of eye; a black area crossing fifth to ninth dorsal spines and extending downward to middle of side; a broad black band including last dorsal spine and anterior third of soft dorsal extending downward and backward across base of soft dorsal, caudal peduncle and posterior third of anal; margin of soft dorsal silvery white, the tips of the rays very narrowly edged with black, a narrow inframarginal black line below marginal band, area between this and broad black band crossing base of fin dusky white; a blackish segment on tips of middle caudal rays; anterior to this a similar white band preceded by a black crescent fading out on base of fin; anterior two-thirds of anal silvery white, posterior third, black; membranes of spines and tips of anterior rays black; dusky or blackish lines extending downward and backward and upward and backward along the rows of scales, forming a checker board appearance and emphasizing scale arrangement.

This species resembles *C. xanthurus* but differs markedly in coloration, in number of dorsal spines, in smaller scales, and in having the rows that extend downward and backward more nearly horizontal.

Type.—Cat. No. 67353, U.S.N.M., 9.6 cm. in length, from Agojo Point, Catanduanes Islands, Pacific coast of Southern Luzon, Philippine Islands.

Another example 8.5 cm. in length was taken at Port San Pio V, Camaguin Island, north of Luzon. This individual differs slightly in coloration from the type; the black markings on body are more pronounced, the black saddle across interorbital is interrupted on the right side, and the black and white markings of caudal are more distinct. Color in life: No yellow; pale parts silvery, darker parts black.

HENIOCHUS SINGULARIUS, new species.

Dorsal XII, 25; anal III, 17; scales 11 + 26 — 50.

General shape trapeziform; head 3.31, short, deep, upper profile from tip of snout to insertion of dorsal comparatively straight; body compressed, elevated, depth 1.45; caudal peduncle half as long as deep, depth 2.60; eye 3.75, high, rather small; snout 2.44, short, blunt; mouth small, terminal, lips thick and fleshy, concealing teeth; maxillary short; nostrils large, the anterior with a well-developed fold ending in a flap posteriorly; posterior nostril elongate; inter-

orbital 3.35, raised, somewhat convex; bony projections over eyes and on forehead moderately developed; preopercle weakly denticulate; teeth small, close-set; gill membranes narrowly joined to the isthmus; peritoneum white.

Scales moderate, regular in arrangement; lateral line complete, moderately arched, parallel with contour of body; about 44 transverse rows of scales between opercle and base of caudal; vertical fins scaled, scaly sheath not extending to tip of dorsal spines, the line of

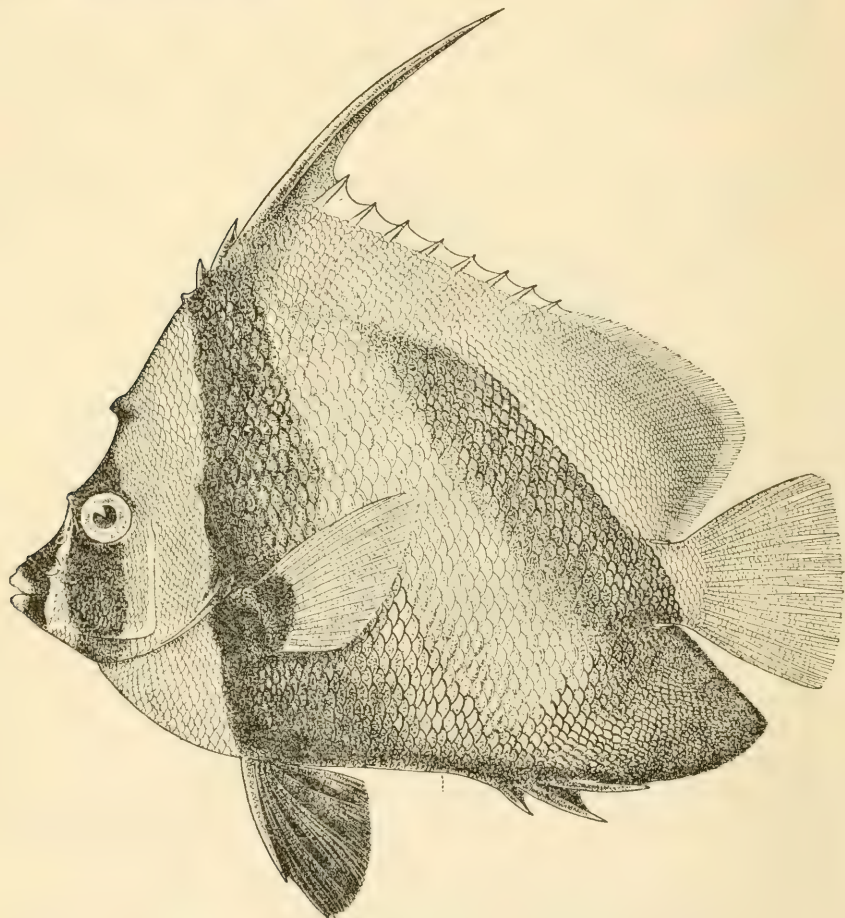


FIG. 2.—HENIOCHUS SINGULARIUS. (From the type. Three-fifths natural size.)

demarcation very distinct; head scaled; lips, upper surface of snout, and opercular flap naked. Scales broad, basal margin truncate, apical margin rounded; sculpturing of scale like that in *Chatodon*; circuli numerous; basal radial folds well developed, few in number; hastate structures composing radial lines on apical margin very distinct.

Dorsal fin inserted anteriorly, distance from tip of snout to origin of dorsal 2.06 in length; first to third dorsal spines relatively short,

graduated; fourth spine 1.90 in length, long, filiform, provided with a broad free membrane extending to tip of spine, other spines except last graduated; soft dorsal moderate, not so high as in *H. monoceros*, margin rounded; caudal truncate; anal deep, obtusely angled, spines graduated; ventrals 1.14, rounded, short, not reaching vent, their base under base of pectorals; pectorals nearly as long as head.

Color in alcohol: Head and nape encircled by alternating bands of black and dusky silvery-white; the first band, jet black in color, encircles the mouth and extends backward on snout to anterior nostril; the second, silvery-white, runs parallel with first and extends backward on top of head to bony projections over eyes; the third, the black ocular band, about width of eye, crosses forehead, extends downward in front of and through anterior seven-eighths of eye, meeting its fellow on under surface of head; the fourth, dusky silvery-white, covers space between ocular band and base of dorsal and extends downward across posterior border of eye and opercular region, meeting its fellow on breast, where it widens out to base of ventrals; posterior border of opercle black; tips of lips yellowish; trunk posterior to vertical from insertion of dorsal to base of ventrals, including ventrals and anal, black; a lighter area, shading into the black, widest ventrally, extends from third to fifth dorsal spines downward and backward to base of anal, shading into black coloration of anal rays; remainder of dorsal, caudal, posterior portion of caudal peduncle and pectoral rays golden yellow; base of pectoral and region below, including ventrals and anal spines, jet black.

Color in life: Upper portions of silvery bands on head, before described, slightly dusky, with a faint brassy wash; first and second dorsal spines black; third spine gray, the color continued as a lighter band diagonally across the black coloration of trunk to middle of anal; centers of scales on darker ventral portions of trunk somewhat pearly or purplish margined with darker brown; scales under the posterior portion of dorsal black, particularly about margins, the centers with a steel bluish area, which becomes smaller toward base of anal; dorsal from tip of fifth spine to base of sixth and diagonally along its basal edge, including the upper and hinder portion of caudal peduncle, and all of caudal fin, cadmium orange; front and posterior margins of anal purplish black; base of pectoral, including base of rays and all of the scaled portion, blackish, the remainder lemon yellow; ventrals black.

This species resembles *H. monoceros*, but is readily differentiated from it by the form of the body, being slenderer and not so nearly circular, the contour lines of dorsal and ventral surfaces rather strongly converging posteriorly; by the longer head and straighter dorsal outline of head; by the smaller eye; by differences in the average number of dorsal and anal rays; by the position of the spinous

dorsal, its insertion being considerably nearer tip of snout in this species, the interspaces between the dorsal spines being normally greater; and by the marked differences in coloration.

The Bureau of Fisheries steamer *Albatross* obtained examples of this species from the following localities in the Philippine Archipelago: Batan and Rapurapu Islands, Lagonoy Gulf, Luzon; Galvaney and Alibijaban Islands, Ragay Gulf, Luzon; Port Dupon, Leyte; Murcielagos Bay, Mindanao; and Ulugan Bay, near Rita Island, Palawan; also from Soo Wan, Formosa; Si Amil Island, eastern Borneo; Binang Unang Island, Gulf of Tomini, Celebes; and Gane Road, Gillolo Island.

Type.—Cat. No. 67354, U.S.N.M., 22.8 cm. in length, from Alibijaban Island, Ragay Gulf, Luzon.

HOLACANTHUS MULTIFASCIATUS, new species.

Dorsal XIII, 17; anal III, 16; scales 7 + 22 - 46.

General form elliptical; head 3.25, upper profile steep, nearly straight; body compressed, curvature of dorsal and ventral surfaces similar, depth 1.55; caudal peduncle short and slender, depth 2.20; eye 3.10, rather small; snout 2.75, short and blunt; mouth small, terminal; maxillary short; nostrils of moderate size, the anterior with a fold ending in a flap posteriorly, the posterior elliptical; interorbital 3.50, flattened; preorbital armed with several strong, sharp denticulations; denticulations on vertical limb of preopercle well developed; spine at angle strong, curved, longer than snout, two weaker spines on horizontal limb; teeth fine, brush-like, trilobed, lateral lobes small; rows of teeth distinct, with well-marked interspaces; gill-membranes free from isthmus; peritoneum silvery-white.

Scales regular in arrangement, those on middle of side slightly larger than others; 30 transverse rows between opercle and end of last vertebra; vertical fins and head finely scaled. Scales subrhomboidal, strongly ctenoid; circuli fine, regular; basal radial folds comparatively few, converging, and extending to nuclear region; about 17 to 20 rod-like structures ending in a well-developed spine extending from nuclear region to apical margin, characteristically different from the sculpturing of the same region on the *Chaetodon* scales.

Dorsal spines slender, curved, fifth slightly longer than others, 1.46; membranes of anterior spines deeply incised; soft dorsal higher than spinous dorsal, evenly rounded; caudal short, margin rounded; anal similar to soft dorsal; anal spines well developed; ventrals 2.65 in length, first ray filamentous, its tip reaching base of second anal spine; pectorals slightly longer than head.

Color in alcohol: Dusky cream, crossed by ten seal-brown vertical bands of about the same width as the interspaces; first band, the

ocular, slightly narrower than eye, crosses nape in front of dorsal and extends downward across base of preopercular spine toward base of ventral, fading out on breast; second band extends from first and second dorsal spines downward across posterior border of opercle and base of pectoral, traces of it reaching behind base of ventrals; third to eighth cross-bands have their origin on spinous dorsal, seventh and eighth crossing anterior basal portion of soft dorsal, thence extending downward across base of anal; ninth band crosses tips of last two dorsal spines, extends across middle of soft dorsal rays, anterior part of caudal peduncle, and middle of anal rays; tenth band crosses upper third of soft dorsal, base of caudal peduncle, and posterior third of anal; traces of another band crossing tips of soft dorsal rays, base

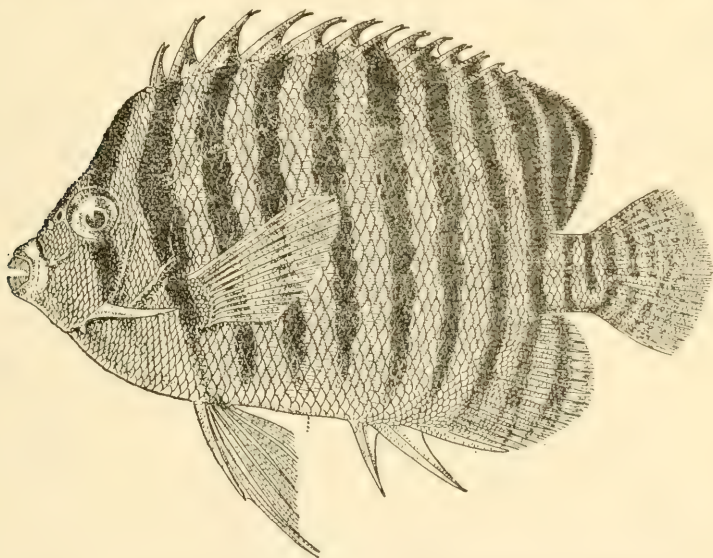


FIG. 3.—*HOLACANTHUS MULTIFASCIATUS*. (From the type. Natural size.)

of caudal, and tips of anal rays; the body bands are widest at top; those on lower part of anal faded to yellowish-white (orange in life); a short median stripe on top of head, widest between eyes; traces of a dusky-brown circumoral band; caudal crossed by five bands, the first complete, the second with a single interruption, the others composed of a series of brown blotches, those nearest tip least distinct; anal spines white; ventrals white; pectorals dusky.

Color in life of an individual from Mabul Island (7.2 cm. long): Ground color pearl gray, paler below, crossed by ten dark brown bands merging into orange ventrally, bands slightly wider above than below, slightly narrower than eye in widest part and about equal to interspaces; the first, the ocular band, becomes orange below eye; an orange circumoral ring; snout and chin dusky; a short brown stripe between eyes; a black blotch near middle of brown margin of

soft dorsal; bands on anal mostly orange; ventrals cadmium yellow, produced tip white; pectorals hyaline.

This species has characters intermediate between the subgenera *Chatodontoplus* Bleeker and *Centropyge* Kaup. It has the form of body and fins of the former and the larger scales of the latter.

The collection contains examples of this species from Port Galera, Mindoro; Romblon Harbor, Romblon Island; Mabul Island, Borneo; Buka, Dodepo, Pasejogo, and Binang Unang Islands, Gulf of Tomini, Celebes; Uki, Bouro Island, and Talisse Island, Dutch East Indies.

Type.—Cat. No. 67355, U.S.N.M., 9.3 cm. in length, from Port Galera, Mindoro.

THE RECENT AND FOSSIL MOLLUSKS OF THE GENUS CERITHIOPSIS FROM THE WEST COAST OF AMERICA.

By PAUL BARTSCH,

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The first *Cerithiopsis* known from the west coast of America was reported by Alcide D'Orbigny in 1840 from Peru.¹ This was followed twelve years later by two additional species, discovered by Prof. C. B. Adams at Panama and described as *Cerithium neglectum* C. B. Adams and *Triforis infrequens* C. B. Adams.²

In 1857 Dr. P. P. Carpenter published that part of his Catalogue of Mazatlan Shells which deals with the members of this genus, citing the following species:

| | |
|--|--------------------------------|
| <i>tuberculoides</i> Carpenter. | <i>sorex</i> Carpenter. |
| <i>tuberculoides albonodosa</i> Carpenter. | <i>convexa</i> Carpenter. |
| <i>cerea</i> Carpenter. | <i>decussata</i> Carpenter. |
| <i>pupiformis</i> Carpenter. | <i>assimilata</i> C. B. Adams. |

Of these, *C. convexa* is now placed in the genus *Metaxia*. *C. decussata* is a *Bittium*, and *Cerithiopsis assimilata* Carpenter = *Cerithium assimilatum* C. B. Adams must be referred to the genus *Seila*.

In 1865 Doctor Carpenter described *Cerithiopsis intercalaria*³ and at the same time referred *Cerithium bimarginatum* C. B. Adams to this genus. At present both of these species are placed in the genus *Eumeta*. In the Supplementary Report on the Present State of Our Knowledge with Regard to the Mollusca of the West Coast of America⁴ Doctor Carpenter published a terse diagnosis of the following species:

| | |
|-------------------------------|--------------------------------|
| <i>Cerithiopsis columna</i> . | <i>Cerithiopsis purpurea</i> . |
| <i>Cerithiopsis munita</i> . | <i>Cerithiopsis fortior</i> . |

All of these were later more fully described. Three of them, *C. munita*, *C. purpurea*, and *C. fortior*, are now placed in the genus *Bittium*. In 1867 De Folin added another species,⁵ *Cerithium destrugesii*, which may not belong to our fauna, as the locality is cited as Panama or Negritos Island.

¹ Voy. Amer. Merid., p. 443, pl. 77, figs. 9-10.

² Ann. Lyc. Nat. Hist. of N. Y., 1852, pp. 379-80.

³ Proc. Zool. Soc., 1865, p. 281.

⁴ Rep. Brit. Ass. Adv. Sci. for 1863, published in 1864.

⁵ Les Meleagrinicoles, p. 71, pl. 6, fig. 12.

After this no additions were made for seventeen years, when Dr. W. H. Dall described *Cerithiopsis stejnegeri*, from Alaska.¹ Two years later the same author added another species,² also from Alaska, under the name *Cerithiopsis stejnegeri truncata*.

After another lapse of seventeen years we find another species added to our list, this time a fossil described as *Bittium williamsoni* by Dr. Ralph Arnold,³ from the Pleistocene beds of San Pedro and San Diego, California. Five years later the present writer described:⁴

Bittium tumidum.

Cerithiopsis cosmia.

Bittium quadrifilatum ingens.

Cerithiopsis pedroana.

the first two of which must be referred to the present genus. Since then Doctor Dall has added *Cerithiopsis excelsus*,⁵ and the present writer described *Cerithiopsis stephense*.⁶

The nuclear characters of the species studied are quite interesting and can be used to advantage in subdividing the genus into minor groups. Unfortunately, twenty of the forty-five forms under consideration have lost these early turns, which leaves a rather large percentage in an uncertain position.

Of the twenty-five species in which the nuclear whorls are known, eighteen belong to *Cerithiopsis* proper, having smooth nuclear whorls. These are:

fatua Bartsch.

abrejosensis Bartsch.

oxys Bartsch.

berryi Bartsch.

cerea Carpenter.

galapagensis Bartsch.

sorex Carpenter.

cesta Bartsch.

carpenteri Bartsch.

stejnegeri Dall.

pedroana Bartsch.

stejnegeri dina Bartsch.

tuberculoides Carpenter.

neglecta C. B. Adams.

tuberculoides albonodosa Carpenter.

halia Bartsch.

pupiformis Carpenter.

aurea Bartsch.

Two species have the early portion of the nuclear whorls smooth and the later part axially ribbed; for these I would suggest the sub-generic name *Cerithiopsina*. The two species are *Cerithiopsis* (*Cerithiopsina*) *necropolitana* Bartsch and *Cerithiopsis* (*Cerithiopsina*) *adamsi* Bartsch. The first of these may be considered the type.

Two species have the early portion of the nuclear whorls smooth, which is succeeded by an axially ribbed part, which in turn is followed by a portion bearing two spiral cords in addition to the axial ribs. The last ornamentation resembles the sculpture of the early post-nuclear whorls, but is less strong, with many more axial ribs

¹ Proc. U. S. Nat. Mus., vol. 7, 1884, pp. 345-6, pl. 2, fig. 4.

² Proc. U. S. Nat. Mus., vol. 9, 1886, p. 304, pl. 4, fig. 5.

³ Mem. California Acad. Sci., vol. 3, 1903, p. 295, pl. 6, fig. 11.

⁴ Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 79-82.

⁵ Prof. Paper No. 59, U. S. Geol. Surv., 1909, p. 75.

⁶ Proc. U. S. Nat. Mus., vol. 37, 1909, pp. 399-400 and figure.

than are present on the early post-nuclear turns. To this group I would apply the subgeneric name *Cerithiopsida*. The two species are *Cerithiopsis (Cerithiopsida) diegensis* Bartsch, which may be considered the type of the subgenus, and *Cerithiopsis (Cerithiopsida) rowelli* Bartsch.

A fourth group, consisting of three species, has the early portion of the nuclear turns smooth; the rest finely, axially ribbed, with the intercostal spaces finely, spirally lirated. For these I would suggest the subgenus *Cerithiopsidella*, with *Cerithiopsis (Cerithiopsidella) cosmia* Bartsch as type. The other two species are *Cerithiopsis (Cerithiopsidella) antefilosa* Bartsch and *Cerithiopsis (Cerithiopsidella) alcima* Bartsch.

The species in which the nuclear whorls are unknown are:

| | |
|--------------------------------|-------------------------------|
| <i>excelsa</i> Dall. | <i>antemunda</i> Bartsch. |
| <i>curtata</i> Bartsch. | <i>diomedeeae</i> Bartsch. |
| <i>fossilis</i> Bartsch. | <i>williamsoni</i> Arnold. |
| <i>gloriosa</i> Bartsch. | <i>truncata</i> Dall. |
| <i>columna</i> Carpenter. | <i>stephensae</i> Bartsch. |
| <i>infrequens</i> C. B. Adams. | <i>montereyensis</i> Bartsch. |
| <i>paramoea</i> Bartsch. | <i>ingens</i> Bartsch. |
| <i>arnoldi</i> Bartsch. | <i>tumida</i> Bartsch. |
| <i>bicolor</i> Bartsch. | <i>peruviana</i> D'Orbigny. |
| <i>magellanica</i> Bartsch. | <i>destrugesi</i> De Folin. |

Only five of the forty-four known species are fossils, and none, as far as known, occur both recent and fossil. Of these five, two have their nuclear characters well preserved and thus enable us to assign them to their proper positions. These are *Cerithiopsis (Cerithiopsis) fatua* Bartsch and *Cerithiopsis (Cerithiopsina) necropolitana* Bartsch. Both of these are from the Pleistocene of San Pedro, California. The other three species without the nuclear characters are *Cerithiopsis excelsa* Dall, from the Eocene of Oregon; *Cerithiopsis fossilis* Bartsch and *Cerithiopsis williamsoni* Arnold, from the Pleistocene of San Pedro, California.

It is hoped that the present paper may stimulate the west American collectors to be on the lookout for these charming little shells, and that their efforts will result in a speedy elimination of the species now referred to an uncertain position.¹

¹ In the preparation of the present diagnoses the following terminology is used:

"Axial sculpture," the markings which extend from the summit of the whorls toward the umbilicus.

The axial sculpture may be—

"Vertical," when the markings are in general parallelism with the axis of the shell.

"Protractive," when the markings slant forward from the preceding suture.

"Retractive," when the markings slant backward from the suture.

"Spiral sculpture," the markings following the directions of the coils of the whorls.

KEY TO THE GENUS CERITHIOPSIS.¹

- Shell with varices.....*excelsa*.
 Shell without varices.
 Spiral cords between the sutures three.
 Spiral cord at summit equal to the others in strength.
 Sutures strongly channeled.
 Shell of medium size, less than 6.5 mm. long.....*fatua*.
 Shell minute; adult less than 4 mm. long.
 Base with two spiral cords.
 Shell elongate-conic.....*oxys*.
 Shell elongate-ovate.....*curtata*.
 Base with more than two spiral cords.
 Spiral cords of base three.....*cerea*.
 Spiral cords of base nine.....*sorex*.
 Sutures not channeled.
 Whorls shouldered at the summit
 Base with strong spiral cords.
 Shell large; adult more than 7 mm. long.
 Spaces inclosed between axial ribs and spiral cords on the spire, large squarish pits.
 Base with a strong keel next to peripheral keel.....*fossilis*.
 Base with no strong keel next to peripheral keel.....*gloriosa*.
 Spaces inclosed between axial ribs and spiral cords on the spire, small round pits.
 Peripheral keel completely exposed in the suture in adult shells,
*columna*.
 Peripheral keel never completely exposed in the suture in adult shell.
 Basal cords three, strong.....*cosmia*.
 Basal cord single, feeble.....*carpenteri*.
 Shell smaller.
 Adult between 3 and 5 mm. long.
 Basal cord broad and round.
 Axial ribs on last whorl about 32.....*pedroana*.
 Axial ribs on last whorl about 20.....*tuberculoides*.
 Basal cords sublamellar.
 Adult less than 3 mm. long.....*infrequens*.
 Shell stout.....*pupiformis*.
 Shell slender.....*abreojosensis*.
 Base with feeble sculpture only.
 Basal fasciole present.
 Base with a single fasciole (encircling the columella) only.
 Shell broadly elongate-conic.....*paramoea*.
 Shell slender elongate-conic.....*necropolitana*.
 Base with more cords than a single fasciole.....*arnoldi*.
 Basal fasciole absent.
 Whorls not shouldered at the summit.....*magellanica cesta*.
 Spiral cord at summit weaker than the rest.
 Sutures strongly channeled.
 Shell robust.
 Basal keels strong.....*berryi*.

¹ Since so many of the species under discussion lack the nucleus, it was deemed advisable to treat the genus as a unit and ignore the subgeneric division in this key, by utilizing characters present on the post-nuclear whorls only.

- Basal keel obsolete.
- Axial ribs retractive.....*antemunda*.
- Axial ribs protractive.....*diomedex*.
- Shell very slender.....*galapagensis*.
- Sutures not channeled.
- Tubercles of middle keel truncated on both posterior and anterior margin.
- Axial ribs and spiral cords inclosing strong, squarish pits.
- Base with two strong keels.
- Adult shell more than 5 mm. long.....*alcima*.
- Adult shell less than 3 mm. long.....*williamsoni*.
- Base with a feeble fasciole only.....*truncata*.
- Axial ribs and spiral cords inclosing rounded pits.
- Spiral cords slender.....*cesta*.
- Spiral cords very broad.
- Shell very elongate-conic.....*stephensæ*.
- Shell broadly conic.
- Adult shell less than 6 mm. long.....*stejnegeri*.
- Adult shell more than 7 mm. long.....*s. dina*.
- Tubercles of middle keel not truncated on both posterior and anterior margin. Tubercles of middle keel truncated on posterior margin only.
- Base marked by a slender fasciole only.....*rowelli*.
- Base marked by spiral cords.
- Spiral cords of base three.....*anteflosa*.
- Spiral cords of base two.....*neglecta*.
- Tubercles of middle keel not truncated.
- Whorls strongly, slopingly shouldered at the summit.....*halia*.
- Whorls not slopingly shouldered at the summit.
- Shell robust.
- Base with a single keel at the periphery.....*diegersis*.
- Base with three keels near the periphery.....*montereyensis*.
- Shell slender and minute.....*adamsi*.
- Spiral cords between the sutures four.
- Shell very large; adult more than 12 mm. long.
- Intercalated cords absent or very fine.....*ingens*.
- Shell smaller; adult less than 7 mm. long.
- Spiral cords wider than the spaces which separate them.
- Shell elongate-conic.....*tumida*.
- Shell elongate-ovate.....*peruviana*.
- Spiral cords narrower than the spaces which separate them.
- Spiral cords subequal.....*aurea*.
- Spiral cords decidedly unequal.....*destrugesi*.

CERITHIOPSIS (CERITHIOPSIS) FATUA, new species.

Plate 36, fig. 5.

Shell very elongate-conic, creamy white. Nuclear whorls three, strongly rounded, separated by well marked sutures, forming a slender, regular spire. Post-nuclear whorls well rounded, separated by a deeply channeled suture, ornamented with three nodulose, spiral cords one of which is at the summit, the third immediately above the periphery, while the second is median between the two. These cords are a little wider than the spaces which separate them. In addition to the spiral sculpture, the whorls are marked by retractive, axial

ribs which are as strong as the spiral cords and render the junctions with these nodulose. Of these ribs 16 occur upon the first to fifth, 18 upon the sixth, 20 upon the seventh, and 22 upon the penultimate turn. The spaces inclosed between the axial ribs and spiral cords appear as strongly impressed, rounded pits. The tubercles are slightly truncated posteriorly, sloping gently anteriorly. Periphery of the last whorl marked by a channel like those occurring between the spiral cords on the spire and like them crossed by the continuations of the axial ribs. Base rather long, well rounded, free from sculpture excepting very fine, incremental lines. Aperture regularly ovoid, strongly channeled anteriorly; posterior angle obtuse, outer lip thin, rendered wavy by the external sculpture; columella stout, decidedly curved and somewhat twisted, projecting considerably beyond the anterior margin of the outer lip.

The type and seven specimens (Cat. No. 195194, U.S.N.M.) come from the Lower Pleistocene (Lower San Pedro Series), Deadmans Island, California. The type has twelve whorls and measures: Length 6 mm., diameter 1.6 mm.

CERITHIOPSIS (CERITHIOPSIS) OXYs, new species.

Plate 36, fig. 2.

Shell minute, elongate-conic, dark brown. Nuclear whorls almost four, forming a slender, elongate-conic spire, having the whorls well rounded. Post-nuclear whorls well rounded, separated by a strongly channeled suture, marked by three equally strong, spiral cords, the first of which is at the summit, the third slightly above the periphery, while the second is median between these two. In addition to the spiral cords, the whorls are marked by vertical, axial ribs, almost as strong as the spiral cords. Of these ribs, 16 occur upon the first, 20 upon the second, 18 upon the third to fifth, and 24 upon the penultimate turn. The junctions of the axial ribs and spiral cords form strong tubercles of which those of the posterior cord are rounded while the other two are truncated posteriorly and slope gently anteriorly, while the spaces inclosed between the spiral cords and axial ribs are strongly impressed, rounded pits. Periphery of the last whorl marked by a strong cord which is feebly nodulose and separated from the tuberculate keel posterior to it by a channel as wide as those occurring on the spire; this channel is marked by the continuations of the axial ribs. Base moderately long, marked by a strong, spiral cord about halfway between the peripheral cord and the insertion of the columella, the spaces which separate it from the peripheral cord on one side and from the columella on the other, appearing as deep, rounded channels. Aperture rather small, irregularly ovate, very strongly channeled anteriorly; posterior angle obtuse; outer lip ren-

dered sinuous by the external sculpture; columella very stout, twisted revolute, and reflected; parietal wall glazed with a thin callus.

The type and another specimen (Cat. No. 106505, U.S.N.M.) come from Point Abreojos, Lower California. The type has seven post-nuclear whorls and measures: Length 3.3 mm., diameter 1.2 mm. Two additional specimens (Cat. No. 195181, U.S.N.M.) come from San Pedro Bay, California.

CERITHIOPSIS (CERITHIOPSIS) CERA Carpenter.

Plate 37, fig. 6.

Cerithiopsis cerea CARPENTER, Cat. Maz. Shells, 1857, p. 443.

Shell small, broadly conic, semitransparent, light horn-color. Nuclear whorls well rounded. Post-nuclear whorls separated by a strongly channeled suture, marked by three spiral cords, the first of which is a little anterior to the summit, the second median, and the third a little posterior to the suture. In addition to the spiral cords, the whorls are marked by axial ribs which equal the spiral cords in strength. Of these ribs, 12 occur upon the first to third, 14 upon the fifth and sixth, and 22 upon the penultimate turn. The junctions of the spiral cords and the axial ribs form prominent tubercles, while the spaces inclosed between them are elongated, oval pits on the early whorls, having their long axes parallel to the spiral sculpture. On the last volution they are rounded. Periphery of the last whorl marked by a strong channel. Base moderately long, well rounded, marked by three strong, spiral keels, of which the first is immediately below the peripheral sulcus, and the second halfway between this and the cord which surrounds the insertion of the columella. In addition to the spiral cords, the base is marked by numerous, fine incremental lines. Aperture irregular, very strongly channeled anteriorly; posterior angle obtuse; edge of outer lip rendered sinuous by the external sculpture; columella moderately long, twisted, with the edge reflected.

Doctor Carpenter's type is on Tablet No. 2030, Liverpool collection, British Museum, and was collected on *Spondylus* at Mazatlan. It has seven post-nuclear whorls and measures: Length 2.4 mm., diameter 1 mm.

CERITHIOPSIS (CERITHIOPSIS) SOREX Carpenter.

Plate 37, fig. 2.

Cerithiopsis sorex CARPENTER, Cat. Maz. Shells, 1857, p. 444.

Shell minute, pupiform. Nuclear whorls three, smooth, well rounded, forming a slender, mucronate apex. The first three post-nuclear whorls increasing very rapidly in size, well rounded, ornamented with three spiral cords, of which the first is a little anterior

to the summit, the second median, and the third a little posterior to the suture. In addition to the spiral cords, the whorls are marked by retractive axial ribs which are almost as strong as the spiral cords. Of these ribs, 16 occur upon the second, 18 upon the third, and 20 upon the penultimate whorl. The junctions of the axial ribs and the spiral cords form prominent tubercles, while the spaces inclosed between them are elongated pits on the second whorl and well-rounded, well-impressed pits on the remaining ones. Sutures channeled. Periphery of the last whorl marked by a deep sulcus which is crossed by the continuations of the axial ribs which extend to the posterior edge of the first basal cord. Base moderately long, concave in the middle, marked by eight low, rounded, subequally spaced, spiral cords, which grow successively weaker from the periphery toward the tip of the columella. Aperture irregular, decidedly channeled anteriorly; posterior angle acute; outer lip rendered sinuous at the edge by the external sculpture; columella moderately long, twisted, the edge reflected, and joined to the posterior angle of the aperture by a strong callus which covers the parietal wall.

The type, which is on Tablet No. 2032, Liverpool collection, British Museum, has five post-nuclear whorls and measures: Length 1.6 mm., diameter 0.7 mm. It and three additional specimens were found on *Spondylus* at Mazatlan.

CERITHIOPSIS (CERITHIOPSIS) CARPENTERI, new species.

Plate 38, fig. 9.

Shell broadly elongate-conic, dark chocolate brown. Nuclear whorls three, smooth, well rounded, separated by a slender suture, forming an elongate-conic spire. Post-nuclear whorls well rounded, marked by three strong, broad, spiral bands which are as wide as the spaces that separate them. Of these, the first and widest is at the summit, the next is median, while the third is a little posterior to the suture. In addition to the spiral keels, the whorls are marked by slender, rounded, axial ribs which are about half as wide as the spiral cords. Of these ribs, 20 occur upon the first and second, 22 upon the third to fifth, 24 upon the sixth and seventh, 28 upon the eighth, and 30 upon the penultimate turn. The junctions of the axial ribs and spiral cords form strong, elongated tubercles, having their long axes parallel with the axial sculpture. The tubercles at the summit are well rounded anteriorly and posteriorly; those of the median series are a little more suddenly rounded anteriorly than posteriorly; while those belonging to the supraperipheral cord are truncated suddenly posteriorly and slope gently anteriorly. The spaces between the spiral cords and axial ribs are small, moderately rounded, well-impressed pits. Suture constricted, showing a portion of the basal cord. Periphery of the last whorl marked by a deep, spiral groove as wide as

that separating the first suprapерipheral cord from the median spiral cord and, like it, crossed by the continuations of the axial ribs. Base short, well rounded, marked by a broad, spiral cord which is truncated posteriorly and slopes gently anteriorly toward the shallow, well-marked groove which separates it from the base proper. Entire surface of spire and base marked by numerous, very slender, incremental lines. Aperture irregularly oval, very strongly channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, rendered decidedly sinuous at the edge by the external sculpture; columella stout, moderately long, the edge reflected; parietal wall glazed with a thin callus.

The above description is based upon the two cotypes which, together with 130 specimens, are registered as Cat. No. 109510, U.S.N.M., and come from Terminal Island, California. One of these specimens is a young individual consisting of the three nuclear whorls and six post-nuclear whorls; the other is an adult which has lost the nuclear whorls and has ten post-nuclear whorls which measure: Length 8.1 mm., diameter 2.8 mm.

Named for the late Dr. Philip P. Carpenter.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|---|----------------------|
| ¹ 109510 | Terminal Island, California..... | 132 |
| 109511 |do..... | 1 |
| 173088 |do..... | 21 |
| 73725 | San Pedro, California..... | 1 |
| 195178 | White's Point, San Pedro Bay, California..... | 2 |
| 152758 | Alamitos Bay, California..... | 35 |
| 159330 | San Diego, California..... | 5 |
| 134857 |do..... | 3 |
| ¹ 15653 |do..... | 1 |
| ¹ 130584 | San Diego, California (on sponge)..... | 4 |
| 56005 | San Diego, California..... | 17 |
| 32219 |do..... | 15 |
| 32287 |do..... | 114 |
| 130315 | False Bay, San Diego, California..... | 1 |
| 3566 | San Diego Bay, California (3 fathoms, sand and shell bottom, bottom temperature 58°)..... | 1 |
| 32220 | San Diego, California..... | 48 |
| 56006 |do..... | 18 |
| 123401 | San Diego, California (living on sponges)..... | 2 |

¹ Cotypes.

CERITHIOPSIS (CERITHIOPSIS) PEDROANA Bartsch.

Plate 38, fig. 2.

Cerithiopsis pedroana BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 181-182.

Shell small, slender, dark brown. Nuclear whorls three, yellowish-white, smooth. Post-nuclear whorls strongly differentiated from the nuclear ones, showing the sculpture characteristic of the adult shell from the very beginning. This sculpture consists of three equally spaced tuberculate spiral keels between the sutures, the posterior one of which is slightly smaller than the other two. These keels are sepa-

rated by deep, rounded channels almost as wide as the keel. In addition there are many low, rather broad axial ribs, the intersections of which with the keel form the tubercles. About 20 of them occur upon the first, 22 upon the fifth, and 30 upon the penultimate post-nuclear turn. The connections between the tubercles, both spiral and axial, are about equal, inclosing deep, squarish pits. In addition to the above sculpture the entire surface is marked by fine spiral lines and lines of growth. Sutures strongly marked, constricted, showing the peripheral keel in the later whorl. Periphery marked by a broad, low, rounded keel. Another of equal width is located upon the middle of the base. The sulcus which separates these keels and the supra-peripheral sulcus are of equal width; both are crossed by the weak continuations of the axial ribs, which gradually weaken as they pass toward the columella. The basal keel is separated from the columella by broad, shallow grooves. Aperture irregularly oval, decidedly channeled anteriorly, outer lip thin, rendered sinuous by the external keel; columella stout and somewhat twisted, with a strong callus on its inner edge that extends over the parietal wall.

The two cotypes, Cat. No. 109512, U.S.N.M., were collected by Mrs. W. H. Eshnaur at Terminal Island, San Pedro, California. The one has the nucleus and three post-nuclear whorls; the other has lost the nucleus and has nine post-nuclear turns and measures: Length 5.2 mm., diameter 1.8 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|--|----------------------|
| ¹ 109512 | Terminal Island, California..... | 350 |
| 56751 | Catalina Island, California..... | 1 |
| 195179 | San Pedro, California..... | 3 |
| 14825 | do..... | 1 |
| 195180 | White's Point, San Pedro, California..... | 1 |
| 73725a | San Pedro, California..... | 1 |
| 130581 | San Diego, California..... | 9 |
| 32287a | do..... | 40 |
| 32220b | do..... | 13 |
| 56006a | do..... | 3 |
| 123401 | do..... | 6 |
| 109364 | do..... | 1 |
| 199179 | do..... | 1 |
| 153058 | Government Jetty, San Diego, California..... | 7 |
| 106504 | Point Abreojos, Lower California..... | 1 |
| 32292 | Todos Santos Bay, Lower California..... | 1 |

¹ Cotypes.

CERITHIOPSIS (CERITHIOPSIS) TUBERCULOIDES Carpenter.

Plate 37, fig. 7.

Cerithiopsis tuberculoides CARPENTER, Cat. Maz. Shells, 1857, pp. 442-443.

Shell elongate-conic. Nuclear whorls five, well rounded, smooth, separated by a moderately constricted suture forming a well elevated spire. Post-nuclear whorls moderately rounded, ornamented with

three spiral cords of which the first is a little below the summit, the second median and the third a little posterior to the suture. These cords are separated by spaces a little wider than the cords. In addition to the spiral sculpture, the whorls are marked by decidedly retractive, axial ribs which are about as strong as the spiral cords. Of these ribs, 12 occur upon the first and second, 14 upon the third, 18 upon the fourth, and 20 upon the penultimate whorl. The junctions of the axial ribs and spiral cords form well rounded tubercles, while the spaces enclosed between them are deep, rounded pits. Sutures moderately constricted. Periphery of the last whorl marked with a strong, smooth, spiral cord which is separated from the first supraperipheral cord by a channel as wide as that which separates the supraperipheral cord from the median and, like it, is crossed by the continuations of the axial ribs, which extend to the posterior edge of the peripheral cord. Base moderately long, well rounded, marked by two broad rounded, spiral cords. Aperture irregularly oval, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella curved, twisted, the edge reflected; parietal wall covered with a thick callus.

Nine specimens of this species were reported by Doctor Carpenter taken from *Spondylus* and *Chama* at Mazatlan. The cotypes are on Tablet 2028, Liverpool collection, British Museum. The larger, a perfect specimen with seven post-nuclear whorls, measures: Length 3.75 mm., diameter 1.2 mm. Our figure is after a camera lucida sketch of the type by Doctor Carpenter.

CERITHIOPSIS (CERITHIOPSIS) TUBERCULOIDES, var. ALBONODOSA Carpenter.

Plate 37, fig. 3.

Cerithiopsis ? tuberculoides albonodosa CARPENTER, Cat. Maz. Shells, 1857, p. 443.

Of this Doctor Carpenter says:

Shell similar to *tuberculoides* with the tubercles more distant and white. Nuclear whorls four, less elevated and subcarinate.

Tablet 2029, Liverpool collection, British Museum, contains a young shell and a fragment of an adult shell taken from *Spondylus* at Mazatlan, Mexico.

Our figure is after a camera lucida sketch of the type by Doctor Carpenter.

CERITHIOPSIS (CERITHIOPSIS) PUPIFORMIS Carpenter.

Plate 38, figs. 1 and 5.

Cerithiopsis pupiformis CARPENTER, Cat. Maz. Shells, 1857, pp. 443-444.

Shell minute, elongate-conic, brown. Nuclear whorls four, smooth, separated by a constricted suture forming a mucronate apex. Post-nuclear whorls marked by three spiral cords of which the first is at

the summit, the third immediately posterior to the suture, while the second is half way between these two. These cords are a little wider than the spaces that separate them. In addition to the spiral cords, the whorls are marked by somewhat retractive, axial ribs a little less strong than the spiral cords. Of these 20 occur upon the second, 22 upon the third and fourth, and 24 upon the penultimate turn. The junctions of the axial ribs and spiral cords form well rounded tubercles, while the spaces between them are small rounded pits. Sutures well impressed. Periphery of the last whorl marked by a deep spiral sulcus. Base moderately long with two tumid, broad, rounded, spiral cords. Aperture irregularly oval, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella curved and twisted, with the edge reflected; parietal wall covered with a thick callus.

Tablet 2031, Liverpool collection, British Museum, contains Doctor Carpenter's two cotypes which were collected on *Spondylus* at Mazatlan, Mexico. The largest of these cotypes measures: Length 1.9 mm., diameter 0.3 mm. Our figure is after a camera lucida drawing by Doctor Carpenter of the type.

CERITHIOPSIS (CERITHIOPSIS) ABREOJOSENSIS, new species.

Plate 37, fig. 4.

Shell minute, elongate-conic, brown, excepting the nuclear whorls which are white. Nuclear whorls four and one-half, well rounded, smooth, separated by a moderately constricted suture, forming an elevated, cylindric spire which gives the apex of the shell a mucronate appearance. Post-nuclear whorls very slightly rounded, ornamented by three spiral cords, the first of which is at the summit, the second at the anterior termination of the posterior third between the sutures, while the last is considerably posterior to the suture. The median cord, therefore, is much nearer the cord at the summit than that at the suture. In addition to these spiral cords, the whorls are marked by very slightly retractive, axial ribs which are almost as strong as the spiral cords. Of these ribs 16 occur upon all but the penultimate turn, which has 18. The junctions of the axial ribs and the spiral cords form well rounded tubercles, while the spaces enclosed between them are elongated slits between the first and second spiral cords and elongated, almost squarish pits between the median and the peripheral cord. Sutures strongly constricted. Periphery of the last whorl marked by a spiral sulcus as wide as that which separates the suprapерipheral cord from the median cord between the sutures, and crossed by the continuations of the axial ribs. Base moderately long, marked by two strong, spiral cords, one of which is immediately below the periphery, while the other is a little posterior to the middle of the base, the two being separated by a channel equaling the periph-

eral one in width. In addition to the above sculpture, the base is marked by weak incremental lines. Aperture irregularly ovate, very strongly channeled anteriorly; posterior angle obtuse; outer lip thin, rendered somewhat sinuous by the external sculpture; columella stout, curved, and somewhat twisted, the edge reflected; parietal wall glazed with a thick callus.

The type (Cat. No. 106506, U.S.N.M.) comes from Point Abrejos, Lower California. It has six post-nuclear whorls and measures: Length 2.3 mm., diameter 0.8 mm.

CERITHIOPSIS (CERITHIOPSIS) BERRYI, new species.

Plate 39, fig. 8.

Shell small, elongate-conic, brown. Nuclear whorls four, well rounded, separated by constricted sutures, smooth, forming a mucronate apex to the shell. Post-nuclear whorls strongly sculptured, having three spiral cords between the sutures, of which the one at the summit is much smaller than the rest on the early whorls; the other two are subequal in strength, the second one being close to the one at the summit, while the third is almost halfway between the second and the suture. On the last whorl, the cord at the summit is almost equal to the other two. In addition to the spiral sculpture, the whorls are marked by vertical axial ribs which are stronger than the spiral cords. Of these ribs, 12 occur upon the second, 16 upon the third to fifth, 18 upon the sixth, and 20 upon the penultimate turn. The junctions of the axial ribs and spiral cords form strong tubercles, which are truncated posteriorly and slope gently anteriorly. The spaces inclosed between them are elongated, narrow pits between the first and second spiral cords on the early whorls, while on the last they are squarish pits in this region. The spaces between the median and supraperipheral cord are strongly impressed, large, squarish pits on all the whorls. Sutures strongly channeled. Periphery of the last whorl marked by a broad sulcus, equaling that which separates the supraperipheral from the median cord, crossed by the continuations of the axial ribs. Base marked by a strong, broad, rounded cord immediately below the periphery and a second less strong on its middle, while a slender thread encircles the insertion of the columella. In addition to this sculpture, the base is marked by strong, incremental lines. Aperture irregularly oval, decidedly channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, rendered sinuous at the edge by the external sculpture; columella stout, curved, strongly twisted, with the edge reflected; parietal wall glazed with a thick callus.

The type and two additional specimens (Cat. No. 195182, U.S.N.M.) were dredged by Mr. S. S. Berry in 12 fathoms off Del Monte, Monterey, California. The type has lost the nucleus, the eight post-nuclear

whorls measuring: Length 3.4 mm., diameter 1.3 mm. The nucleus was described from one of four specimens (Cat. No. 195198*a*, U.S.N.M.) from Whites Point, San Pedro, California. Cat. No. 195183, U.S.N.M., contains seven specimens from Monterey, and Cat. No. 195184, U.S.N.M., contains four specimens from San Pedro Bay, California.

CERITHIOPSIS (CERITHIOPSIS) GALAPAGENSIS, new species.

Plate 39, fig. 4.

Shell minute, regularly elongate-conic, golden brown, with the row of tubercles at the summit of the shell darker. Nuclear whorls five, well rounded, smooth, separated by a well-impressed suture. Post-nuclear whorls moderately rounded, ornamented with three tuberculate, spiral cords, of which the first (which is at the summit) is considerably less strong than the other two; the third is immediately above the suture, while the second is considerably nearer the first than the third. The space between the first and second is about half the width of the middle cord, while that between the second and third is equal to it. In addition to the spiral cords, the whorls are marked by axial ribs, which are about equal to the spiral cords in strength; of these ribs, 16 occur upon all but the penultimate whorl, which has 20. The intersections of the axial ribs and spiral cords form prominent tubercles, which are truncated posteriorly and slope gently anteriorly, while the spaces inclosed between them are elongated pits between the first and second spiral cords, having their long axes parallel with the spiral sculpture, and squarish pits between the second and third cords. Sutures strongly channeled. Periphery of the last whorl marked by a channel almost as wide as that which separates the supraperipheral cord from the median and, like it, crossed by the continuations of the axial ribs. Base moderately long, concave, marked by a strong spiral cord immediately below the peripheral sulcus, and another almost as strong which encircles the columella at its insertion. In addition to the spiral sculpture, the base is marked by fine, incremental lines. Aperture irregularly triangular, strongly channeled anteriorly, very effuse and angulated at the junction of the basal and outer lip; posterior angle very obtuse; outer lip thin, showing the external sculpture within, rendered sinuous at the edge by the external sculpture; columella moderately long, stout, curved, with the edge reflected; parietal wall covered with a thick callus.

The type and two additional specimens (Cat. No. 195185, U.S.N.M.) were dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 2813 in 40 fathoms, on coral sand bottom, bottom temperature 81°, off Galapagos Islands. The type is a perfect specimen, having six post-nuclear whorls and measures: Length 2.4 mm.,

diameter 0.8 mm. Cat. No. 195187, U.S.N.M., contains three specimens from the same locality. Cat. No. 122128, U.S.N.M., contains two specimens dredged off Indefatigable Island, Galapagos Islands.

CERITHIOPSIS (*CERITHIOPSIS*) *CESTA*, new species.

Plate 39, fig. 5.

Shell elongate-conic, chestnut brown. Nuclear whorls, three, well rounded and smooth forming a slender elongate spire. Post-nuclear whorls strongly rounded, marked with three feebly tuberculated spiral keels between the sutures of which the posterior is at the summit and the anterior at some little distance posterior to the suture, the median one being a little nearer the anterior than its other neighbor. The spaces between these keels are not quite as wide as the keels. In addition to the spiral keels, the whorls are marked with feeble, somewhat irregular axial riblets which are less than half as strong as the spiral keels; of these ribs, 14 occur upon the third and 32 upon the remaining whorls. These ribs render their junction with the spiral cords feebly nodulose. The spaces inclosed between the spiral cords and the axial ribs are feebly impressed, squarish pits. In addition to the above sculpture, the entire surface of the shell is crossed by fine incremental lines and very fine spiral striations. Sutures strongly impressed, with the peripheral cord showing as a slender, smooth band in all but the first two whorls. Periphery of the last whorl marked by a broad, depressed spiral cord which is separated from the first suprasutural cord of the spire by a sulcus as wide as that separating this cord from its posterior neighbor. This groove is crossed by the continuations of the axial ribs. Base large, moderately rounded, marked with a slender spiral cord which is a little nearer the peripheral cord than the slender fasciole at the insertion of the columella. Aperture irregularly ovate; outer lip thin, rendered sinuous at the edge by the external sculpture showing the external sculpture within; columella stout, rather long, twisted and curved; parietal wall glazed with a thin callus. The above description is based on two individuals, one an adult (Cat. No. 153057, U.S.N.M.) collected at the Government Jetty, San Diego, California. This has lost all but the last nuclear whorl, having eight post-nuclear whorls and measuring: Length 5.8 mm., diameter 2.1 mm. The other is one of three specimens (Cat. No. 160079 U.S.N.M.) collected at San Diego. This has the nucleus and six post-nuclear whorls and measures: Length 3.2 mm., diameter 1.6 mm.

CERITHIOPSIS (CERITHIOPSIS) STEJNEGERI Dall.

Plate 40, fig. 3.

Cerithiopsis stejnegeri DALL, Proc. U. S. Nat. Mus., vol. 7, 1884, pp. 345-346, pl. 2, fig. 4.

Shell broadly conic, light chestnut brown, excepting the nucleus and the columella. Nuclear whorls two, strongly rounded, smooth. Post-nuclear whorls well rounded, marked with three nodulose spiral keels, of which one is at the shouldered summit, another somewhat posterior to the suture, while the third is median between the two. The anterior of the three is the stronger and the one at the summit the weakest. These cords are about as wide as the spaces that separate them. In addition to the spiral cords the whorls are marked by very poorly developed, almost vertical axial riblets, the junctions of which with the spiral cords form the nodules. Of these ribs 16 occur upon the second, 18 upon the third, 22 upon the fourth, 24 upon the fifth, and 26 upon the penultimate whorl. The spaces inclosed between the spiral cords and axial ribs are irregular, shallow, impressed, rounded pits. Sutures strongly constricted, showing the posterior edge of the base. Periphery of the last whorl marked by a sulcus which is crossed by the feeble axial riblets; base well rounded, smooth, excepting incremental lines. Aperture broadly ovate; decidedly channeled anteriorly; posterior angle obtuse; outer lip thin, rendered wavy by the external sculpture showing the external sculpture within; columella short, stout, twisted, and curved; parietal wall glazed with a thin callus which extends from the inner edge of the columella to the posterior angle of the aperture.

The type (Cat. No. 40932, U.S.N.M.) was collected by Dr. L. Stejneger at Bering Island. It has eight post-nuclear whorls, having lost the nuclear turns and measures: Length 5.5 mm., diameter 2.2 mm. The nuclear whorls were described from a specimen of Cat. No. 195172, U.S.N.M.

Specimens examined.

| U.S.N.M. Cat. No. | Locality. | Number of specimens. |
|----------------------|---|-------------------------|
| 40932 | Bering Island..... | 1 |
| 161049 | Kyska Harbor, Aleutian Islands, Alaska..... | 1 |
| 195172 | Amchitka Islands, Aleutian Islands, Alaska..... | 28 |
| 130625 | Amchitka Islands, Aleutian Islands, Alaska (low water)..... | 4 |
| 195174 | Constantine Harbor, Aleutian Islands, Alaska..... | 4 |
| 161108 | do..... | 4 |
| 161036 | Captains Harbor, Unalaska, Aleutian Islands, Alaska..... | 1 |
| 195173 | East side Simeonoff Island, Shumagin Islands, Alaska..... | 5 |

¹ Type.

CERITHIOPSIS (CERITHIOPSIS) STEJNEGERI DINA, new subspecies.

Plate 40, fig. 7.

This is the southern representative of *C. stejnegeri*, differing from the species in having the sculpture much more strongly pronounced and in being larger. Three specimens are known (Cat. No. 195175, U.S.N.M.) which come from Sitka, Alaska. The type has three nuclear whorls and seven post-nuclear whorls and measures: Length 7 mm., diameter 2.6 mm.

CERITHIOPSIS (CERITHIOPSIS) NEGLECTA C. B. Adams.

Plate 40, fig. 5.

Cerithium neglectum C. B. ADAMS, ANN. N. Y. LYCEUM NAT. HIST., vol. 5, 1852, p. 378.

Shell minute, elongate-conic, dark brown excepting the nuclear whorls, which are white. Nuclear whorls at least four, well rounded, smooth, forming a mucronate apex. Post-nuclear whorls ornamented with three spiral cords, the first of which is very feeble on the early whorls and even less strong than the other two on the last volution; the second cord is at the posterior termination of the anterior third between the sutures, while the third is a little nearer the suture than the median. The first and second are only about half as far apart as the median and third. In addition to the spiral sculpture, the whorls are marked by retractive axial ribs, which are about as strong as the spiral cords. Of these ribs, 16 occur upon the first, 14 upon the second to fourth, 16 upon the fifth and sixth, and 18 upon the penultimate turn. The intersections of the axial ribs and the spiral cords form strong, cusped tubercles. Those on the first spiral cord are the weakest and are well rounded; those on the second and third are truncated posteriorly and slope less abruptly anteriorly. The spaces inclosed between the axial ribs and spiral cords are elongated pits between the first and second spiral cords, having their long axes parallel to the spiral sculpture, while those between the second and third are strongly impressed, squarish pits. Suture strongly constricted. Periphery of the last whorl marked by a strong, spiral cord, separated from the supra-sutural cord by a sulcus as wide as that which separates the supra-sutural from the median and, like this, crossed by the continuations of the axial ribs, which terminate at the posterior edge of the peripheral cord. Base moderately long, ornamented with two spiral cords. Aperture irregularly subquadrate, decidedly channeled anteriorly; posterior angle acute; outer lip rendered wavy by the external sculpture, which is apparent within the aperture; columella short, stout, curved, with the free edge reflected; parietal wall covered

with a thick callus which connects the columella with the posterior angle of the aperture.

The specimen described and figured (Cat. No. 211566, U.S.N.M.) is one collected by Prof. C. B. Adams at Panama. It has eight post-nuclear whorls and measures: Length 3.2 mm., diameter 1.1 mm.

CERITHIOPSIS (CERITHIOPSIS) HALIA, new species.

Plate 40, fig. 8.

Shell small, broadly elongate-conic, chocolate brown. (Early nuclear whorls decollated.) Only the last volution remains, which is smooth. Post-nuclear whorls strongly shouldered at the summit on the early whorls, ornamented with three spiral cords, of which the first, at the summit, is very poorly developed; the second is situated at the posterior termination of the anterior third between the sutures; while the third, which equals the second, is about halfway between this and the suture. In addition to the spiral cords, the whorls are marked by decidedly retractive, axial ribs which are almost equal to the spiral cords in strength. Of these ribs, 12 occur upon the first, 14 upon the second, 16 upon the third and fourth, 18 upon the fifth, and 20 upon the penultimate turn. The intersections of the axial ribs and spiral cords form well-rounded tubercles, while the spaces inclosed by them are elongated pits between the first and second spiral cord, and large, squarish pits between the second and third. Periphery of the last whorl marked by a sulcus not quite as broad as that which separates the supraperipheral from the median cord, and crossed by the continuations of the axial ribs. Base short, concave, marked by two spiral cords immediately below the peripheral sulcus and by numerous fine, incremental lines. Aperture subquadrate, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous at the edge by the external sculpture which is apparent in the aperture; columella short, curved, and twisted, with the free edge reflected; parietal wall glazed with a thin callus.

We have seen three specimens of this species, none of them quite mature. Cat. No. 32399, U.S.N.M., contains the type and another specimen from Todos Santos Bay, Lower California. The type has eight post-nuclear whorls and measures: Length 4.5 mm., diameter 2.1 mm. The third specimen (Cat. No. 16196, U.S.N.M.) comes from Cape San Lucas, Lower California.

CERITHIOPSIS (CERITHIOPSIS) AUREA, new species.

Plate 40, fig. 1.

Shell elongate-conic, bright, light chestnut brown, excepting the extreme apex, which is wax yellow. Early nuclear whorls decollated; the last one only remains and is well rounded and smooth. Post-nuclear whorls well rounded, appressed at the summit; marked

by three nodulose, spiral cords which divide the spaces between the sutures into four equal parts. In addition to the spiral cords, the shell is marked with well-rounded, vertical, axial ribs which extend from the summit to the suture and are as strong as the spiral cords, rendering their intersections with them strongly tuberculate. Of these ribs, 16 occur upon the first, 18 upon the second to fifth, and 24 upon the penultimate turn. The spaces inclosed between the spiral cords and axial ribs are deep, squarish pits, except on the last whorl, on which they are rectangular, having their long axes coinciding with the axial ribs. In addition to the above sculpture, the entire surface of the spire is marked by very fine lines of growth and numerous microscopic, spiral striations. Suture well impressed, in the last two turns showing the posterior edge of the peripheral cord as a slender, raised thread. Periphery of the last whorl marked by a strong, smooth, spiral cord; the sulcus which separates this keel from the supraperipheral cord is crossed by the strong continuations of the axial ribs. Base decidedly concave between the peripheral cord and the slender, basal fasciole which is at the insertion of the columella; marked by rather strong lines of growth and fine microscopic, spiral striations. Aperture broadly ovate; decidedly channeled anteriorly; posterior angle obtuse; outer lip thin, rendered sinuous by the external sculpture which shows strongly within; columella short, very broad at base, curved and somewhat twisted; parietal wall glazed with a thin callus.

The type (Cat. No. 16196, U.S.N.M.) has seven post-nuclear whorls and measures: Length 7 mm., diameter 2.4 mm. It was collected by Xantus at Cape San Lucas, Lower California.

CERITHIOPSIS (CERITHIOPSINA) NECROPOLITANA, new species.

Plate 39, fig. 1.

Shell almost cylindro-conic, creamy white. Nuclear whorls two, a little wider than the first post-nuclear whorl succeeding them; first half smooth, the rest marked by strong, slightly retractive, sublamellar, axial ribs, of which 14 occur upon the first whorl and 17 upon the second. Post-nuclear whorls moderately rounded, ornamented with three spiral cords, the first of which is at some little distance below the summit, giving this a decidedly shouldered aspect, while the third is an equal distance posterior to the suture, the second being halfway between the two. In addition to the spiral cords, the whorls are marked by vertical, axial ribs, almost equaling the spiral cords in strength; of these ribs, 14 occur upon the first, 16 upon the second to sixth, 18 upon the seventh, and 22 upon the penultimate turn. The junctions of the axial ribs and spiral cords form strong, cusp-like tubercles which are elongate on the first spiral cord, having their long axes parallel to the spiral sculpture, and are suddenly

truncated posteriorly on the second and third cords, sloping gently anteriorly. The spaces inclosed between the spiral cords and axial ribs are rectangular pits, having their long axes parallel to the spiral sculpture. The axial ribs extend prominently to the appressed summit of the whorls, forming a series of pits above the first spiral cord. Suture strongly constricted, showing the posterior edge of the base in all the turns. Periphery of the last whorl marked by a sulcus not quite as wide as that which separates the second and third cords and, like it, crossed by the continuations of the axial ribs. Base moderately long, smooth except for incremental lines, the peripheral sulcus giving the posterior edge of the base a decidedly angulated aspect. Aperture irregularly, broadly oval, decidedly channeled anteriorly; posterior angle very obtuse; outer lip rendered sinuous by the external sculpture; columella strongly curved and twisted, the free edge reflected; parietal wall covered with a moderately thick callus.

The type is a perfect specimen of nine post-nuclear whorls and measures: Length 7.7 mm., diameter 1.8 mm. It and seven additional specimens (Cat. No. 195205, U.S.N.M.) came from the Lower San Pedro Series, Deadmans Island, California.

CERITHIOPSIS (CERITHIOPSISINA) ADAMSI, new species.

Plate 41, fig. 1.

Shell minute, elongate-conic, dark brown. Nuclear whorls three and one-half, of which the first one and one-half are smooth, while the succeeding two are marked by slender, axial riblets, 30 of which occur upon the last and 24 upon the preceding turn. Post-nuclear whorls moderately rounded, marked by three spiral cords, of which the first, which is at the summit, is more poorly developed than the other two, which are equal. These two cords divide the remainder of the whorls between the sutures into three equal areas. In addition to the spiral sculpture, the whorls are marked by axial ribs which are almost as strong as the spiral cords. Of these ribs, 16 occur upon the second and third, 18 upon the fourth, and 24 upon the penultimate turn. The junctions of the axial ribs and spiral cords form well-rounded tubercles, while the spaces inclosed between them are strongly impressed, rectangular pits. Suture strongly impressed. Periphery of the last whorl marked by a broad sulcus which equals the sulcus between the supraperipheral and the median cord in width and, like this, is crossed by the continuations of the axial ribs, which extend to the posterior edge of the first basal cord. Base moderately long, well rounded, marked by two strong, spiral cords, the stronger of which is immediately below the peripheral sulcus, while the other is a little posterior to the insertion of the columella. Aperture broadly

oval, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture, which is apparent within the aperture; columella very short, very broad and curved, with the free edge reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 3775, U.S.N.M.) comes from Panama. It has six postnuclear whorls and measures: Length 2.1 mm., diameter 0.7 mm.

Named for the late Prof. C. B. Adams.

CERITHIOPSIS (*CERITHIOPSIDA*) *DIEGENSIS*, new species.

Plate 40, fig. 4.

Shell small, broadly elongate-conic, chestnut brown. Nuclear whorls two and one-half; the first half smooth; the next turn has about 20 slender, axial threads; while the last whorl has about 32 axial threads and 2 spiral cords, the first of which is on the middle of the whorl, and the second one about halfway between this and the suture. The early post-nuclear whorls have 2 spiral cords, like the last of the nuclear whorls. Beginning with the third turn, a slender, spiral cord appears immediately anterior to the summit, increasing rapidly in size until, on the last volution, it is about equal to the other two. In addition to the spiral sculpture, the whorls are marked by strong, axial ribs equaling the spiral cords in strength. Of these ribs, 16 occur upon all but the penultimate turn, which has 18. The junctions of the axial ribs and spiral cords form prominent, cusp-like tubercles, while the spaces inclosed between them form large, squarish pits. Suture strongly impressed. Periphery of the last whorl marked by a strong keel, separated from the supraperipheral cord by a sulcus as wide as that which separates the supraperipheral from the median cord and, like it, crossed by the continuations of the axial ribs which terminate at the posterior border of the peripheral cord. Base short, concave, bearing a slender fasciole at the insertion of the columella. Entire surface of spire and base crossed by numerous fine, incremental lines. Aperture subquadrate, very strongly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture, which is apparent in the aperture; columella short and broad, twisted, the free edge reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 160079, U.S.N.M.) comes from San Diego, California. It is not quite mature, has six post-nuclear whorls, and measures: Length 4 mm., diameter 1.6 mm. Another specimen (Cat. No. 162044, U.S.N.M.) comes from San Clemente Island, California.

CERITHIOPSIS (CERITHIOPSISIDA) ROWELLI, new species.

Plate 40, fig. 6.

Shell elongate-conic, pale brownish yellow. Nuclear whorls large and tumid extending considerably beyond the lateral outline of the first post-nuclear whorl; the first half volution, smooth, well rounded; the remaining one and a half decidedly inflated, strongly rounded, crossed by very strong acute axial ribs which are about one-third as wide as the strongly impressed intercostal spaces that separate them. Of these ribs, about 17 are on the last turn. Post-nuclear whorls slopingly shouldered, below the appressed summit marked by three tuberculate, spiral keels which divide the spaces between the sutures into four equal rows. In addition to the spiral keels, the whorls are marked by strong, broad axial ribs, the intersection of which with the spiral keels appear as prominent cusps. Of these ribs, 16 occur upon the first and second, 18 upon the third, 20 upon the fourth and penultimate turn. The individual tubercles of all three keels are truncated posteriorly and slope gently and regularly to the anterior border. The spaces inclosed by the axial ribs and spiral keels are well impressed, squarish pits. Suture strongly constricted; periphery of the last whorl marked by a prominent, smooth keel; base short, almost flat, smooth, excepting lines of growth and a slender fasciole about the base of the columella. Aperture irregularly ovate; decidedly channeled anteriorly; posterior angle acute; outer lip rendered decidedly sinuous by the external sculpture; columella very broad at base, somewhat twisted and sinuous, the anterior edge slightly reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 15559) was taken from *Haliotis* by Rowell, exact locality not known. The label bears the legend "West coast of North and Middle America." It probably came from California. It has six post-nuclear whorls and measures: Length 4.5 mm., diameter 1.8 mm.

CERITHIOPSIS (CERITHIOPSISIDELLA) COSMIA Bartsch.

Plate 38, fig. 7.

Cerithiopsis cosmia BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 180-181.

Shell elongate-conic, variegated with various shades of brown, white, and wax yellow. Nuclear whorls three and one-half, slender, lending the apex a mucronate appearance. First nuclear whorl smooth, second crossed by feeble axial riblets. The riblets increase considerably in size in the remaining turns, where they are very regularly developed and evenly spaced. These riblets are strongly protractive as they pass from summit to suture, the extremity at the suture being considerably in advance of the extremity at the summit. In addition to the vertical riblets, microscopic, crinkly lines appear in the intercostal spaces

which intersect the riblets in oblique even curves at right angles. The transition from the nuclear to the post-nuclear sculpture is abrupt, the three chief tuberculate spiral keels being present from the very beginning of the first post-nuclear turn. On the first four post-nuclear turns the posterior spiral keel is less developed than the rest, but it increases with each succeeding turn and finally becomes the strongest of the three. The tubercles on the early whorls are almost round and slope abruptly, concavely posteriorly and are gently well rounded anteriorly. On the later whorls they are oblong, with their long axis vertical. Channels separating the spiral keels about as wide as the keels on the early whorls, less so in the later turns, curved by the low, broad, strong, backward-slanting, axial riblets. The spaces between these ribs and the spiral keels appear as rounded pits. Sutures well impressed. Periphery of the last whorl marked by a strong spiral keel. Base well rounded, marked by three equal and equally spaced, spiral keels separated by equally wide and strong channels. The entire surface of the spire and base are marked by microscopic lines of growth and spiral striations. Aperture sub-quadrate, posterior angle obtuse, decidedly channeled at the junction of the short, thick, somewhat twisted columella and outer lip.

This description is based upon two specimens, cotypes, Cat. No. 195196, U.S.N.M. One has the nucleus and eleven post-nuclear whorls, and has furnished the description of the nucleus. This measures: Length 7.3 mm., diameter 2.3 mm. The other has lost its nucleus and probably the first two post-nuclear turns, and measures: Length 9 mm.; diameter 2.9 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|--|----------------------|
| 160870 | Monterey, California..... | 1 |
| 56012 |do..... | 1 |
| 56008 |do..... | 3 |
| 160677 | Catalina Island, California..... | 2 |
| 195197 | San Pedro Bay, California..... | 5 |
| ¹ 195196 | Whites Point, San Pedro Bay, California..... | 33 |
| 195190 | San Pedro Bay, California..... | 1 |
| 153057a | Government Jetty, San Diego, California..... | 3 |
| 198601 | San Diego, California..... | 5 |
| 109365 |do..... | 2 |
| 195171 | San Diego, California (dredged 12-15 fathoms)..... | 2 |
| 198757 | Southern California..... | 1 |
| 32392 | Todos Santos Bay, Lower California..... | 3 |
| 198972 |do..... | 1 |

¹ Cotypes.

CERITHIOPSIS (CERITHIOPSISIDELLA) ANTEFILOSA, new species.

Plate 40, fig. 9.

Shell elongate-conic, light chestnut brown. Nuclear whorls three and one-half, moderately rounded, separated by a poorly defined suture; the first one smooth, the next two and one-half with slender

closely spaced axial threads and fine, spiral lirations in the intercostal spaces. Post-nuclear whorls slightly rounded, marked by three tuberculate spiral cords of which the posterior one is at the summit, the anterior at some little distance posterior to the suture, while the third is about median between the two. The posterior cord is very poorly developed on the early whorls, in fact quite absent on the first volution, but grows steadily in size until, in the last volution, it is as strong as the other two. In addition to the spiral cords, the whorls are marked by vertical axial ribs which are as strong as the spiral cords and render the junction with them tuberculate. Of these ribs, 14 occur upon the first to third, 16 upon the fourth, 18 upon the fifth and sixth, 20 upon the seventh to ninth, 22 upon the tenth, and 24 upon the penultimate turn. The tubercles of the posterior cord are well rounded, that of the median slightly truncated posteriorly, while on the anterior cord they appear truncated in the middle, sloping gently anteriorly and very suddenly posteriorly. Sutures strongly constricted; periphery of the last whorl marked by a sulcus which is as wide as the spaces that separate the keels on the spire and like them is crossed with the continuations of the axial ribs. Base short, well rounded, marked by four spiral keels which grow gradually weaker and a little closer spaced from the periphery to the umbilical area, the last one forming a slender basal fasciole about the insertion of the columella. In addition to the spiral sculpture, the base is marked by numerous fine incremental lines. Aperture rhomboidal; decidedly channeled anteriorly; posterior angle acute; outer lip thin, rendered wavy by the external sculpture; columella moderately long, stout, decidedly curved, and somewhat twisted.

The type (Cat. No. 195200, U.S.N.M.) has lost the first two nuclear whorls, the thirteen remaining whorls measuring: Length 6.9 mm., diameter 1.8 mm., and comes from 8 miles off Point Loma Light, California, U. S. Bureau of Fisheries station 4310, and was dredged in 71 to 75 fathoms on gray mud and fine sand bottom. The early nuclear whorls were described from a young specimen (Cat. No. 195201, U.S.N.M.) from Whites Point, San Pedro Bay. Three other specimens (Cat. No. 195202, U.S.N.M.) were dredged in 12 to 15 fathoms off San Diego.

CERITHIOPSIS (CERITHIOPSIDELLA) ALCIMA, new species.

Plate 39, fig. 2.

Shell elongate-conic, chestnut brown. Nuclear whorls three and one-half, small, moderately rounded, separated by a well-impressed suture; the first whorl smooth; the second and third marked by slender, protractive, curved, axial ribs, of which 18 occur upon the second and 20 upon the third. Intercostal spaces about twice as wide as the axial ribs, crossed by about 15 slender, spiral lirations.

Post-nuclear whorls moderately rounded, appressed at the summit, ornamented with three spiral cords, of which the first is at the summit, which on the first five whorls is scarcely apparent; beginning with the sixth turn, it increases in size until on the last volution it almost equals the other two. The third cord is about as far posterior to the suture as it is from the second cord, which is halfway between the first and third. The spiral cords are not quite as wide as the spaces that separate them. In addition to the spiral cords, the whorls are marked by low, almost vertical, axial ribs, which are less strong than the spiral cords and render their intersections with these cuspidate. Of the axial ribs, 16 occur upon the second to fourth, 18 upon the fifth and sixth, 20 upon the seventh, 22 upon the eighth, and 24 upon the ninth and penultimate turn. The tubercles formed by the junction of the first cord and the axial ribs are well rounded; those formed by the junction of the median cord and the ribs are truncated anteriorly and posteriorly, sloping a little more gently anteriorly than posteriorly; those formed by the junction of the third cord and the ribs are decidedly truncated posteriorly, sloping gently anteriorly. The spaces inclosed between the axial ribs and the spiral cords are strongly impressed, squarish pits. Suture well marked, showing the posterior edge of the peripheral cord. Periphery of the last whorl marked by a strong cord, separated from the supraperipheral cord by a sulcus almost as wide as that which separates the supraperipheral cord from the median and, like it, crossed by the continuations of the axial ribs which terminate at the posterior border of the peripheral cord. Base rather short, concave, marked by two, strong, spiral cords and a slender fasciole, the latter surrounding the columella at its insertion, while the former divides the space between it and the peripheral cord into equal areas. In addition to the above sculpture, the entire base and spire are marked by numerous slender, incremental lines. Aperture irregularly subquadrate, strongly channeled anteriorly; posterior angle obtuse; outer lip thin, rendered sinuous at the edge by the external sculpture, which is apparent in the aperture; columella short, stout, twisted, with the free edge reflected; parietal wall glazed with a thin callus.

The type has ten post-nuclear whorls and measures: Length 7.2 mm., diameter 1.2 mm. It and twenty-one additional specimens (Cat. No. 195198, U.S.N.M.) come from Whites Point, San Pedro, California. Cat. No. 195199, U.S.N.M., contains four specimens, also from San Pedro, California.

CERITHIOPSIS EXCELSA Dall.

Plate 36, fig. 1.

Cerithiopsis excelsus DALL, Prof. Paper No. 59, U. S. Geol. Surv., 1909, p. 75.

Shell very large, elongate-conic. (Nuclear whorls decollated.) Post-nuclear whorls appressed at the summit, well rounded, marked by poorly developed, rounded, almost vertical, axial ribs, of which 12 occur upon the first three of the remaining whorls, 14 upon the fourth to sixth, 16 upon the seventh, 20 upon the eighth, 24 upon the ninth, and 32 upon the penultimate turn. In addition to these axial ribs, the shell is provided at irregular intervals with long varices. The spiral sculpture consists of slender cords. These are of several strengths. On the eighth whorl there are four equally strong, which divide the space between the sutures into four subequal parts. The first of these cords is at the summit. In addition to these four there are four more spiral cords, less strong than those just mentioned, occupying the space midway between the other cords. On the penultimate whorl additional slender threads, which are still weaker, occur between the spirals just mentioned. The junctions of the axial ribs and the spiral cords, particularly the stronger, form feeble, rounded nodules. Suture strongly constricted. Periphery of the last whorl marked by a spiral cord as strong as the strongest between the sutures. Base well rounded, marked by six equal and equally spaced spiral cords, in the spaces between which a slender spiral thread is present. The aperture is obstructed by the matrix and is strongly channeled anteriorly; outer lip slightly expanded and thickened; columella short and stout.

The type (Cat. No. 107400, U.S.N.M.) comes from the Oregonian Eocene of North Fork of Umpqua River, at Schrum's Ranch, station 2798. It measures: Length 20.5 mm., diameter 6.5 mm.

CERITHIOPSIS CURTATA, new species.

Plate 36, fig. 3.

Shell small, elongate-ovate, light brown. Nuclear whorls decollated. Post-nuclear whorls moderately rounded, ornamented with three spiral keels, of which the first is at the summit, the next immediately adjacent to it, being separated from it by a strong, incised line only, on all but the last whorl; on this it is a little more distant. The third keel is immediately above the suture. In addition to the spiral keels, the whorls are marked by slightly retractive, axial ribs which are almost equal to the spiral keels in strength. Of these ribs, 14 occur upon the second, 16 upon the third, 18 upon the fourth, 20 upon the fifth and the penultimate whorl. The junctions of the axial ribs and spiral keels form prominent tubercles which are truncated posteriorly and slope gently anteriorly, while the spaces inclosed

between them are moderately large, rounded pits. The last whorl is considerably contracted anteriorly, which gives the oval outline to the shell. Sutures strongly channeled. Periphery of the last whorl marked by a strong, spiral cord, which is smooth. Base moderately produced, bearing a strong, spiral cord at the insertion of the columella. Aperture small, irregularly ovate, very strongly channeled anteriorly; posterior angle obtuse; outer lip thick within, thin at the edge, rendered sinuous by the external sculpture; columella moderately long, stout, twisted, revolute and reflected.

The type (Cat. No. 195186, U.S.N.M.) has seven post-nuclear whorls and measures: Length 2.5 mm., diameter 1.0 mm. It was dredged at U. S. Bureau of Fisheries station 2813, in 40 fathoms, on coral sand bottom, bottom temperature 81°, off the Galapagos Islands.

CERITHIOPSIS FOSSILIS, new species.

Plate 38, fig. 3.

Shell elongate, subcylindrical. (Nuclear whorls decollated.) Post-nuclear whorls almost flattened, marked by three equal and equally spaced tuberculated spiral cords, of which one is at the summit, another at some little distance above the periphery, while the third is median between the two. In addition to the spiral cords, the whorls are crossed by almost vertical axial riblets which are as strong as the spiral cords and render them tubercular at their junction. Of these ribs 26 occur upon the penultimate turn and the one preceding it, 24 on the next two, 22 upon the next, and 20 upon the first of the remaining turns. The spaces inclosed between the spiral cords and axial ribs are strongly impressed, rounded pits. Sutures moderately constricted, showing the posterior edge of the first basal cord as a slender thread in all of the whorls. Periphery of the last whorl marked by a channel, which is as broad as those that separate the spiral cords on the spire and like them crossed by the continuation of the axial ribs. Base short, almost concave near the columella, marked by three equal and equally spaced spiral cords. Aperture (?) decidedly channeled anteriorly; posterior angle acute; outer lip fractured; columella, stout, curved, and twisted.

The type (Cat. No. 195193, U.S.N.M.) has seven whorls remaining, and measures: Length 7.2 mm., diameter 2.6 mm. It comes from the Lower San Pedro Series of Dead Man's Island, California.

CERITHIOPSIS GLORIOSA, new species.

Plate 36, fig. 7.

Shell elongate-conic, flesh-color, variegated with flecks of brown; the early whorls are light brown, while the base is dark chestnut. (Nuclear whorls decollated.) Post-nuclear whorls marked by three

strong sublamellar keels, which are not quite as wide as the spaces that separate them. The first of these is near to the appressed summit, the third quite a bit anterior to the suture, while the second occupies the space midway between these two. In addition to these keels, the whorls are marked by slightly protractive, axial ribs which are equal to the spiral cords in strength. Of these ribs, 16 occur upon the first to fifth, 18 upon the sixth, 20 upon the seventh, 22 upon the eighth, 24 upon the ninth, and 26 upon the penultimate turn. The junctions of the axial ribs and spiral cords form strong, cusp-like tubercles, which are suddenly truncated posteriorly and slope gently anteriorly; the spaces between them are deep, squarish pits. Sutures moderately constricted, showing the peripheral cord on all the turns. Periphery of the last whorl marked by a very strong, spiral keel, the space between which and the first supraperipheral keel is almost as wide as that separating the supraperipheral keel from the median, and, like that, is crossed by the continuations of the axial ribs which extend prominently to the posterior termination of the peripheral keel. Base marked by a slender, basal fasciole which surrounds the insertion of the columella, the space between the fasciole and the peripheral cord being concave. Aperture irregularly oval, very strongly channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, rendered decidedly sinuous at the edge by the external sculpture; columella short and stout, the edge reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 213301, U.S.N.M.) comes from California without definite designation of locality. It has eleven post-nuclear whorls (having lost the nucleus and probably the first post-nuclear turn) and measures: Length 8.6 mm., diameter 2.4 mm.

CERITHIOPSIS COLUMNA Carpenter.

Plate 36, fig. 6.

Cerithiopsis columna CARPENTER, Rept. Brit. Ass. Adv. Sci., 1864, p. 660; Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 32.

Shell elongate-conic, light chestnut brown. (Early whorls decolored.) Succeeding turns very slightly rounded, marked by three tuberculate spiral keels, of which one is at the summit, another a little above the periphery, and a third a little nearer the posterior than its supra-sutural neighbor. These keels are separated by spiral grooves, which are only about one-third as wide as the keels. In addition to the spiral keels, the whorls are marked by almost vertical axial ribs, which are about two-thirds as strong as the spiral cords and very closely spaced. Of these, 16 occur upon the second and third, 18 upon the fourth, 22 upon the fifth and sixth, 24 upon the seventh, 26 upon the eighth and 32 upon the penultimate turn. The narrow spaces inclosed between the ribs and spiral cords appear as small,

well impressed, rounded pits. Suture moderately constricted, showing the posterior edge of the first basal keel in the early whorls. Periphery of the last whorl marked by a sulcus as wide as those that separate the keels on the spire, and the continuation of the axial ribs. Base short, well rounded, marked with three slender spiral keels which are situated on the posterior two-thirds and separated by shallow channels. The first of these is crossed by slender continuations of the axial ribs. The space immediately about the base of the columella is free of sculpture excepting fine, incremental lines. Aperture subquadrate, decidedly channeled anteriorly; posterior angle acute; outer lip rendered sinuous by the external sculpture; columella very broad at base, stout, somewhat twisted and curved and the edge reflected.

Doctor Carpenter's type (Cat. No. 14823*b*, U.S.N.M.) was collected by J. G. Swan at Neah Bay, Washington, and measures: Length 9.2 mm., diameter 2.6 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|-----------------------------|----------------------------------|----------------------|
| ¹ 14823 <i>b</i> | Neah Bay, Washington..... | 1 |
| 32218 | Vancouver Island..... | 3 |
| 14823 <i>c</i> | Monterey, California..... | 1 |
| 32398 | Monterey Harbor, California..... | 2 |
| 56007 | Monterey, California..... | 3 |

¹ Type.

CERITHIOPSIS INFREQUENS C. B. Adams.

Plate 37, fig. 1.

Cerithium infrequens C. B. ADAMS, Ann. N. Y. Lyc. Nat. Hist., vol. 5, 1852, p. 383.

Shell small, broadly elongate-conic, blackish-red. Nuclear whorls five, well-rounded, smooth. Post-nuclear whorls marked by three strong, spiral cords which are about half as wide as the spaces that separate them. The first of these is a little anterior to the summit, and the second is a little nearer the first than the third, which is about as far removed from the second as it is from the suture. In addition to the spiral cords, the whorls are marked by decidedly retractive, axial ribs which are about as wide as the cords. Of these ribs, 12 occur upon the second, 14 upon the third, 16 upon the fourth and fifth, 18 upon the sixth and seventh, and 20 upon the penultimate turn. The junctions of the axial ribs and the spiral cords form well-rounded tubercles, while the spaces inclosed between them are deep, rounded pits. Suture strongly impressed. Periphery of the last whorl marked by a sulcus as wide as that which separates the third from the second cord and, like it, crossed by the continuations of the

axial ribs which terminate at the posterior border of the first basal keel. Base moderately long, somewhat concave, marked by three strong, sublamellar keels, the first of which borders the peripheral sulcus, while the other two are a little less strong and situated close together on the middle of the base. Aperture large, subquadrate, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture which is apparent within the aperture; columella moderately long, curved, and twisted.

The type, which is at Amherst College, Massachusetts, has nine post-nuclear whorls and measures: Length 3.25 mm., diameter 1.13 mm. It and another specimen were collected by Prof. C. B. Adams at Panama.

CERITHIOPSIS PARAMOEA, new species.

Plate 38, fig. 4.

Shell moderately large, broadly elongate-conic, brown. (Nuclear whorls decollated.) Post-nuclear whorls appressed at the summit, ornamented with three nodulose, spiral cords which are about as wide as the spaces that separate them. The first of these is at the summit, the third is on the anterior fourth between the sutures, while the second is halfway between the two. In addition to the spiral cords, the whorls are marked by axial ribs almost equalling the spiral cords in strength; of these ribs, 16 occur upon the first and second, 18 upon the third, 20 upon the fourth, 22 upon the fifth, and 32 upon the penultimate turn. The junctions of the axial ribs and spiral cords form nodules which on the early whorls are well rounded and on the last elongate, their long axes corresponding with the axial sculpture. The spaces inclosed between them are well rounded pits. Sutures moderately impressed, showing the posterior edge of the first basal cord. Periphery of the last whorl marked by a sulcus almost as wide as that separating the supraperipheral from the median cord, and, like it, crossed by the continuations of the axial ribs. Base well rounded, smooth except for the feeble cord immediately below the peripheral sulcus. Aperture irregularly oval, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered somewhat sinuous by the external sculpture; columella short, curved, with the free edge reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 15582, U.S.N.M.) comes from Neah Bay, Washington. It has lost the nucleus and probably the first one and a half post-nuclear turns. The eight remaining whorls measure: Length 6.3 mm., diameter 2.1 mm.

CERITHIOPSIS BICOLOR, new species.

Plate 38, fig. 6.

Shell small, elongate-conic, white, excepting the base of the posterior row of tubercles which is light brown. (Nuclear whorls decollated.) Post-nuclear whorls flat, marked by three spiral rows of tubercles, of which one is at the summit of the whorls, another immediately above the peripheral sulcus, and the third a little nearer the one at the summit than its anterior neighbor. These tubercles are connected by narrow bands into a spiral cord and axially by slender riblets, the two inclosing well-impressed squarish pits. Of these tubercles, 16 occur upon the first four of the remaining turns, 18 upon the fifth to seventh, and 20 upon the eighth and the penultimate turn. Suture strongly constricted. Periphery of the last whorl marked by a slender spiral cord. Base smooth. Aperture rhomboidal, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture, columella short, strong and twisted.

The type has lost the nucleus and several of the early post-nuclear whorls; the ten remaining measure: Length 4 mm., diameter 1.2 mm. The type and three specimens (Cat. No. 195214, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2813 in 40 fathoms on coral sand bottom, bottom temperature 81° off Galapagos Islands.

CERITHIOPSIS ARNOLDI, new species.

Plate 39, fig. 3.

Shell elongate-conic. (Nuclear whorls decollated.) The post-nuclear whorls slightly rounded, ornamented by three tuberculate spiral keels of which one is at the summit, the anterior at some little distance above the suture, and the third halfway between the two. The posterior of these three keels is much weaker than the other two on the early turns, but gradually increases in size until on the last volution it is practically equal to them. In addition to the spiral keels, the whorls are marked by somewhat protractive axial ribs, which are about as strong as the spiral keels and render them tuberculate at their junction. Of these ribs, 14 occur upon the first of the remaining turns, 16 upon the third, 18 upon the fourth, 20 upon the fifth, 22 upon the sixth, 24 upon the seventh and eighth, and 26 upon the penultimate turn. The spaces inclosed between the ribs and spiral cords are strongly impressed rounded pits. Sutures moderately constricted, showing the posterior edge of the first basal cord. Periphery of the last whorl marked by a deep sulcus, as wide as those occurring between the spiral cords on the spire and, like them, crossed by the continuations of the axial ribs. Base very short, almost flattened, somewhat concave near the columella,

marked by two spiral cords of which the first is immediately below the peripheral sulcus, while the next, which is less strong, is separated from it by a narrow channel. The anterior limit of this cord is a mere impressed line. There is another impressed line a little anterior to this one. Aperture decidedly channeled anteriorly; posterior angle obtuse (outer lip fractured); columella short, stout, curved, and slightly twisted.

The type (Cat. No. 195195, U.S.N.M.) has nine and a half post-nuclear whorls remaining and measures: Length 5.4 mm., diameter 1.8 mm. It comes from San Pedro Bay, California

Named for Dr. Ralph Arnold.

CERITHIOPSIS MAGELLANICA, new species.

Plate 38, fig. 8.

Shell broadly elongate-conic, light brown. (Nuclear whorls decollated.) Post-nuclear whorls appressed at the summit, not shouldered, well rounded, ornamented with three low, broad, spiral keels, which are at least twice as wide as the spaces that separate them. The first of these keels is a little below the summit, the second is median, and the third a little anterior to the suture. The middle keel is about one and one-fourth times as wide as the other two, which are equal. In addition to this spiral sculpture, the whorls are marked by decidedly curved, somewhat retractive, low, rounded, axial ribs. Of these, 20 occur upon the second of the remaining turns, 24 upon the third, 26 upon the fourth and fifth, 28 upon the sixth, and 30 upon the penultimate turn. The junctions of the axial ribs and spiral cords form low, elongated tubercles, which have their long axes parallel with the axial sculpture. The spaces inclosed between the axial ribs and spiral cords are shallow, rounded pits. Sutures moderately constricted, showing the basal cord. Periphery of the last whorl marked by a slender groove as wide as those separating the first supraperipheral cord from the median and, like them, crossed by the feeble continuations of the axial ribs. Base of the last whorl well rounded, marked by at least two low, very feeble, broad, spiral cords on the posterior half; the anterior half apparently smooth. Aperture quite large, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella very curved and reflected; parietal wall glazed with a thin callus.

The type has the last eight post-nuclear whorls and measures: Length 8.5 mm., diameter 2.5 mm. It and another specimen (Cat. No. 96224, U.S.N.M.) come from the U. S. Bureau of Fisheries station 2778, in 61 fathoms, sand bottom, bottom temperature 48°, from the Straits of Magellan.

CERITHIOPSIS ANTEMUNDA, new species.

Plate 36, fig. 4.

Shell elongate-conic, brown. (Nuclear whorls decollated.) Post-nuclear whorls appressed at the summit, very slightly rounded, marked by three spiral cords, of which the first—which is at a little distance anterior to the summit—is obsolete on the first four whorls, giving them a decidedly shouldered appearance, while on the last turn it is almost equal to the other two. The second cord is a little posterior to the middle between the sutures, while the third one is a little posterior to the suture. The spaces between these spiral cords are about double the width of the spiral cords. In addition to the spiral sculpture, the whorls are marked by slender, well rounded, retractive axial ribs, equaling the spiral cords in strength. Of these ribs, 14 occur upon the first to fourth, 16 upon the fifth and sixth, and 20 upon the penultimate turn. The junctions of the axial ribs and spiral cords form well-rounded tubercles, while the spaces inclosed between them are strongly impressed, squarish pits. Sutures strongly channeled, showing the posterior edge of the peripheral cord. Periphery of the last whorl marked by a strong, spiral cord, which is separated from the supraperipheral cord by a sulcus as wide as that which separates the supraperipheral from the median cord, and like it is crossed by the continuations of the axial ribs, which extend to the posterior edge of the peripheral cord. Base concave, with a slender fasciole surrounding the insertion of the columella and marked axially with fine, incremental lines, which also extend over the entire surface of the spire. Aperture subquadrate, strongly channeled anteriorly; posterior angle decidedly obtuse; outer lip thin, showing the external sculpture within, rendered sinuous at the edge by the external sculpture; columella stout, twisted, with the edge reflected; parietal wall covered with a thin callus.

The type and another specimen (Cat. No. 195188, U.S.N.M.) come from San Pedro Bay, California. The type has lost the nucleus. The eight whorls remaining measure: Length 5 mm., diameter 1.9 mm. Another specimen (Cat. No. 213313, U.S.N.M.) was dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 2932 in 20 fathoms on sand bottom, bottom temperature 58°, off San Diego, California.

CERITHIOPSIS DIOMEDEÆ, new species.

Plate 37, fig. 5.

Shell small, elongate-conic, brown. (Nuclear whorls decollated.) Post-nuclear whorls with a strongly channeled suture in which the posterior edge of the peripheral cord is apparent on all the whorls; marked by three spiral cords, of which the first is considerably weaker than the other two and is situated at the summit, rendering this some-

what shouldered; the third is about as far posterior to the suture as it is removed from the median, while the second is halfway between the first and third. The spaces between the spiral cords are equal and about one and one-half times as wide as the cords. In addition to the spiral sculpture, the whorls are marked by well-rounded, slender, protractive, axial ribs which are almost equal to the spiral cords in strength. Of these ribs, 16 occur upon the first, 18 upon the second to fourth, 20 upon the fifth and sixth, and 24 upon the penultimate turn. The junctions of the axial ribs and spiral cords form moderately strong, rounded tubercles, while the spaces inclosed between them are rectangular pits having their long axes parallel with the spiral sculpture. Periphery of the last whorl marked by a strong, spiral cord which is separated from the supraperipheral cord by a channel as wide as that which separates the supraperipheral cord from the median and, like it, is crossed by the axial ribs which terminate at the posterior edge of the peripheral cord. Base very long, concave, marked by incremental lines and a single, obsolete fasciole a little posterior to the insertion of the columella. Aperture irregularly oval; posterior angle very obtuse; outer lip thin, showing the external sculpture within by transmitted light, rendered sinuous at the edge by the external sculpture; columella long, curved and twisted, the edge reflected; parietal wall glazed with a thick callus.

The type and another specimen (Cat. No. 213302, U.S.N.M.) were dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 3566 in 3 fathoms on sand and shell bottom, bottom temperature 58°, in San Diego Bay, California. The type has lost the early nuclear whorls, only a portion of the last remaining. It has eight post-nuclear whorls and measures: Length 4.3 mm., diameter 1.5 mm.

CERITHIOPSIS WILLIAMSONI Arnold.

Plate 39, fig. 6.

Bittium williamsoni ARNOLD, Mem. California Acad. Sci., vol. 3, 1903, p. 295, pl. 6, fig. 11.

Shell minute, elongate-ovate. Post-nuclear whorls ornamented with three spiral cords, of which the first, which is the weakest, is at the summit; the second is considerably nearer to the one at the summit than the third, which is about halfway between the second and the suture. In addition to the spiral sculpture, the whorls are marked with slender, almost vertical, axial ribs, of which about 16 occur upon the first and second, 18 upon the third, 20 upon the fourth, and 22 upon the penultimate whorl. The junctions of the axial ribs and spiral cords form well-rounded tubercles, those on the median cord appearing somewhat truncated anteriorly and posteriorly. The spaces inclosed between the spiral cords and axial ribs are squarish pits. Sutures moderately constricted, showing the pos-

terior edge of the peripheral cord. Periphery marked by a strong spiral cord which is separated from the supraperipheral cord by a sulcus as wide as that which separates the supraperipheral cord from the median and, like it, crossed by the extensions of the axial ribs, which terminate at the posterior edge of the peripheral cord. Base slightly concave, with two strong spiral cords. Aperture broadly, irregularly oval, decidedly channeled anteriorly; posterior angle obtuse; columella somewhat curved and twisted, with the free edge reflected.

Doctor Arnold's type, which came from the Pleistocene of San Pedro, was lost in transit to the U. S. National Museum, had seven post-nuclear whorls and measured: Length 2.5 mm., diameter 1 mm.

Named for Mrs. M. Burton Williamson, of Los Angeles, California.

CERITHIOPSIS TRUNCATA Dall.

Plate 40, fig. 2.

Cerithiopsis stejnegeri truncata DALL, Proc. U. S. Nat. Mus., vol. 9, 1886, p. 304, pl. 4, fig. 5.

Shell wax yellow. (Nucleus and early whorls decollated.) The four remaining well rounded, ornamented with three tuberculate spiral keels of which the median is the strongest; the weakest is at the summit, which it crenulates. The last is midway between the suture and the median cord. In addition to the spiral cords, the whorls are marked by low, well rounded, vertical, axial ribs, the intersection of which with the spiral cord renders them feebly tuberculate. Of these ribs, 30 occur upon the penultimate whorl and 22 upon the preceding turns. The spaces inclosed between the spiral cords and the axial ribs are squarish, well impressed pits. A slender thread of the base is apparent in the somewhat constricted suture. Periphery of the last whorl marked by a sulcus which is about as wide as the spaces between the first and median cord and is crossed by feeble continuations of the axial ribs. Base short, well rounded, with a slender fasciole at the insertion of the columella; entire surface of spire and base crossed by rather strong, incremental lines and numerous fine spiral striations; aperture broadly ovate; decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered wavy by the external sculpture; columella short, very broad, curved; parietal wall glazed with a thin callus which extends from the columella to the posterior angle.

The type (Cat. No. 213303, U.S.N.M.) and two specimens were collected in the canals of sponges at Unalaska. The type measures: Length 3.1 mm., diameter 1.9 mm. Nine specimens (Cat. No. 213304, U.S.N.M.) collected at the same locality under similar conditions. Doctor Dall noted when he collected the specimens that

the apices, though intact, were of a gelatinous consistency, and, when removed from the alcohol in which the shells were preserved, dried up, shriveled, and fell off.

CERITHIOPSIS STEPHENSÆ Bartsch.

Plate 39, fig. 7.

Cerithiopsis stephensi BARTSCH, Proc. U. S. Nat. Mus., vol. 37, 1909, pp. 399-400, fig.

Shell elongate-conic, chocolate brown. (Nuclear whorls decolored in all the specimens seen.) Post-nuclear whorls well rounded, ornamented spirally by four keels between the sutures, of which the posterior three are strong and tuberculate, the fourth smooth and slender. Axially the whorls are marked by irregular ribs, the junctions of which with the spiral keels form tubercles. The posterior row of tubercles is at the summit and is the weakest, the individuals appearing as rounded knobs. The second is on the middle of the whorl. This and the first, which is immediately above the peripheral sulcus, have their tubercles of about equal strength. On these two keels the tubercles slope gently anteriorly and very abruptly posteriorly. The peripheral sulcus and the other two sulci are equally strong and wide. All are crossed by the ribs, which, however, do not extend over the base. Both spiral cords and ribs are crossed by strong incremental lines. Sutures constricted. Periphery of the last whorl marked by a deep channel. Base well rounded, rather short, marked by strong incremental lines and a few very fine spiral striations. The summit of the succeeding whorl drops a little below the peripheral sulcus in all the whorls of the spire and allows a narrow margin of the smooth base to appear as a cord in the suture. Aperture ovate, with a strong anterior sinus, outer lip thin, showing the external sculpture within; columella stout, twisted and curved, having a weak basal fasciole at its insertion.

Type.—Cat. No. 204008, U.S.N.M. It has twelve post-nuclear whorls and measures: Length 9 mm., diameter 2.1 mm. It and two additional specimens in Mrs. Kate Stephens's collection were collected by her at Bear Bay, Peril Strait, Baranoff Island, Alaska. Four more were collected by her at Mole Harbor, Alaska, one of which is in the collection of the U. S. National Museum (Cat. No. 204009). Another in her collection comes from the head of Port Frederick, Chichagoff Island, Alaska.

Cat. No. 126659, U.S.N.M., contains three specimens from Victoria, Vancouver Island, British Columbia. Cat. No. 133233, U.S.N.M., contains five specimens from Port Orchard, Puget Sound, Washington.

Named for Mrs. Kate Stephens, of San Diego, California.

CERITHIOPSIS MONTEREYENSIS, new species.

Plate 41, fig. 5.

Shell small, broadly conic, light brown. (Nuclear whorls decollated.) Post-nuclear whorls marked by three spiral cords, the first of which (which is very poorly developed, in fact almost obsolete on the early whorls) is at the summit, while the next is separated from it by a narrow channel, the third being about as far posterior to the suture as the second is from the first, and the space between the second and third being double the width of that between the first and second. In addition to the spiral cords, the whorls are marked by vertical, axial ribs which are equal to the spiral cords in strength. Of these ribs, 15 occur upon the second and third, 16 upon the fourth and fifth, 18 upon the sixth, and 22 upon the penultimate turn. The junctions of the axial ribs and spiral cords form cusp-like tubercles, while the spaces inclosed between them are very elongate rectangular pits between the first and second spiral cord, and strongly impressed, squarish pits between the second and third. Suture well impressed. Periphery of the last whorl marked by a narrow keel which is separated from the supraperipheral keel by a sulcus as wide as that separating the first from the second spiral cord, and crossed by the continuations of the axial ribs which terminate at its posterior border. Base short, slightly rounded, ornamented with three narrow, spiral keels, of which the first two are much stronger than the other. These keels are equally spaced between the periphery and the middle of the base, which is occupied by the last one. In addition to the above sculpture, the entire surface of spire and base is marked by numerous, fine incremental lines. Aperture subquadrate, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered strongly wavy by the external sculpture, which is apparent in the aperture; columella short, stout, curved and decidedly twisted, the free edge reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 32395, U.S.N.M.) comes from Monterey Harbor, California. It has eight post-nuclear whorls and measures: Length 3.2 mm., diameter 1.3 mm.

CERITHIOPSIS INGENS Bartsch.

Plate 41, fig. 4.

Bittium quadrifilatum ingens BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 180.

Shell large, elongate-conic, white. Nuclear whorls decollated. Post-nuclear whorls slightly shouldered at the summit, moderately well rounded, marked on the first three turns by three spiral cords. On the fourth turn a fourth cord makes its appearance at the summit, rapidly increasing in strength until on the last three whorls it is quite equal to the other cords. These spiral cords are almost as wide as

the spaces which separate them. In addition to the spiral cords, the whorls are marked by rather poorly developed, rounded, axial ribs, of which 14 occur upon the first, 16 upon the second, 18 upon the third and fourth, 20 upon the fifth and sixth, 22 upon the seventh and eighth, and 24 upon the penultimate turn. The intersections of the spiral cords and axial ribs form rather rounded cusps which slope more gently anteriorly than posteriorly, while the spaces inclosed between them are rather shallow, quadrangular pits having their long axes parallel with the spiral sculpture. Sutures moderately constricted, showing the posterior edge of the first basal cord. In addition to the above sculpture, the entire surface of the spire is marked by very slender lines of growth and, on the last whorl, by very slender, intercalated, spiral lirations between the cords. Periphery of the last whorl marked by a channel equal to the space between the cords on the spire. Base moderately long, well rounded, ornamented with six, strong, spiral keels which decrease regularly in size and spacing from the periphery to the columella. Aperture irregularly oval, strongly channeled anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within, rendered decidedly wavy at the edge by the external sculpture; columella moderately long, somewhat twisted, and reflected; parietal wall covered with a thick callus.

The type (Cat. No. 32213, U.S.N.M.) comes from Monterey, California. It has lost the nucleus and probably the first post-nuclear turn; the ten remaining turns measure: Length 12.5 mm., diameter 4:2 mm.

CERITHIOPSIS TUMIDA Bartsch.

Plate 41, fig. 3.

Bittium tumidum BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 179-180.

Shell medium size, light yellowish-brown, shining. Nuclear whorls decollated. Post-nuclear whorls somewhat inflated, well rounded, separated by a constricted suture and ornamented with strong tuberculate axial ribs, of which there are 18 upon the second of the remaining whorls and 22 upon the penultimate turn. In addition to the axial ribs there are four, unequally broad, low, spiral ridges between the sutures, which are much wider than the spaces which separate them, the latter appearing as strongly incised lines. The intersection of these ridges and the ribs form the tubercles. The whorls slope gently from the second spiral ridge toward the summit and the first row of tubercles, which is only feebly developed and is located on the sloping shoulder. The second set of tubercles are rounded, while the third and fourth rows are decidedly elongated. Periphery of the last turn marked by a strong smooth spiral keel, which is separated from the supraperipheral keel by a mere constriction. Base rather short, without keel, marked only by lines of growth.

Aperture suboval, decidedly channeled anteriorly; outer lip rendered sinuous by the external sculpture; columella short, very broad, and slightly expanded at the insertion, a little lighter in color than the rest of the shell; provided with a strong callus on its inner edge which is reflected over the parietal wall.

The type (Cat. No. 74001, U.S.N.M.) was collected by Canfield at Monterey, California. It has eight post-nuclear whorls and measures: Length 4.2 mm., diameter 1.7 mm. A second immature specimen (Cat. No. 23261, U.S.N.M.) is in the Stearns collection, also from Monterey, California.

CERITHIOPSIS PERUVIANA Orbigny.

Plate 41, fig. 2.

Cerithium peruvianum ORBIGNY, Voy. Amer. Mérid., 1840, p. 443, pl. 77, figs. 9 and 10.

Shell broadly elongate-conic, grayish-brown. Nuclear whorls small, at least two. Post-nuclear whorls moderately rounded, ornamented with four nodulose, spiral cords, of which the first (which is at the summit) is much smaller than the rest, the other three being subequal. On the last two turns the first basal cord is apparent in the suture. In addition to the spiral cords, the whorls are marked by low, axial ribs, which are about as wide as the spiral cords. Of these ribs, 12 occur upon the first and second, 14 upon the third, 18 upon the fourth, and 22 upon the penultimate turn. The junctions of the axial ribs and the spiral cords form well-developed tubercles. Sutures moderately constricted. Periphery of the last whorl marked by a feeble, tuberculated, spiral cord. Base slightly concave in the middle, marked by five broad, low, rounded cords, which decrease regularly in size from the periphery to the columella. Aperture rather large, irregularly oval, decidedly channeled anteriorly; posterior angle obtuse; columella very stout, twisted, and reflected; parietal wall covered with a thin callus.

Orbigny's type came from the shore near Arica, Peru. It has six post-nuclear whorls, and measures: Length 7 mm., diameter 2 mm.

CERITHIOPSIS DESTRUGESI De Folin.

Plate 41, fig. 6.

Cerithium destrugesi DE FOLIN, Le Meleagrinicoles, 1867, p. 71, pl. 6, fig. 12.

Shell elongate-conic; early whorls yellow, the later ones darker. Early post-nuclear whorls ornamented with four spiral keels, which are much wider than the spaces that separate them. Of these, the one at the summit and the third are of equal size and considerably less strong than the other two, which are also equal. On the last six turns the third cord becomes divided, the anterior portion being a little stronger than its neighbor. In addition to the spiral sculpture

the whorls are marked by somewhat retractive, broad, axial ribs, which render the junctions with the spirial cords strongly cuspidate. Of these ribs, about 12 occur on the first to fifth, 14 upon the sixth, 18 upon the seventh to tenth, 20 upon the eleventh and twelfth, and 22 upon the penultimate whorl. Suture moderately constricted. Periphery of the last whorl marked by a slender sulcus, which is crossed by the continuations of the axial ribs. Base moderately long, concave, ornamented with four strong, rounded, spiral cords, the first of which is immediately below the peripheral sulcus, and the last surrounds the insertion of the columella. These cords grow successively weaker from the periphery to the columella. Aperture irregularly subquadrate, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella rather long, curved and twisted, the free edge reflected.

De Folin's type was taken from pearl oysters which are said to have come from Panama or Negritos Island. (The last may be intended for Negros Island, Philippines.) It has 14 whorls, and measures: Length 6 mm., diameter 1.8 mm.

EXPLANATION OF PLATES.

The measurements cited after each species constitute the actual length of the figured specimen.

PLATE 36.

- Fig. 1. *Cerithiopsis* (subgenus?) *excelsa*; type; 20.5 mm.; p. 352.
 2. *Cerithiopsis* (*Cerithiopsis*) *oxyis*; type; 3.5 mm.; p. 332.
 3. *Cerithiopsis* (subgenus?) *curtata*; type; 2.5 mm.; p. 352.
 4. *Cerithiopsis* (subgenus?) *antemunda*; type; 5 mm.; p. 359.
 5. *Cerithiopsis* (*Cerithiopsis*) *fatua*; type; 6 mm.; p. 331.
 6. *Cerithiopsis* (subgenus?) *columna*; type; 9.2 mm.; p. 354.
 7. *Cerithiopsis* (subgenus?) *gloriosa*; type; 8.6 mm.; p. 353.

PLATE 37.

- Fig. 1. *Cerithiopsis* (subgenus?) *infrequens*; type; 3.25 mm.; p. 355.
 2. *Cerithiopsis* (*Cerithiopsis*) *sorex*; type; 1.6 mm.; p. 333.
 3. *Cerithiopsis* (*Cerithiopsis*) *albonodosa*; type; p. 337.
 4. *Cerithiopsis* (*Cerithiopsis*) *abrejosensis*; type; 2.3 mm.; p. 338.
 5. *Cerithiopsis* (subgenus?) *diomedex*; type; 4.3 mm.; p. 359.
 6. *Cerithiopsis* (*Cerithiopsis*) *cerea*; type; 2.4 mm.; p. 333.
 7. *Cerithiopsis* (*Cerithiopsis*) *tuberculoides*; type; 3.75 mm.; p. 336.

PLATE 38.

- Fig. 1. *Cerithiopsis* (*Cerithiopsis*) *pupiformis*; cotype; 1.9 mm.; p. 337.
 2. *Cerithiopsis* (*Cerithiopsis*) *pedroana*; cotype; 5.2 mm.; p. 335.
 3. *Cerithiopsis* (subgenus?) *fossilis*; type; 7.2 mm.; p. 353.
 4. *Cerithiopsis* (subgenus?) *paramæa*; type; 6.3 mm.; p. 356.
 5. *Cerithiopsis* (*Cerithiopsis*) *pupiformis*; cotype; p. 337.
 6. *Cerithiopsis* (subgenus?) *bicolor*; type; 4 mm.; p. 357.
 7. *Cerithiopsis* (*Cerithiopsidella*) *cosmia*; cotype; 9 mm.; p. 348.
 8. *Cerithiopsis* (subgenus?) *magellanica*; type; 8.5 mm.; p. 358.
 9. *Cerithiopsis* (*Cerithiopsis*) *carpenteri*; cotype; 8.1 mm.; p. 334.

PLATE 39.

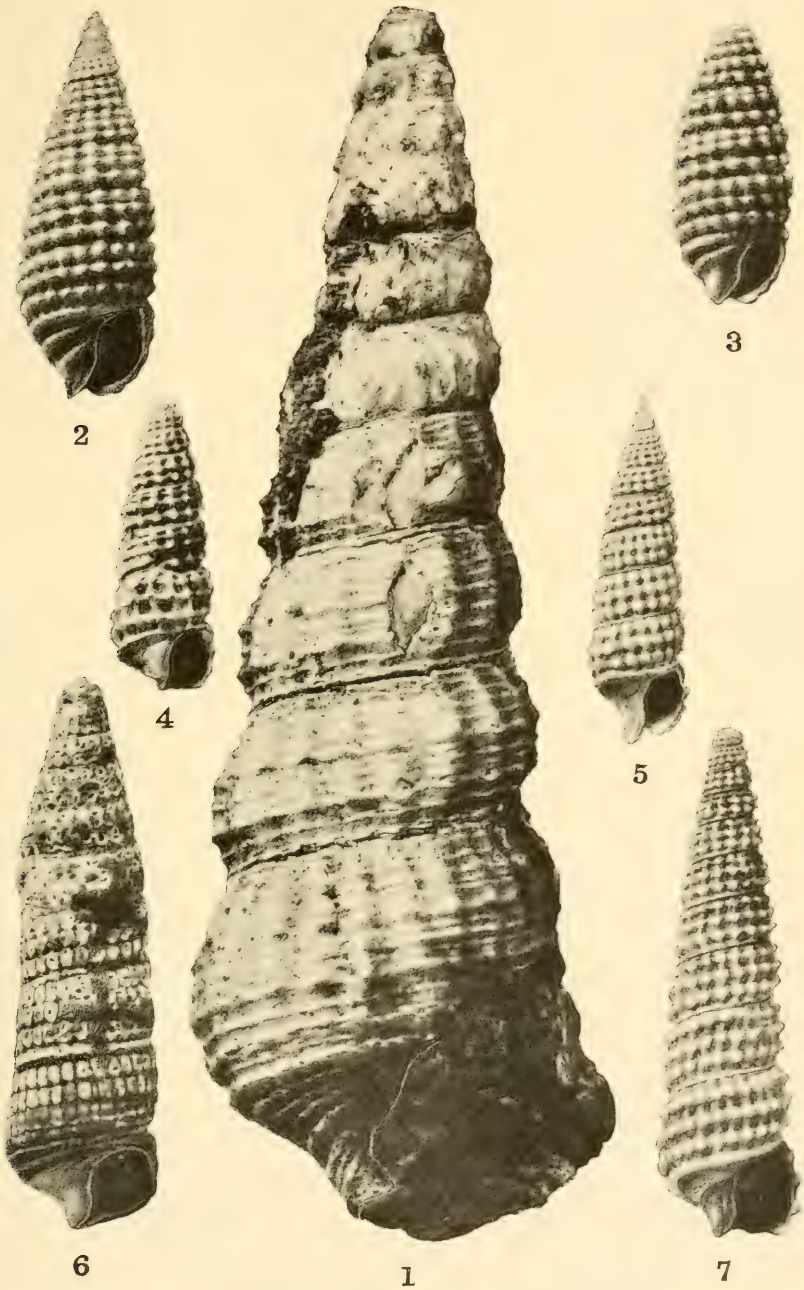
- Fig. 1. *Cerithiopsis* (*Cerithiopsina*) *necropolitana*; type; 7.7 mm.; p. 345.
 2. *Cerithiopsis* (*Cerithiopsidella*) *alcima*; type; 7.2 mm.; p. 350.
 3. *Cerithiopsis* (subgenus?) *arnoldi*; type; 5.4 mm.; p. 357.
 4. *Cerithiopsis* (*Cerithiopsis*) *galapagensis*; type; 2.4 mm.; p. 340.
 5. *Cerithiopsis* (*Cerithiopsis*) *cesta*; cotype; 5.8 mm.; p. 341.
 6. *Cerithiopsis* (subgenus?) *williamsoni*; type; 2.5 mm.; p. 360.
 7. *Cerithiopsis* (subgenus?) *stephensæ*; type; 9 mm.; p. 362.
 8. *Cerithiopsis* (*Cerithiopsis*) *berryi*; type; 3.4 mm.; p. 339.

PLATE 40.

- Fig. 1. *Cerithiopsis* (*Cerithiopsis*) *aurea*; type; 7 mm.; p. 344.
 2. *Cerithiopsis* (subgenus?) *truncata*; type; 3.1 mm.; p. 361.
 3. *Cerithiopsis* (*Cerithiopsis*) *stejnegeri*; type; 5.5 mm.; p. 342.
 4. *Cerithiopsis* (*Cerithiopsida*) *diegensis*; type; 4 mm.; p. 347.
 5. *Cerithiopsis* (*Cerithiopsis*) *neglecta*; type; 3.2 mm.; p. 343.
 6. *Cerithiopsis* (*Cerithiopsida*) *rowelli*; type; 4.5 mm.; p. 348.
 7. *Cerithiopsis* (*Cerithiopsis*) *stejnegeri dina*; type; 7 mm.; p. 343.
 8. *Cerithiopsis* (*Cerithiopsis*) *halia*; type; 4.5 mm.; p. 344.
 9. *Cerithiopsis* (*Cerithiopsidella*) *antefilosa*; 6.9 mm.; p. 349.

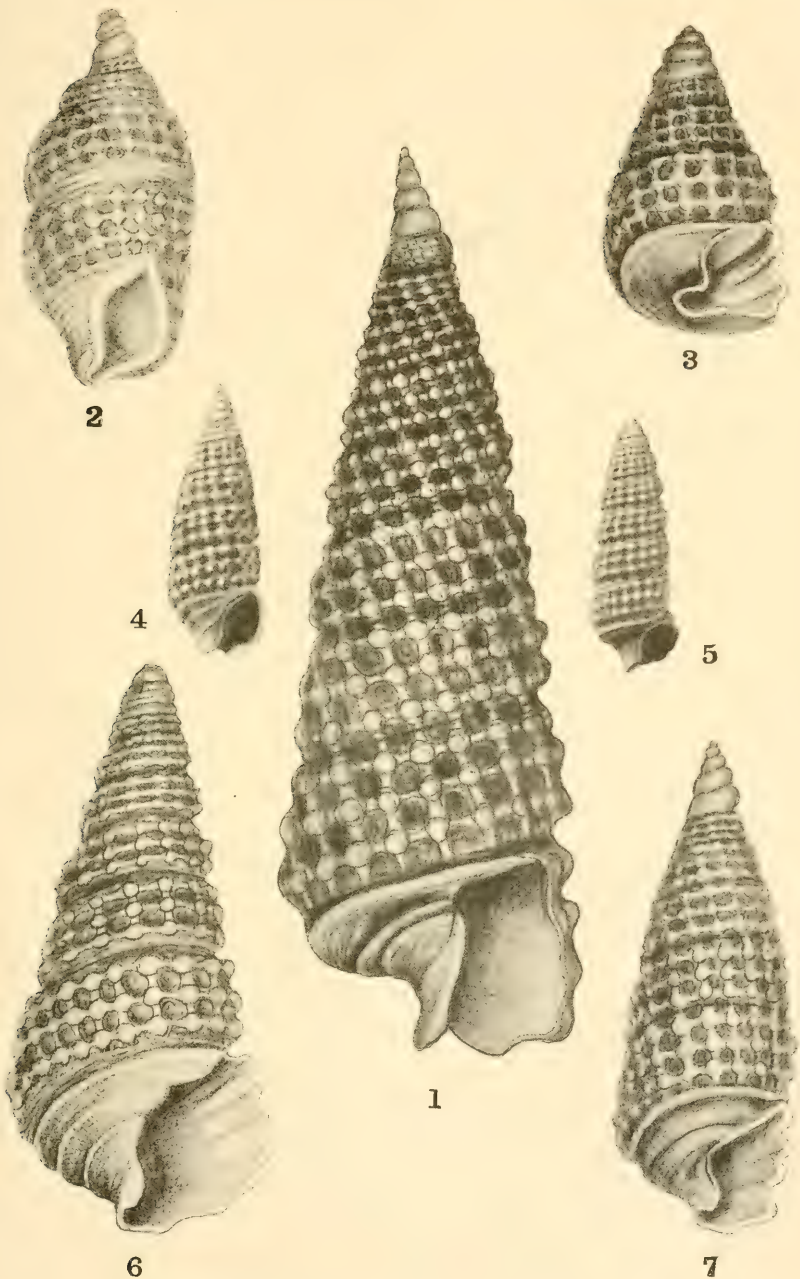
PLATE 41.

- Fig. 1. *Cerithiopsis* (*Cerithiopsina*) *adamsi*; type; 2.1 mm.; p. 346.
 2. *Cerithiopsis* (subgenus?) *peruviana*; type; 7 mm.; p. 365.
 3. *Cerithiopsis* (subgenus?) *tumida*; type; 4.2 mm.; p. 364.
 4. *Cerithiopsis* (subgenus?) *ingens*; type; 12.5 mm.; p. 363.
 5. *Cerithiopsis* (subgenus?) *montereyensis*; type; 3.2 mm.; p. 363.
 6. *Cerithiopsis* (subgenus?) *destrugesi*; type; 6 mm.; p. 365.



WEST AMERICAN MOLLUSKS OF THE GENUS CERITHIOPSIS.

FOR EXPLANATION OF PLATE SEE PAGE 366.



WEST AMERICAN MOLLUSKS OF THE GENUS CERITHIOPSIS.

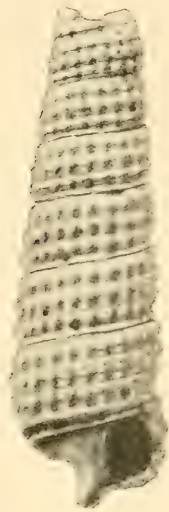
FOR EXPLANATION OF PLATE SEE PAGE 366.



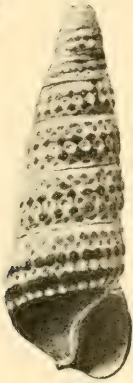
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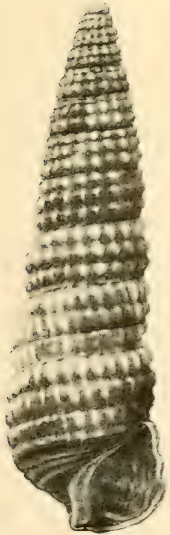
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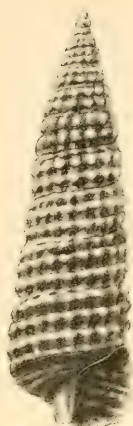
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WEST AMERICAN MOLLUSKS OF THE GENUS CERITHIOPSIS.

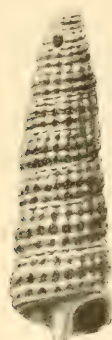
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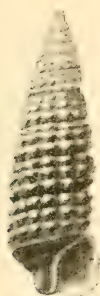
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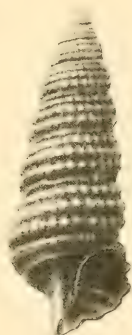
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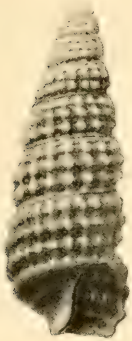
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WEST AMERICAN MOLLUSKS OF THE GENUS CERITHIOPSIS

FOR EXPLANATION OF PLATE SEE PAGE 367



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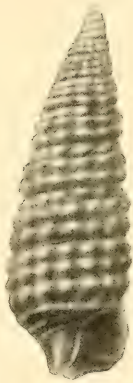
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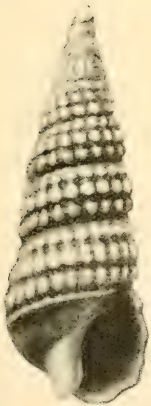
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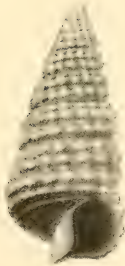
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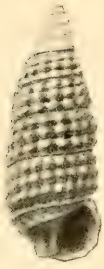
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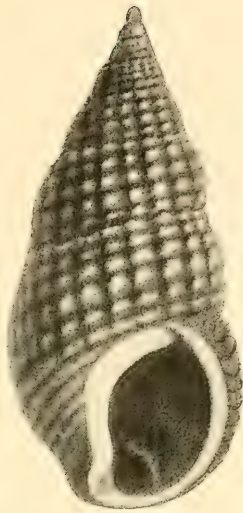
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WEST AMERICAN MOLLUSKS OF THE GENUS CERITHIOPSIS.

FOR EXPLANATION OF PLATE SEE PAGE 367.



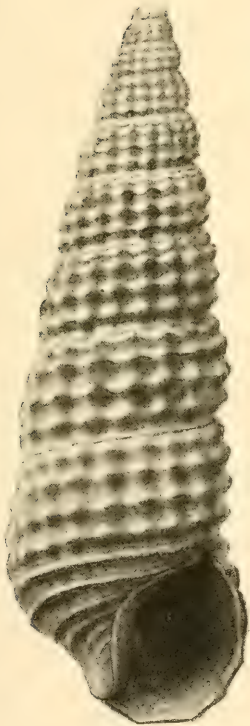
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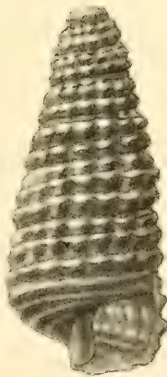
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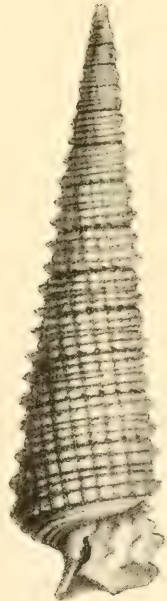
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WEST AMERICAN MOLLUSKS OF THE GENUS CERITHIOPSIS.

FOR EXPLANATION OF PLATE SEE PAGE 367

NOTES ON THE GENUS LEPOMIS.

By BARTON A. BEAN and ALFRED C. WEED,
Of the Division of Fishes, U. S. National Museum.

This group of fresh-water sunfishes has been variously divided by different authors. It has been separated into at least eleven nominal genera, distinguished mainly by the presence or absence of a supplemental maxillary and by the shape of the lower pharyngeal bones, the character of their teeth, the length and shape of the pectoral fin, and the presence or absence of a red spot on the opercular flap. Two of the later authors who have worked on this subject, McKay¹ and Bollman² decided that they should be included under one generic name, *Lepomis*, and that the others are not tenable. On the other hand, Forbes and Richardson³ decided that the species must be divided between the genera *Lepomis* Rafinesque and *Eupomotis* Gill and Jordan, and after a careful examination of a considerable series of pharyngeal bones and teeth we were inclined to agree with the latter. An examination of the pharyngeal bones of the type-specimens of *Lepomis euryurus* McKay and of *Bryttus albulus* Girard, however, makes it evident that these two nominal genera are not separable, as these specimens show a complete intergradation between the characters of the two.

The character of the presence or absence of a supplemental maxillary has no value, as this bone is present or absent in individuals of the same species, and, when present, the size is extremely variable in fishes of the same species from the same locality. (See pls. 42 and 43.)

In the typical *Eupomotis* the pharyngeal bones are broad, and the teeth are large and blunt. This character is subject to much variation. In the two specimens of *Lepomis holbrookii* illustrated, obtained in the Center Market in Washington, which are presumably from the same general locality (North or South Carolina),

¹ Proc. U. S. Nat. Mus., vol. 4, 1881, p. 88.

² Rept. U. S. Fish Comm., 1888 [1892], pp. 557-580.

³ Bull. Illinois State Lab. Nat. Hist., vol. 7, pp. 27-32, published in 1904.

and show no other important differences, there is considerable variation in the width of the bones, in their relative thickness, and in the size and arrangement of the teeth. In the two specimens illustrated, which were identified as *Lepomis heros*, but which do not agree very closely with the type, especially in depth of body, this difference is even more marked. These two specimens were from the same section of Indiana and showed no variations except those due to slight difference of age. In both of these species the pharyngeal bones are much heavier than in *Lepomis gibbosus*, which, however, has the largest and bluntest teeth of the group. In the type of *Lepomis heros* the pharyngeal teeth and bones are much more like those of *Lepomis gibbosus* than are those in the Indiana specimens. The main characters given by Forbes and Richardson for the separation of these two groups are not so much the size of the teeth but more especially the shape of the outer edge and lower surface of the pharyngeal bones. In *Lepomis* this edge is straight, while in *Eupomotis* it has more or less of a sigmoid curve. In *Lepomis* the lower surface of the bone is straight or concave, while in *Eupomotis* it is more or less convex, and the bone is usually much heavier. In both of these characters *Bryttus albulus* and *Lepomis euryorvus* are intermediate, as they are in size and bluntness of the teeth.

Small specimens of *Lepomis gibbosus* and *Lepomis pallidus*¹ when taken from the same waters can not be distinguished, unless they are large enough to show the adult coloration. In order to determine whether the character of the form of the pharyngeal bones was likewise difficult of application to young individuals, we examined several small *Lepomis gibbosus* obtained for us at Ithaca, New York, where this species alone is found, and compared their pharyngeal bones with those of young of both species taken in Sodus Bay, Wayne County, New York. The specimens used for comparison were about 1 inch ($2\frac{1}{2}$ cm.) long, and it was necessary to use a compound microscope in examining the pharyngeals. It was found that although the bones were narrower in young *Lepomis gibbosus* than in adults, nevertheless they were broader than in *Lepomis pallidus* of the same size and that the teeth in *Lepomis gibbosus* were much heavier.

The pharyngeal bones and teeth are similar in form and structure in *Xystroplites gillii* Jordan and *Bryttus albulus* Girard, but there are slight differences in the size of the scales and in proportional measurements which have caused us to leave them for the present under separate specific names, *Lepomis gillii* (Jordan) and *Lepomis albulus* (Girard) until an examination of a long series of specimens shall show whether they are or are not distinct species. The pharyn-

¹ We are unable to satisfy ourselves of the exact status of the name *pallidus* and retain it in accordance with current usage until a proper decision can be reached.

geal bones and teeth of the type of *Calliurus murinus* Girard are much heavier than those of *Lepomis cyanellus*. They more closely resemble *Lepomis euryorus* McKay.

We do not have the material available to determine the status of *Pomotis pallidus* Agassiz which has been assigned to the genus *Eupomotis* by Jordan and Evermann.

Lepomis cyanellus, the type of the genus *Apomotis* has the pharyngeal bones thinner and lighter than in any of the other sunfishes examined. The teeth, however, are heavier than in some other species. (See pl. 50.)

Lepomis auritus, the type of the genus *Lepomis*, has the pharyngeal bone heavier than in *Lepomis cyanellus*, with the teeth about the same. (See pl. 48.)

Lepomis pallidus has the pharyngeal bone rather lighter than in *Lepomis auritus*, but heavier than in *Lepomis cyanellus*. The teeth, however, are finer than those of any other species which we have examined. (See pl. 49.)

In *Lepomis megalotis* the pharyngeal bones are similar to those of *Lepomis pallidus* and the teeth are somewhat heavier. (See pl. 50.)

Lepomis albulus has the pharyngeal bone about as heavy as in *Lepomis auritus* but the teeth considerably thicker and blunter. (See pl. 48.)

Lepomis euryorus has the pharyngeal teeth about as in *Lepomis albulus*, but the bone is heavier and broader and begins to show the condition which Richardson describes for *Eupomotis*. (See pl. 47.)

Lepomis holbrookii has the pharyngeal bone very heavy and the teeth quite variable, but usually half of them, or a little less than half, round molars. (See pls. 42 and 43.) (Note variations in supplemental maxillary.)

The teeth of the type specimen of *Lepomis heros* are large molars over practically the entire surface of the bone, which is broad but not especially thick, much as in *Lepomis gibbosus*. Two specimens from Indiana, labeled as this species, had the bones very broad and thick as in *Lepomis holbrookii*, but with a larger proportion of molar teeth. (See pls. 44, 45, and 47.)

Lepomis gibbosus, the type of the genus *Eupomotis* of Gill and Jordan, has the pharyngeal bone very broad with very large molar teeth. The bone, however, is rather thin as compared with that of *Lepomis holbrookii*. (See pl. 46.)

The genus *Lepomis* seems to us to be most certainly a natural group. The species are so similar in squamation, coloring, number of fin rays, and proportions that with a few well-marked exceptions, perhaps only one exception (*Lepomis gibbosus*), it requires much experience and long study to separate species. Adult specimens of

Lepomis gibbosus in bright color can be almost always identified at sight, but this can not be said of the others.

Below we give a list of some of the prominent writers who have treated more or less at length of the sunfishes:

C. S. Rafinesque¹ did not mention pharyngeal teeth in his diagnoses of the genera *Lepomis*, *Pomotis*, and *Apomotis*. Later (1819–1821) the same author² proposed the names *Calliurus*, *Ichthelis* (= *Lepomis*), and *Telipomis* (= *Apomotis*) giving various unimportant characters in his diagnoses, but making no mention of pharyngeal bones or teeth or any other structural distinctions.

Cuvier and Valenciennes³ gave paved pharyngeal teeth as one of the principal characters of the genus *Pomotis*. In a revision of the generic characters in the seventh volume (1831) this is not mentioned and is evidently not considered.

J. P. Kirtland, in his notes on fishes of the Ohio River,⁴ does not mention pharyngeal bones in the descriptions.

Charles Girard did not use this character in his diagnoses of several genera of *Centrarchidæ* in *Fishes of the Pacific Railroad Survey* (1858) and *Fishes of the Mexican Boundary Survey* (1859).

John Edwards Holbrook in the *Ichthyology of South Carolina* (1860) defines the genus *Pomotis* (= *Eupomotis* Gill and Jordan) on page 7, and *Ichthelis* (= *Lepomis* Rafinesque), page 12. He seems to have been the first author to have used the character of the pharyngeal teeth as the major difference between groups of sunfishes. We quote his diagnosis in full:

GENUS POMOTIS.—*Rafinesque*.

CHARACTERS: Pre-opercle more or less denticulated; opercle with a membranous appendix at its angle; intermaxillary, vomerine, and inferior maxillary teeth villiform; tongue and palate bones smooth, or without teeth; pharyngeal teeth paved; dorsal fin single; anal with three spines; branchiostegal rays, six.

GENUS ICHTHELIS.—*Rafinesque*.

CHARACTERS: Body elliptical or oval, much more compressed; mouth small, armed with small teeth; *pharyngeal teeth not paved*; branchiostegal rays, six.

This is a change from the first edition (1855) where all the species are grouped in the genus *Pomotis*, which is thus defined on page 6:

Pre-opercle more or less denticulated; intermaxillary, vomerine, inferior maxillary, and pharyngeal teeth; tongue and palate bones smooth or without teeth, a membranous appendix at the angle of the opercle; branchial rays, six.

David Humphreys Storer⁵ mentions minute teeth on pharyngeal as one of the characters of *Pomotis*, but gives it no special consideration.

David Starr Jordan⁶ proposes the name *Lepiopotomus* as a better

¹ Journ. de Physique, 1819, pp. 402–420.

² Ichthyologia Ohiensis, pp. 26, 27.

³ Hist. Nat. Poiss., vol. 3, 1829, p. 91.

⁴ Boston Journ. Nat. Hist., vols. 3, 4, 5, 1840 to 1845.

⁵ Fishes of Massachusetts, 1867, p. 12.

⁶ Ann. N. Y. Lyc. Nat. Hist., 1876, p. 316.

spelling for *Lepomis*. On page 355 of the same publication he proposes the name *Helioperca* as a generic designation for *Lepomis pallidus*.

Gill and Jordan¹ propose the name *Eupomotis* for the genus typified by the common sunfish *Eupomotis gibbosus*, no diagnosis being given, but the synonymy of this species in full as then understood. In the same year David Starr Jordan² amplifies the statement of reasons for offering a new name, but gives no generic diagnosis. He adds two species to the list of those in the new genus.

Early in 1877 Doctor Jordan³ proposed the name *Xenotis* for species of *Lepomis* with the gill rakers on the first arch especially short and weak. No mention is made of the pharyngeal bones and the generic characters given are not distinctive.

On May 20, 1877, Edward D. Cope read before the American Philosophical Society a paper⁴ in which he described *Xystroplites longimanus* as a new genus and species from two localities in Florida.

About the same time Doctor Jordan⁵ described *Xystroplites gillii* as a new genus and species, giving Garden Key, Florida, as the locality from which the specimen was received. This is obviously an error and we have no means now of knowing the type-locality of this species. Professor Cope says in his description that Doctor Jordan's description was written first and, he supposes, was published first.

The two generic diagnoses are somewhat at variance in describing the pharyngeal teeth. We quote both:

The pharyngeal bones themselves are much narrower and smaller than in *Eupomotis*, being in form more like those of *Xenotis*. The teeth are less strongly "paved," being smaller, less crowded, and rounded rather than truncate; on the inner border of the bone are a few enlarged acute teeth. (Bull. 10, U. S. Nat. Mus., p. 24.)

Inferior pharyngeal bones wide and robust, and paved with truncate grinding teeth. (Proc. Amer. Phil. Soc., vol. 17, 1877-78, p. 67.)

Charles L. McKay⁶ says of the genus *Lepomis*:

This genus, as understood by me, includes *Apomotis*, *Xenotis*, *Bryttus*, *Helioperca*, *Xystroplites*, and *Eupomotis* of authors. *Apomotis* has been separated from *Lepomis* on account of the large size of the supplemental maxillary. On careful comparison this is found to be scarcely larger than in one or two other species of *Lepomis*. It disappears by degrees, but seems to exist in all the species, though sometimes so small as to be inappreciable. I have even found it present in large specimens of *L. pallidus*. Its presence in the species is only a character of degree, therefore not generic. Till the group had been more carefully studied, *Xenotis* was supposed to contain a large number of species, and was separated from *Lepomis* principally for convenience sake and on the slight character of the feeble gill rakers. By a comparison of a very large series of the alleged species from Professor Jordan's collection, I have come to the conclusion that they are all forms of a single species. The gill rakers are usually rather more feeble than in the rest of the species of *Lepomis*, but this again is a question of degree. *Bryttus* has been distinguished from *Lepomis* by the presence of palatine teeth. This

¹ Field and Forest, May, 1877, p. 190.

² Bull. 10, U. S. Nat. Mus., 1877.

³ Proc. Acad. Nat. Sci., Phila., 1877, p. 76.

⁴ Proc. Amer. Philos. Soc., vol. 17, pp. 63 to 68.

⁵ Bull. 10, U. S. Nat. Mus., 1877, p. 24.

⁶ Proc. U. S. Nat. Mus., vol. 4, 1881, June 2.

is also a character of degree, and is subject to the most perfect gradation. I have found it impossible to retain *Xystroplites* and *Eupomotis* also, as there is complete gradation in the character of the pharyngeals between *Lepomis* proper and *Xystroplites*, and again between *Xystroplites* and *Eupomotis* both as to the width and form of the bones themselves and the form of the teeth.

Jordan and Gilbert¹ include all the species in the single genus *Lepomis*, giving as one of the characters "lower pharyngeals narrow, the teeth conic or paved." That this will not hold true of all species may be seen from an examination of the accompanying illustrations.

Charles Harvey Bollman, in A Review of the *Centrarchidæ*,² places all the species under one generic name, *Lepomis*.

Boulenger³ separates the genera *Apomotis*, *Lepomis*, and *Eupomotis* on the characters of the supplemental maxillary and of the form of the pectoral fin. He does not mention the pharyngeal bones or teeth.

Jordan and Evermann⁴ base the genera *Apomotis*, *Lepomis*, and *Eupomotis* on the characters of the pharyngeal teeth and the supplemental maxillary. Under the genus *Lepomis*, page 999, they say: "* * * lower pharyngeals narrow, the teeth spherical or paved, all or nearly all sharp, few or none conical." This does not hold true of *Lepomis pallidus* or *Lepomis megalotis*.

Tarleton H. Bean⁵ follows Jordan and Evermann⁶ in assigning characters to the three genera.

Robert Earl Richardson⁷ disagrees with the findings of McKay and of Bollman and makes two genera, *Lepomis* and *Eupomotis*, on the character of the pharyngeal teeth. He examined the bones and teeth of many specimens of about fifteen species. His conclusions were justified by the material used and it was largely by accident that we found the intermediate conditions.

Henry W. Fowler⁸ mentions the pharyngeal teeth in the key to the genera of *Centrarchidæ*, where he used the same terms descriptive of the shape of teeth and bones as are used by Jordan and Evermann⁹. In the description of *Lepomis phenax* (p. 290) and of *Eupomotis gibbosus* (p. 295) the pharyngeal bones and teeth are briefly described.

Hugh M. Smith¹⁰ includes all the species mentioned under the genus *Lepomis*, giving the following diagnosis on page 239:

Body ovate, compressed, the dorsal outline in adults rather more strongly arched than the ventral; mouth of moderate size, jaws equal, maxillary narrow and not extending beyond pupil, supplemental bone small or wanting; no teeth on tongue

¹ Bull. 16, U. S. Nat. Mus., 1882, p. 472.

² Report U. S. Fish Commission for 1888 (1892), p. 565.

³ Catalogue of Fishes in the British Museum, ed. 2, vol. 1, p. 6.

⁴ Bull. 47, U. S. Nat. Mus., vol. 1, 1896.

⁵ Fishes of New York, 1903, pp. 475, 477, 482.

⁶ Bull. 47, U. S. Nat. Mus.

⁷ Bull. Ill. State Lab. Nat. Hist., vol. 7, March, 1904, p. 27.

⁸ Fishes of New Jersey, 1905, p. 728.

⁹ Bull. 47, U. S. Nat. Mus.

¹⁰ Fishes of North Carolina, 1907.

or pterygoids; pharyngeal bones narrow or broad, with sharp or blunt paved teeth; preopercular margin entire; opercle ending in a more or less elongated flap which is conspicuously colored; gill rakers usually short and feeble; dorsal spines, 10; anal spines, 3; caudal fin concave or emarginate behind; pectorals long or short, pointed or rounded.

Forbes and Richardson¹ say:

The genus *Lepomis*, as here understood, includes *Apomotis* of various authors. The forms that have been known under these two names agree in their pharyngeal dentition, which is remarkably different from that of the genus *Eupomotis*. The fact that the opercular flap is usually either entirely black or black with a definite border above, behind, and below serves as a useful distinction of the species of this genus from the single commonly distributed species of *Eupomotis* (*E. gibbosus*), in which there is always a conspicuous roundish spot of red at the lower posterior corner of the opercular flap.

In a footnote on the same page they add:

We have not found the "complete gradation in the character of pharyngeals between *Lepomis* * * * and *Eupomotis*, both as to the width and form of the bones themselves and the form of the teeth" that was described by McKay (Proc. U. S. Nat. Mus., vol. 4, 1881, p. 88). (See Richardson, 1904, Bull. Ill. State Lab. Nat. Hist., vol. 7, pp. 27-32.)

Also on page 259 under genus *Eupomotis*:

Form as in *Lepomis*; mouth always small; no supplemental maxillary bone and no teeth on palatines; lower pharyngeals deep and broad, with inferior and lateral prominences, the width of the toothed portion about 2 in its length; pharyngeal teeth short with the upper surfaces bluntly rounded or paved (truncate); gill-rakers short; fins rather long; red color on opercular flap in typical species forming a roundish spot. Eastern United States and Canada; 3 species.

Meek and Hildebrand² adopt the generic diagnosis of Forbes and Richardson.

EXPLANATION OF PLATES.

PLATE 42.

- Fig. 1. Left side of left lower pharyngeal of *Lepomis holbrookii*, Cat. No. 66310, U.S.N.M., South Carolina (?). × 6 diameters. Fish 25 cm. long.
 2. Dorsal aspect of left lower pharyngeal of same. × 6 diameters.
 3. Right maxillary of same showing supplemental bone. × 6 diameters.

PLATE 43.

- Fig. 1. Left side of left lower pharyngeal of *Lepomis holbrookii*, Cat. No. 66311, U.S.N.M., South Carolina (?). × 6 diameters. Fish 20.4 cm. long.
 2. Dorsal aspect of left lower pharyngeal of same. × 6 diameters.
 3. Right maxillary of same, supplemental bone absent. × 6 diameters.

PLATE 44.

- Fig. 1. Left side of left lower pharyngeal of *Lepomis heros*, Cat. No. 65185, U.S.N.M., Lake Maxinkuckee, Indiana. × 6 diameters. Fish 17.4 cm. long.
 2. Dorsal aspect of left lower pharyngeal of same. × 6 diameters.
 3. Right maxillary of same, no supplemental bone. × 6 diameters.

¹ Fishes of Illinois, 1907, p. 247.

² Fishes Known to Occur Within Fifty Miles of Chicago, Field Mus., Zool. Ser., vol. 7, No. 9, April, 1910, pp. 311 and 314.

PLATE 45.

- Fig. 1. Left side of lower pharyngeal of *Lepomis heros*, Cat. No. 65192, U.S.N.M., Lost Lake, Indiana. $\times 6$ diameters. Fish 22.2 cm. long.
2. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.

PLATE 46.

- Fig. 1. Left side of left lower pharyngeal of *Lepomis gibbosus* from Washington, District of Columbia. $\times 6$ diameters. Fish about 15 cm. long.
2. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.
3. Right maxillary of same, no supplemental bone. $\times 6$ diameters.
4. Upper pharyngeal of *Lepomis heros*, Cat. No. 65185, U.S.N.M., from Lake Maxinkuckee, Indiana. $\times 6$ diameters.
5. Upper pharyngeal of *Lepomis holbrookii*, Cat. No. 66310, U.S.N.M., from South Carolina (?). $\times 6$ diameters.

PLATE 47.

- Fig. 1. Left side of left lower pharyngeal of *Lepomis heros*, from type of *Pomotis heros* Girard, Cat. No. 438, U.S.N.M., Texas. $\times 6$ diameters. Fish 18.5 cm. long.
2. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.
3. Left side of left lower pharyngeal of type of *Lepomis eurycorpus* McKay, Cat. No. 4109, U.S.N.M., Lake Huron. $\times 6$ diameters. Fish 17.5 cm. long.
4. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.

PLATE 48.

- Fig. 1. Left side of left lower pharyngeal of *Lepomis albulus*, from type of *Bryttus albulus* Girard, Cat. No. 421, U.S.N.M., Texas. $\times 6$ diameters. Fish 15.5 cm. long.
2. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.
3. Left side of left lower pharyngeal of *Lepomis auritus*, Cat. No. 44139, U.S.N.M., Laurel, Maryland. $\times 6$ diameters. Fish 15.5 cm. long.
4. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.

PLATE 49.

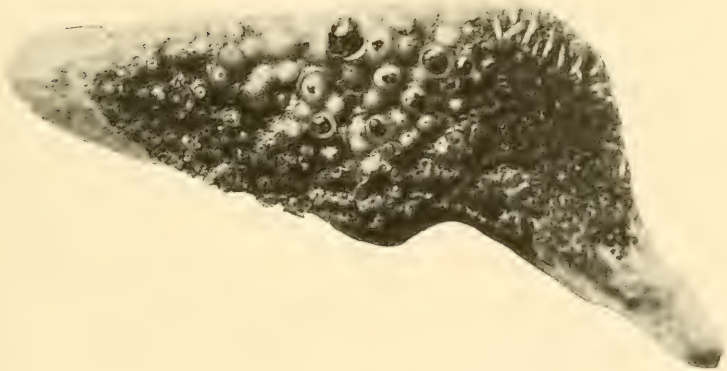
- Fig. 1. Left side of left lower pharyngeal of *Lepomis pallidus*, Cat. No. 66312, U.S.N.M., South Carolina (?). $\times 6$ diameters. Fish 21.6 cm. long.
2. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.
3. Right maxillary of same, no supplemental bone. $\times 6$ diameters.
4. Left side of lower pharyngeal of *Lepomis pallidus*, Cat. No. 64234, U.S.N.M., Sodus Bay, Wayne County, New York. $\times 6$ diameters.
5. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.

PLATE 50.

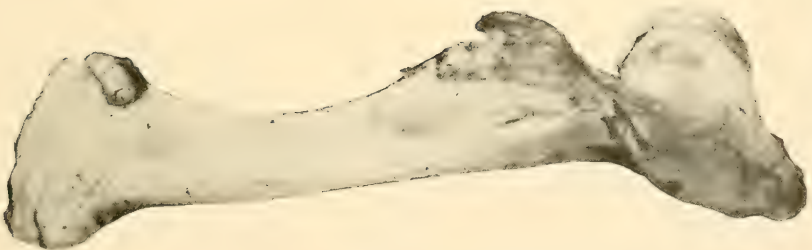
- Fig. 1. Left side of left lower pharyngeal of *Lepomis megalotis* from Tippecanoe River, Marshland, Indiana. $\times 6$ diameters. Fish 11.9 cm. long.
2. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.
3. Right maxillary of same, showing supplemental bone. $\times 6$ diameters.
4. Left side of left lower pharyngeal of *Lepomis cyanelus*, Cat. No. 64372, U.S.N.M., Washington, District of Columbia. Fish 14.1 cm. long.
5. Dorsal aspect of left lower pharyngeal of same. $\times 6$ diameters.
6. Right maxillary of same, supplemental bone present. $\times 6$ diameters.



1



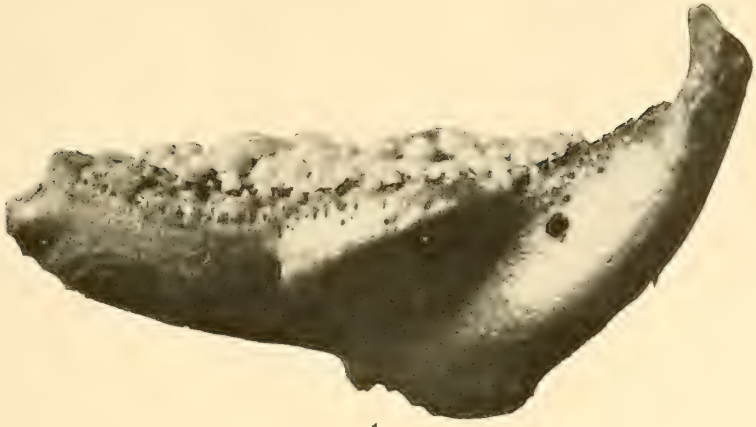
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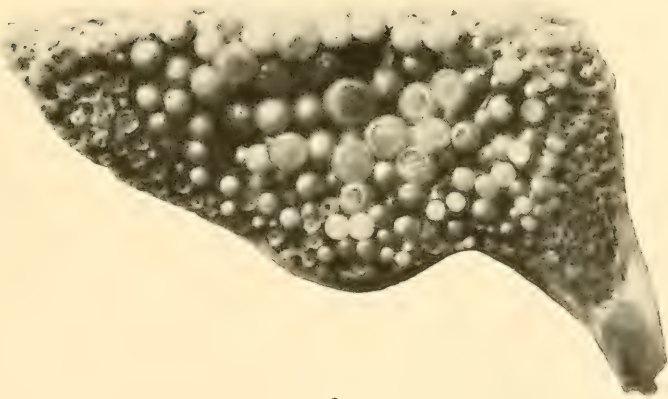
3

LEPOMIS HOLBROOKII.

FOR EXPLANATION OF PLATE SEE PAGE 375.



1



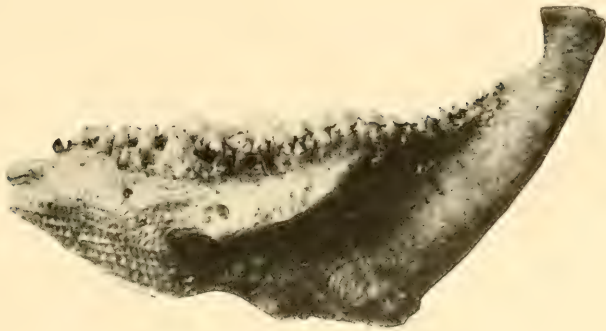
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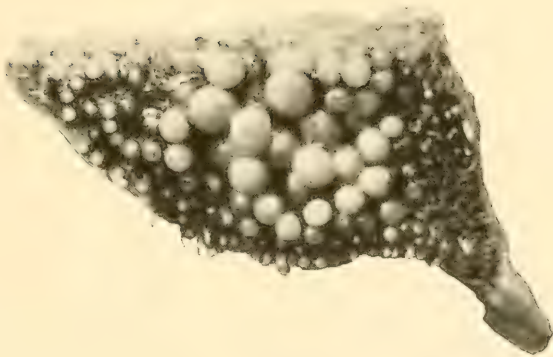
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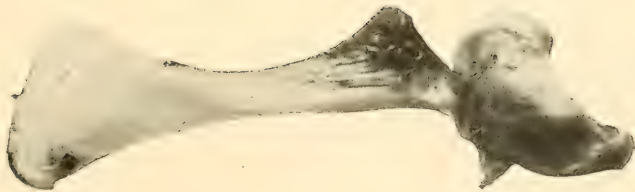
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1



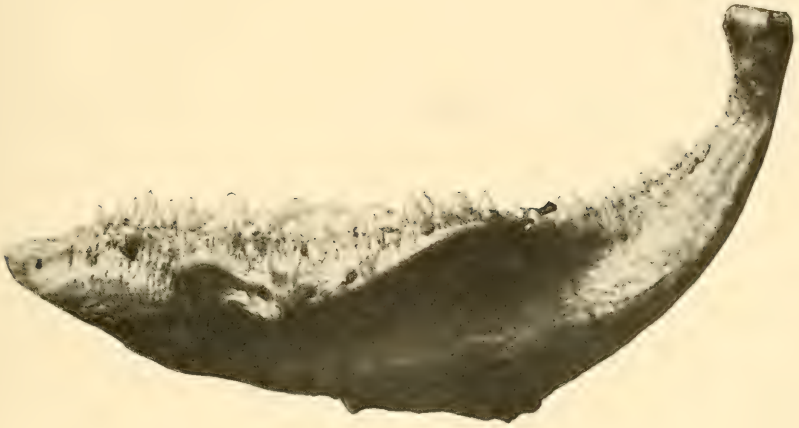
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3

LEPOMIS HEROS.

FOR EXPLANATION OF PLATE SEE PAGE 375.



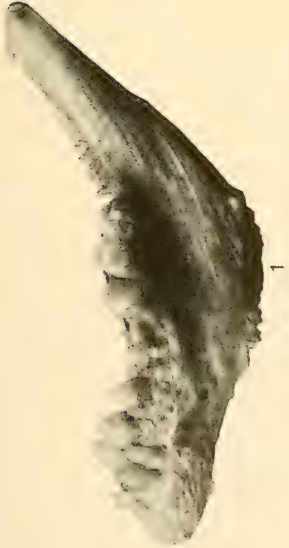
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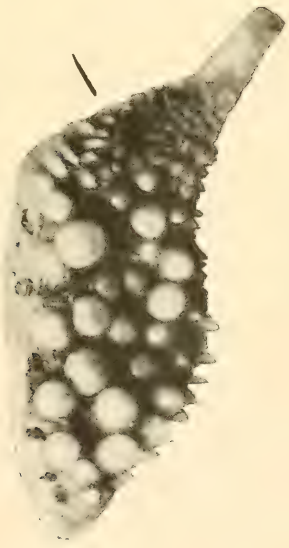
FOR EXPLANATION OF PLATE SEE PAGE 376.



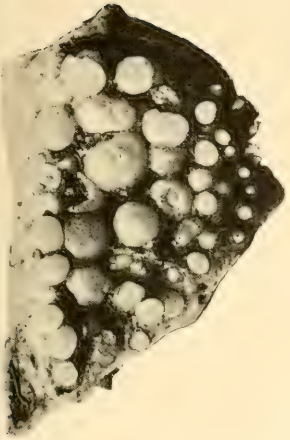
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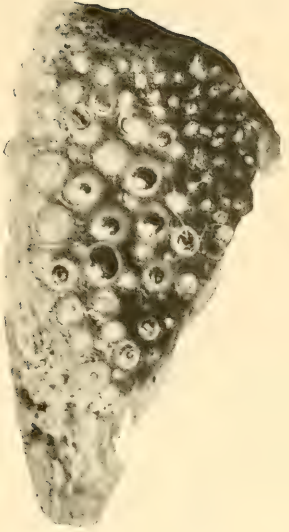
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FIGS. 1-3.—LEPOMIS GIBBOSUS.

FIG. 4.—LEPOMIS HEROS.

FOR EXPLANATION OF PLATE SEE PAGE 376.

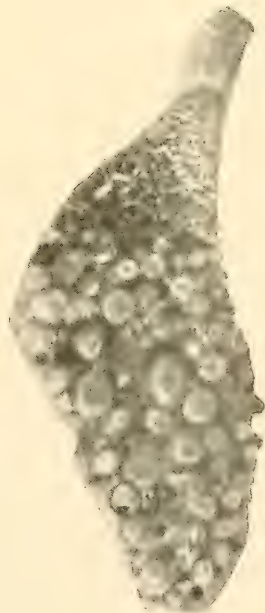
FIG. 5.—LEPOMIS HOLBROOKII.



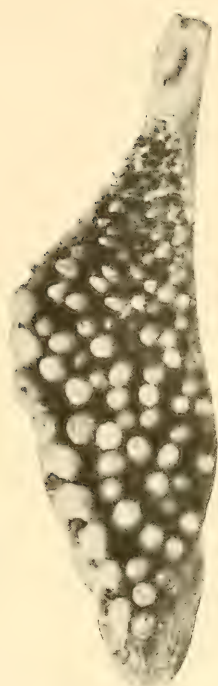
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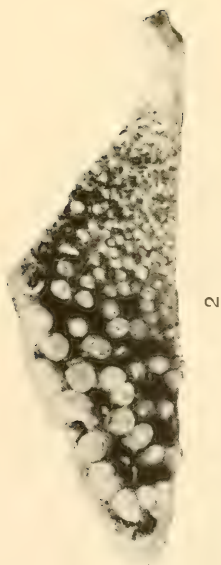
FIGS. 1-2.—LEPOMIS HEROS.

FIGS. 3-4.—LEPOMIS EURYMORUS.

FOR EXPLANATION OF PLATE SEE PAGE 376.



1

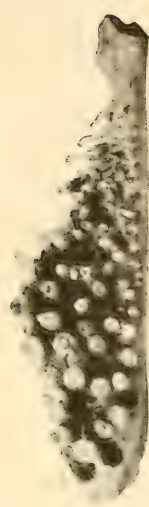


2

FIGS. 1-2.—LEPOMIS ALBULUS.



3



4

FIGS. 3-4.—LEPOMIS AURITUS.

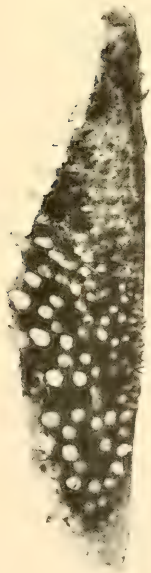
FOR EXPLANATION OF PLATE SEE PAGE 376.



1



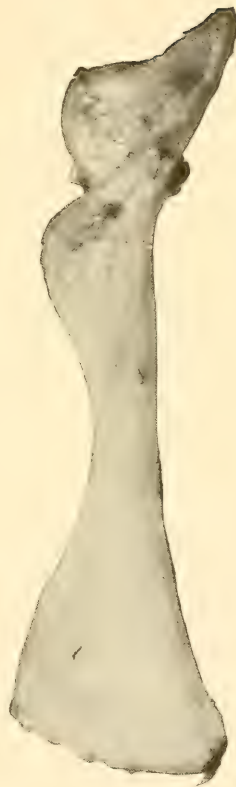
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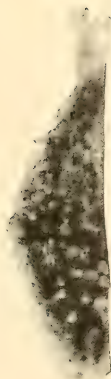


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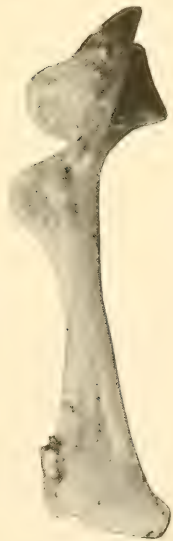
FIGS. 1-5.—LEPOMIS PALLIDUS.
FOR EXPLANATION OF PLATE SEE PAGE 376.



1



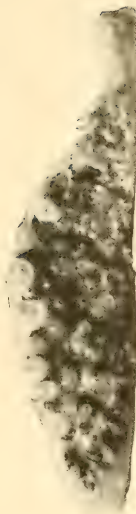
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6

FIGS. 1-3.—LEPOMIS MEGALOTIS.

FIGS. 4-6.—LEPOMIS CYANELLUS.

FOR EXPLANATION OF PLATE SEE PAGE 376.

REMARKS ON THE LONG-TAILED SHREWS OF THE
EASTERN UNITED STATES, WITH DESCRIPTION OF A
NEW SPECIES.

By N. HOLLISTER,

Assistant Curator, Division of Mammals, U. S. National Museum.

Since the publication of Dr. C. Hart Merriam's Synopsis of the American Shrews of the genus *Sorex*, 1895,¹ the number of specimens from southern localities has been greatly increased. Aside from *Sorex personatus* and *S. fumeus* from mountain localities, there was nothing available at that time but two imperfect specimens of the supposed "*lesueurii*," a few specimens of *S. fisheri* from the Dismal Swamp, and perhaps half a dozen specimens from Raleigh, North Carolina, which were assumed to represent *Sorex longirostris*, described by Bachman from the swamps of the Santee River, South Carolina. The overhauling of the old alcoholic shrews in the collection of the United States National Museum and a study of the recently acquired material in skins and skulls have resulted in some interesting discoveries and given a better understanding of the southern forms of *Sorex* than was ever before possible. South of New York and Wisconsin the restricted genus *Sorex* is represented by five distinct species.²

SOREX PERSONATUS I. Geoffroy.

1827. *Sorex personatus* I. GEOFFROY, Mém. mus. d'hist. nat. Paris, vol. 15, p. 122.

The most abundant and generally distributed species in the northern States, this shrew is represented in the collection by many specimens from Maine to Wisconsin. The few specimens from the southern boundary of its range in the upper Mississippi Valley (southeastern Wisconsin, northern Illinois, Indiana, and Ohio) and from New Jersey and the lower Hudson Valley, New York, average slightly smaller than specimens from New England, northern New York, northern Wisconsin, and Minnesota, the skulls averaging about 1 millimeter shorter, with flatter braincases. Farther south, where the species occurs only in the mountains of Maryland, the Virginias,

¹ North Amer. Fauna, No. 10, pp. 57-98, December 31, 1895.

² Three other long-tailed shrews have been found in this area: *Necosorex albibarbis* in Pennsylvania, *Microsorex hoyi* in Ohio, and *Microsorex winnemana* in Virginia and Maryland.

and North Carolina, the specimens are intermediate between those from the previously mentioned northern and southern areas. The difference in series of skulls is very noticeable, but it is difficult to assign a definite distribution for a southern race and it seems hardly proper to recognize one. The name *Sorex personatus platyrhinus* (De Kay),¹ type-locality Tappan, Rockland County, New York, is available should a southern subspecies of *personatus* ever be recognized.

The name *Sorex personatus lesueurii* (Duvernoy), based on a specimen from the Wabash Valley, Indiana, has been used for a southern form of *personatus*. As no specimen of a shrew of the *personatus* type is known from southern Indiana, and the few specimens collected in that region have all very surprisingly proved referable to *Sorex longirostris* Bachman, it is obvious that the name *Amphisorex lesueurii* Duvernoy is not applicable to a *personatus* shrew.² The status of *Sorex fimbripes* Bachman, 1837, is discussed below.

SOREX FONTINALIS, new species.

1895. [*Sorex personatus*] *lesueuri* MERRIAM, North Amer. Fauna, No. 10, p. 61, December 31 (in part, as to specimen from Sandy Spring, Maryland). Not *Amphisorex lesueurii* Duvernoy, 1842.

Type.—From Cold Spring Swamp, near Beltsville, Maryland. Cat. No. 85439, U.S.N.M. Skin and skull, old adult female. Collected November 6, 1898, by Gerrit S. Miller, jr.

General characters.—A diminutive shrew of the *S. personatus* group; smaller than *personatus*, with much shorter tail.

Color.—Almost precisely like *personatus*. The type matches exactly a skin of *S. personatus* from Highland Falls, New York, collected in September. Upperparts dark sepia, darkest posteriorly; sides lighter, about broccoli brown; underparts brownish gray; tail distinctly bicolor, tip blackish. Specimens collected in February and March are darker than the type, and a skin collected in May is much browner.

Skull and teeth.—Skull, compared with *S. personatus*, much smaller; braincase narrow and compressed; rostrum shorter and relatively wider, less attenuate. Teeth as in *personatus*, but unicuspid more crowded and uniformly decreasing in size from first to fourth.

Measurements.—Flesh measurements of type: Total length, 90 mm.; tail vertebrae, 31; hind foot, 10. (An average specimen of *S. personatus* from the Catskills measures: Length, 99; tail, 40; hind foot, 12.) Skull of type: Condylbasal length, 14.2; breadth of brain case, 7; greatest anteorbital breadth, 3.9; length of bony palate, 5.6.

¹ Zool. New York, Mamm., 1842, p. 22, pl. 5, fig. 1.

² Dr. W. L. Hahn has, in his Mammals of Indiana, 1909, p. 607, already placed *lesueurii* in the synonymy of *S. longirostris*.

Remarks.—There are no specimens showing intergradation between this species and *Sorex personatus*. Specimens of *personatus* from the mountains of western Maryland and Virginia in no way approach it in external or cranial characters, and it is apparently a true Austral species, perfectly distinct from the species of the southern Alleghenies. Only ten specimens of *Sorex fontinalis* are known. They were all collected near the District of Columbia, in Maryland, at localities as follows: Beltsville, 2; Hyattsville, 5;¹ Laurel, 2; Sandy Spring, 1.

SOREX LONGIROSTRIS Bachman.

1837. *Sorex longirostris* BACHMAN, Journ. Acad. Nat. Sci. Phila., vol. 7, pt. 2, p. 370.

1842. *Amphisorex lesueurii* DUVERNOY, Mag. de zool., ser. 2, mamm., p. 33, November.

1901. *Sorex personatus lesueurii* MILLER and REHN, Proc. Bost. Soc. Nat. Hist., vol. 30, No. 1, p. 235, December.

An alcoholic specimen of this rare shrew from Butler, Taylor County, Georgia, has been found in the collection of the National Museum. It was presented by Dr. H. M. Neisler, and was catalogued in 1873 as No. 11318. The locality is the most southern point from which *Sorex* is known in the eastern United States, and the specimen is of great interest because it probably represents the typical form of Bachman's *S. longirostris*, described from the Swamps of the Santee River, South Carolina. The specimen, a pregnant female, is in an excellent state of preservation. It measures (from alcohol, before removal of the skull): Total length, 82 mm.; tail vertebrae, 28; hind foot, 10.5. The skull measures: Condylbasal length, 14.1; breadth of cranium, 7.4; greatest anteorbital breadth, 4.2; length of bony palate, 5.3.

Howell has already recorded this species from northern Georgia and from Bicknell, Indiana,² and its known range was still further extended by the capture of a specimen at Chesapeake Beach, Calvert County, Maryland, July 3, 1908, by Dr. M. W. Lyon, jr. An additional specimen from Washington, District of Columbia, collected by C. Girard, and entered April 19, 1855, as number 637, has been found in the Museum collection. The skin without skull, from New Harmony, Indiana, recorded somewhat doubtfully by Doctor Merriam as *Sorex personatus lesueurii*, seems certainly to be *S. longirostris*. At that time the occurrence of this species in Indiana was unthought of, and the determination of a skin alone, with so few specimens of *longirostris* for comparison, was virtually impossible. The eight specimens³ before me show a little variation in the shape of the

¹ Biological Survey collection.

² Proc. Biol. Soc. Wash., vol. 22, p. 66, Apr. 17, 1909.

³ Five specimens from Biological Survey collection; Young Harris, Georgia; Raleigh, North Carolina; New Harmony and Bicknell, Indiana.

braincase, probably due to age, but all seem to belong to one wide-ranging form. If larger series from Illinois and Indiana should show the northern specimens to be separable, the name *Sorex longirostris lesueurii* (Duvernoy), type-locality Wabash River, Indiana, is available.

SOREX FISHERI Merriam.

1895. *Sorex fisheri* MERRIAM, North Amer. Fauna, No. 10, p. 86, December 31.

This very distinct species continues to be known only from the Dismal Swamp, Virginia. In addition to the original specimens, a series of skins with skulls and alcoholic specimens was collected by Dr. W. L. Ralph and Lieut. J. W. Daniel, jr., and presented to the National Museum. The species is apparently related to *S. longirostris*, but is readily recognizable by its larger size and much larger skull. A litter of five young was collected by Doctor Ralph in the Dismal Swamp, May, 1905, and preserved in alcohol.

SOREX FUMEUS Miller.

1895. *Sorex fumeus* MILLER, North Amer. Fauna, No. 10, p. 50, December 31.

This species extends its range down the Alleghenies as far south as Brasstown Bald, Georgia, from which locality it has been recorded by Howell.¹ The National Museum collection contains specimens from southern localities as follows: Mount Rogers, Grayson County, and Rowleysburg, Virginia; Franklin, West Virginia; Roan Mountain, North Carolina. A single specimen from Racine, Wisconsin, carries the known range far to the west. The southern specimens seem perfectly typical.

NOTE ON THE SUPPOSED TYPE OF SOREX FIMBRIPES.

Bachman described *Sorex fimbripes*² from a specimen received at the Philadelphia Academy of Sciences from Drury's Run, Pennsylvania. Baird, in the Mammals of North America, 1857, states that he had not seen the type, which he says is in the Philadelphia Academy. Coues, 1877,³ writes: "In 1861 Baird examined Bachman's type, preserved in the Philadelphia Academy, and found it to be a species of ordinary 32-toothed shrew, scarcely or not distinguishable from '*cooperi*.'" On this authority Miller⁴ placed the name in the synonymy of *Sorex personatus*, remarking on the strange characters attributed to the animal by Bachman. As recorded by Lyon and Osgood,⁵ an alcoholic shrew, without number and absolutely without record, but bearing a parchment label marked "*Sorex fimbripes*, Type," was found in the National Museum early in 1898. In the

¹ Proc. Biol. Soc. Wash., vol. 22, p. 66, Apr. 17, 1909.

² Journ. Acad. Nat. Sci. Phila., 1837, vol. 7, pt. 2, p. 391.

³ Bull. U. S. Geol. and Geog. Survey of Terr., 1877, vol. 3, p. 641.

⁴ N. Amer. Fauna, No. 10, p. 41, 1895.

⁵ Cat. Type-Spec. Mamm. in U. S. Nat. Mus., p. 243, 1909.

type-catalogue, as is carefully stated, the locality, Drurys Run, Pennsylvania, was supplied from Bachman's description. The skull of this specimen has recently been removed, and it proves to be not *personatus*, but *Sorex fumeus*. A careful comparison of the specimen with Bachman's description makes it perfectly obvious that it is NOT the single specimen he had before him when he wrote the diagnosis of *Sorex fimbripes*. Beyond a point where a specimen of any shrew might answer, it does not agree with any of the alleged characters, and in all the distinctive characters mentioned differs widely in every detail. In measurements particularly it differs so greatly that it is at once evident this specimen has no claim as the type and it seems probable it did not come from Drurys Run and was never in Bachman's hands. At the time the label was written the word "type" had a very different meaning from what it now has and was used for various purposes. Several specimens in the collection are marked "type" which have not the slightest claim, in the modern meaning of the word, to that distinction. Some were even collected after the description was published. The writing on the parchment label of this specimen is probably that of Professor Baird, who may or may not have believed that the specimen was the original of Bachman's description.

The description of *Sorex fimbripes* differs so widely from any known American shrew that the name is probably unidentifiable. This specimen at any rate can not be considered the type, and the fact that it proves to be the same as *Sorex fumeus* in no way invalidates that currently used name.

NOTE ON THE SOREX ACADICUS OF GILPIN.

Mr. Gerrit S. Miller, jr., has called my attention to the fact that the identity of the shrew described by Gilpin,¹ from Nova Scotia, as *Sorex acadicus*, has never been determined. A careful review of Gilpin's papers makes it reasonably certain that his species is *Sorex personatus*. The only characters given which are of value as evidence are the measurements, and these, though differing considerably among themselves, agree best with the measurements of *Sorex personatus*. The size as given in the table of measurements of five specimens is: Length, $3\frac{6}{8}$ to 4 inches (= 97 to 103 mm.), and tail, $1\frac{1}{2}\frac{5}{8}$ to 2 inches (= 41 to 51 mm.). This is large for *Microsorex hoyi* and too small for *Sorex fumeus*. Though the length of tail is somewhat great for *S. personatus*, it is too short for *S. macrurus*, and was doubtless taken to the end of hairs. At present it seems perfectly proper to consider *Sorex acadicus* Gilpin a synonym of *Sorex personatus*.

¹Trans. Nova-Scotian Inst. Nat. Sci., vol. 1, pt. 2, p. 2, 1867. Erroneously marked vol. 2.

THE RECENT AND FOSSIL MOLLUSKS OF THE GENUS
BITTIUM FROM THE WEST COAST OF AMERICA.

By PAUL BARTSCH,

Assistant Curator, Division of Mollusks, U. S. National Museum.

The first *Bittium* known from the west coast of America was reported by A. A. Gould¹ in 1849, when he described *Cerithium filosum* from the northwestern coast. Unfortunately, Philippi had used this name for a different species the year previous, thus pre-occupying the above combination. The same year A. T. von Middendorff² described the same species as *Turritella eschrichtii*.

Bittium eschrichti Middendorff remained the unique representative until 1857, when Dr. P. P. Carpenter³ published *Cerithiopsis decussata* from Mazatlan, Mexico. To these William M. Gabb⁴ added *Turbonilla aspera*, a fossil species from the Lower Pleistocene of Santa Barbara, California, in 1861. *Bittium nitens*, a fourth species, was described by Doctor Carpenter⁵ in 1864, from Cape St. Lucas, Lower California.

A large number of new forms were listed in the Supplementary Report on the Present State of our Knowledge with Regard to the Mollusca of the West Coast of North America, by Dr. P. P. Carpenter⁶ in 1864. In this report Doctor Carpenter gives a list of the shells known to him and adds a few words of diagnosis to the new forms, which are later fully described in various journals. The species here listed are:

Cerithiopsis munita, pages 628 and 660. *Bittium* ? var. *esuriens*, page 655.
Bittium attenuatum, page 655.

Bittium filosum Gould = *Eschrichtii* Middendorff, page 655.

¹ Proc. Bost. Soc. Nat. Hist., vol. 8, p. 120.

² Beitr. Mal. Ross., vol. 2, 1849, p. 68, pl. 11, fig. 1.

³ Cat. Mazatlan Shells, 1857, p. 368.

⁴ Proc. Acad. Nat. Sci. Philadelphia, p. 368.

⁵ Ann. Mag. Nat. Hist., ser. 3, vol. 13, p. 479.

⁶ Rep. Brit. Ass. Adv. Sci. for 1863, published in 1864.

Bittium quadrifilatum, page 655.

Bittium asperum, page 655.

Bittium armillatum, page 655.

Bittium fastigiatum, page 655.

Rissoa interfossa, page 656.

Cerithiopsis purpurea, page 660.

Cerithiopsis fortior, page 660.

Of these, *Bittium*?, var. *esuriens* Carpenter has proved to be a synonym of *Bittium attenuatum* Carpenter, and *Cerithiopsis fortior* Carpenter is synonymous with *Rissoa interfossa*, while *Bittium asperum* was later diagnosed by him as *Bittium rugatum*, and *Bittium fastigiatum* is now referred to the genus *Diastroma*.

In 1865 we find no additional species added to the *Bittium* fauna, but a more complete diagnosis for—

Bittium ? var. *esuriens* Carpenter. *Cerithiopsis purpurea* Carpenter.

Bittium attenuatum Carpenter. *Cerithiopsis fortior* Carpenter.

Bittium quadrifilatum Carpenter. *Cerithiopsis munitum* Carpenter.

Reference to these descriptions can be found under each species in the present text.

The following year we find the complete diagnosis of—

Rissoa interfossa Carpenter, *Bittium armillatum* Carpenter,

and a full description of the species listed in 1864 as *Bittium asperum* Carpenter, which he now names *Bittium rugatum* Carpenter. Here also he refers *Turbonilla aspera* Gabb properly to the present genus.

The genus *Bittium* breaks up into several convenient groups, on the west coast of America, which may be considered subgenera. These are characterized in the following key:

KEY TO THE SUBGENERA OF BITTIUM, OCCURRING ON THE WEST COAST OF AMERICA.

Nuclear whorls with two spiral lirations.

Postnuclear whorls having varices. *Bittium* Leach s. s.

Postnuclear whorls without varices *Lirobittium*, new subgenus. Type *B. (L.) catalinense* Bartsch.

Nuclear whorls smooth.

Spiral sculpture predominating over the axial. *Stylidium* Dall.

Spiral sculpture not predominating over the axial. *Semibittium* Cossmann.

Bittium s. s. is represented by two species only in the area under discussion, namely *B. panamense* Bartsch and *B. johnstonæ* Bartsch, the first coming from Panama, the last from Lower California, while of *Stylidium* but one species, *B. (S.) eschrichtii* Middendorff, and two subspecies, *B. (S.) e. icelum* Bartsch and *B. (S.) e. montereyense* are known.

To *Semibittium* I refer the following thirteen forms:

armillatum Carpenter.

purpureum Carpenter.

vancouverense Dall and Bartsch.

attenuatum Carpenter.

attenuatum boreale Bartsch.

attenuatum multifilum Bartsch.

attenuatum latifilum Bartsch.

subplanatum Bartsch.

rugatum Carpenter.

quadrifilatum Carpenter.

nicholsi Bartsch.

nitens Carpenter.

Three, *B. armillatum*, *purpureum*, and *vancouverense*, are placed here with some doubt because the nuclear whorls are somewhat worn and it is barely possible that they may possess sculpture when perfect.

Lirobittium has nine forms on the west coast. Of these, two only are placed here of which I have not seen the nucleus in perfect condition, namely, *B. (L.) munitum* Carpenter and *B. larum* Bartsch. However, since *B. (L.) munitum munitoides* Bartsch belongs here, there can scarcely be any doubt about placing *munitum* in this position.

The species of *Lirobittium* are:

| | |
|---------------------------------------|------------------------------------|
| <i>interfossum</i> Carpenter. | <i>munitum munitoides</i> Bartsch. |
| <i>catalinense</i> Bartsch. | <i>asperum</i> Gabb. |
| <i>catalinense inornatum</i> Bartsch. | <i>asperum lomaënse</i> Bartsch. |
| <i>ornatissimum</i> Bartsch. | <i>cerralvoënse</i> Bartsch. |
| <i>munitum</i> Carpenter. | <i>larum</i> Bartsch. |

Of the following seven species, I have not seen the nuclear whorls; their subgeneric position must, therefore, remain doubtful until more perfect material has been examined. They will probably prove to be *Semibittium* or *Lirobittium*.

| | |
|------------------------------|-----------------------------|
| <i>oldroydæ</i> Bartsch. | <i>giganteum</i> Bartsch. |
| <i>fetillum</i> Bartsch. | <i>casmaliense</i> Bartsch. |
| <i>decussatum</i> Carpenter. | <i>arnoldi</i> Bartsch. |

Five species, *Bittium (Stylidium) eschrichtii*, *Bittium catalinense*, *Bittium catalinense inornatum*, *Bittium attenuatum*, and *Bittium quadrifilatum*, occur both recent and fossil. The first, *Bittium (Stylidium) eschrichtii*, has been reported by Doctor Dall¹ from Fossil Rock at Coos Bay, Oregon (Pliocene), but so far has not been found fossil in any Pleistocene strata.

Bittium catalinense Bartsch is known from the Lower Pleistocene of Santa Barbara and San Pedro (Lower San Pedro series), and is found living in rather deep water. The subspecies *Bittium catalinense inornatum* Bartsch is known from the Lower Pleistocene of San Diego and recent. *Bittium attenuatum* Carpenter is the most abundant recent *Bittium* and has been found fossil in the Lower San Pedro Series at San Pedro (Pleistocene). *Bittium quadrifilatum* Carpenter is a common recent species also found in the Lower Pleistocene of Santa Barbara, California.

Of the seven species known as fossils only, *Bittium casmaliense* Bartsch and *Bittium arnoldi* Bartsch are from the Lower Pliocene of Santa Barbara County, California, while *Bittium asperum* Gabb has

¹ Prof. Paper 59, U. S. Geol. Surv., 1909, p. 76.

been reported from the Upper Pliocene, Fernando Formation, at Bath-house Beach, Santa Barbara, and the Pleistocene of Santa Barbara, San Pedro, and San Diego, California.

The remaining four—

Bittium armillatum Carpenter, *Bittium giganteum* Bartsch, and
Bittium ornatissimum Bartsch, *Bittium rugatum* Carpenter,
 are from the Pleistocene of California. Their distribution is noted after their description in the text.

The illustrations accompanying this paper¹ are after photographs made by Mr. T. W. Smillie, and were retouched by Mr. R. Weber.

BITTIUM (BITTIUM) PANAMENSE, new species.

Plate 53, fig. 5.

Shell large, elongate-conic, brown, variegated with whitish areas. Nuclear whorls small, partly decollated, a little more than one, smooth, the remaining portion with two spiral lirations. Post-nuclear whorls marked by feeble spiral cords which are a little stronger on the early whorls than on the later ones. Three of these cords occur upon each of the first five whorls, while on the sixth turn a fourth makes its appearance at the summit; this rapidly increases in strength and soon equals the other three. In addition to the spiral cords, the whorls are marked by axial ribs which are much more strongly developed on the early whorls than on the later ones. On the later whorls they are merely indicated by the tubercles resulting from the junctions of the cords and ribs. The tubercles are truncated anteriorly and slope gently posteriorly. Moderately strong varices occur at irregular intervals. On the last two whorls a slender spiral thread makes its appearance in the middle between the median tubercles and also in the space between the two anterior cords. Sutures weakly impressed. Periphery and base of the last whorl moderately long, well rounded, marked by ten spiral cords which are truncated posteriorly and slope gently anteriorly. These cords decrease regularly in size from the periphery to the columella, over which the last three extend. In addition to this sculpture, the entire surface is marked by numerous fine lines of growth and exceedingly fine, spiral striations. Aperture moderately large, irregularly ovate, decidedly channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, which renders the margin sinuous; columella short, stout, twisted, and very strongly reflected; parietal wall glazed with a thin callus.

¹ In the preparation of the present diagnoses the following terminology is used:

"Axial sculpture," the markings which extend from the summit of the whorls toward the umbilicus. The axial sculpture may be—

"Vertical," when the markings are in general parallelism with the axis of the shell.

"Protractive," when the markings slant forward from the preceding suture.

"Retractive," when the markings slant backward from the suture.

"Spiral sculpture," the markings following the directions of the coils of the whorls.

The type (Cat. No. 32271, U.S.N.M.) comes from Panama. It has twelve post-nuclear whorls and measures: Length 14 mm., diameter 4.1 mm.

BITTIUM (BITTIUM) JOHNSTONÆ, new species.

Plate 53, fig. 6.

Shell very elongate-conic, chestnut brown with strong white varices at irregular intervals. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, the early turns ornamented with four spiral keels, all of which, except the anterior one, which is at the summit, are of equal size and about as wide as the spaces that separate them; the one at the summit being much more slender. On the last three whorls the keel at the summit divides into two slender threads, which occupy the same amount of space as the single keel does on the earlier turns. In addition to the spiral keels, the whorls are marked by strong, well-rounded, axial ribs which are about two-thirds as wide as the spaces that separate them. These ribs render the spiral keels tuberculate at their intersection. There are 12 ribs upon the third, 14 upon the fourth, 16 upon the fifth and sixth, and 18 upon the seventh turn. On the last two whorls, four axial ribs occur between each pair of varices. Varices very large and conspicuous. Sutures strongly constricted. Periphery of the last whorl well rounded, marked by a slender spiral cord which is not tuberculate. Base rather prolonged, well rounded, marked by four equal and equally spaced spiral cords, of which the last is immediately behind the columella. Entire surface of base marked by numerous, rather strong lines of growth. Aperture ovate, decidedly channeled anteriorly; outer lip thin at the edge, rendered sinuous by the external sculpture which is visible within; columella very short, curved, and covered on its entire surface by a strong callus, which also extends over the parietal wall.

The type (Cat. No. 196208, U.S.N.M.) was collected by Mrs. E. E. Johnston in Lower California. It has ten whorls and measures: Length 7.9 mm., diameter 2.6 mm.

Named for Mrs. E. E. Johnston.

BITTIUM (STYLIDIUM) ESCHRICHTII Middendorff.

Plate 58, fig. 4.

Cerithium filosum GOULD, Proc. Boston Soc. Nat. Hist., vol. 3, 1849, p. 120, not of Philippi, Zeitschr. für Mal., 1848, p. 143.

Turritella eschrichtii MIDDENDORFF, Beitr. Mal. Ross., vol. 2, p. 68, pl. 11, fig. 1, 1849.

Bitium filosum CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 655.—ARNOLD, Pal. and Strat. San Pedro, 1903, p. 292.

Bitium (Stylidium) eschrichtii DALL, Proc. U. S. Nat. Mus., vol. 33, No. 1564, p. 178, Oct., 1907.

Bitium (Stylidium) eschrichtii DALL, Prof. Paper 59, U. S. Geol. Surv., p. 76, pl. 14, fig. 2, 1909.

Shell broadly elongate-conic, rather coarse, varying in color from white to chestnut brown. The nucleus consists of a single, smooth, white whorl, well rounded. Post-nuclear whorls well rounded, marked by four strong, somewhat flattened, spiral keels between the sutures, which are separated by deep, strong, spiral grooves about two-thirds as wide as the keels. In addition to this spiral sculpture, the whorls are marked by numerous fine, spiral striations and fine lines of growth. Periphery of the last whorl marked by a sulcus as wide as the sulci between the keels on the spire. Base well rounded, marked by eight equally spaced spiral cords, which grow successively weaker from the periphery to the umbilical area. In addition to these cords the base is marked by fine spiral lines and fine lines of growth. Aperture oval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin, rendered wavy by the external sculpture; columella short, very broad at base, somewhat twisted and reflected; parietal wall glazed with a thin callus.

The specimen described and figured (Cat. No. 122558, U.S.N.M.) has nine post-nuclear whorls and measures: Length 14 mm., diameter 5 mm., and was collected on the beach at Sitka, Alaska.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------|---|----------------------|
| 151626 | Killisnoo, Alaska..... | 3 |
| 73218 | Sitka, Alaska..... | 5 |
| 122558 | Sitka, Alaska (described and figured)..... | 1 |
| 195117 | Sitka, Alaska..... | 1 |
| 195118 |do..... | 10 |
| 160565 | Biorka Island, Sitka Sound, Alaska..... | 1 |
| 193687 | Cormorant Island, Alert Bay, Alaska..... | 1 |
| 195120 | Barelay Sound, British Columbia..... | 19 |
| 152909 | Neah Bay..... | 29 |
| 23332 |do..... | 73 |
| 3935 | Puget Sound..... | 9 |
| 5575 | Puget Sound (type of <i>Bittium filosum</i> Gould)..... | 1 |
| 133690 | Tacoma, Washington..... | 4 |
| 195119 | Port Ludlow, Washington..... | 4 |
| FOSSIL. | | |
| 153992 | Fossil Rock, Coos Bay, Oregon (Pliocene)..... | 1 |

BITTIUM (STYLIDIUM) ESCHRICHTII ICELUM Bartsch.

Plate 57, fig. 3.

Bittium (Stylidium) eschrichtii icelum BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 178.

In *B. eschrichtii* only the early whorls show axial ribs. In the present form they are well developed on all the turns, weakening only on the last. The type, Cat. No. 15209a, U.S.N.M., was collected by J. G. Swan at Neah Bay, Washington. It has nine whorls (the nucleus being lost) and measures: Length 15 mm., diameter 5.5 mm. Another specimen, Cat. No. 32209, U.S.N.M., belongs to the Stearns collection and comes from Monterey, California.

BITTIUM (STYLIDIUM) ESCHRICHTII MONTEREYENSE Bartsch.

Plate 58, fig. 5.

Bittium (Stylidium) eschrichtii montereyense BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 178-179.

This form is a southern race of *B. eschrichtii*. It differs from the typical form in being less strongly spirally keeled, much more smooth, more slender, and in every way more elegant than *eschrichtii*. The typical form varies in color from brown to white, and is very rarely spotted. In *montereyense* the variegated forms predominate—that is, the shells are whitish mottled with rust brown. The type, Cat. No. 32221, U.S.N.M., has ten whorls, and measures: Length 13.8 mm., diameter 5 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|--------------------|---|----------------------|
| 101135 | Cresson City, California..... | 1 |
| ¹ 32221 | Monterey, California..... | 9 |
| 32211 | do..... | 14 |
| 32214 | do..... | 3 |
| 32228 | do..... | 15 |
| 55992 | do..... | 65 |
| 56443 | do..... | 1 |
| 56849 | do..... | 4 |
| 202662 | Pescadero, California..... | 4 |
| 55994 | San Pedro, California..... | 2 |
| 194387 | San Diego, California..... | 3 |
| 32279 | Gulf of California..... | 1 |
| 55993 | Cape St. Lucas, Lower California..... | 2 |
| FOSSIL. | | |
| 162610 | Deadmans Island, California (Lower San Pedro Series)..... | 2 |

¹ Type.

KEY TO THE SPECIES OF THE SUBGENERA SEMIBITTIUM, LIROBITTIUM, AND THOSE OF UNCERTAIN SUBGENERIC POSITION.

Since the nuclear whorls of seven species (probably *Lirobittium* or *Semibittium*), described in the pages which follow, are unknown, I have deemed it wise to embrace the members of these two subgenera, as well as the seven of uncertain position, all in one artificial key.

Spiral sculpture consisting of three strong cords between the sutures, between which intercalated slender cords may occur.

Nodulose spiral keel at the summit less strong than the other two.

Base with two very strong sublamellar keels *interfossa*.

Base with slender spiral cords.

Peripheral cord exposed as a smooth band in the suture..... *catalinense*.

Peripheral cord not apparent in the sutures *c. inornatum*.

Nodulose spiral keel at the summit equal to the other two.

Axial ribs and spiral cords comparatively weak, always narrower than the squarish pits inclosed by them.

Junctions of axial ribs and spiral cords forming sharp cusps.

Whorls with a strong shoulder *oldroydæ*.

Whorls not shouldered..... *fetellum*.

Junctions of axial ribs and spiral cords forming well-rounded tubercles.

Shell large, unicolor, rusty-white (fossil).....*armillatum*.

Shell small, wax-yellow, variegated with chestnut, usually with a broad, chestnut, basal band.

Adult shell more than 6 mm. long.....*purpureum*.

Adult shell less than 5 mm. long.....*decussatum*.

Axial ribs and spiral cords always strong and wider than the spaces inclosed by them.

Shell very large, with strong intercalated spiral cords.....*ornatissimum*.

Shell smaller, without, or with very weak intercalated spiral cords only.

Shell dark purplish-brown.....*vancouverense*.

Shell wax-yellow, banded with brown.

Shell robust, with 25-30 axial ribs on its last whorl.....*munitum*.

Shell smaller, with as many as 40 axial ribs on its last whorl.....*m. munitoide*.

Spiral sculpture, consisting of four strong cords between the sutures, between which intercalated slender cords may occur.

Axial ribs becoming obsolete on the last whorls of the adult shell.

Summit of the whorls appressed.

Intercalated spiral cords absent.

Shell slender, sculpture weak.....*attenuatum*.

Shell robust, sculpture strong.....*a. boreale*.

Intercalated spiral cords present.....*a. multifilum*.

Summit of the whorls slopingly shouldered.....*a. latifilum*.

Axial ribs strong on all the whorls.

Nodulose spiral cords at the summit less strong than the others.

Spiral cords sloping gently anteriorly until fused with the body of the shell; posteriorly they are suddenly truncated.

Axial ribs on the last whorl 12-15.

Shell of 10 post-nuclear whorls 8.1 mm. long.....*asperum*.

Shell of 10 post-nuclear whorls 7.1 mm. long.....*a. lomaense*.

Axial ribs on the last whorl about 25.....*subplanatum*.

Nodulose spiral cord at the summit equal to the rest on the last whorl.

Adult shell more than 17 mm. long.

Shell slender.....*giganteum*.

Shell stout.

Intercalated cords when present very feeble.....*casmaliense*.

Intercalated cords always present, at times more than one between the strong cords and almost equal to them in strength.....*arnoldi*.

Adult shell less than 13 mm. long.

Whorls decidedly overhanging.

Base well rounded.....*rugatum*.

Base flattened.

Early post-nuclear whorls with 4 spiral cords.....*larum*.

Early post-nuclear whorls with 2 spiral cords.....*cerralvoense*.

Whorls not overhanging.

Shell large; adult shell more than 11 mm. long.....*quadrifilum*.

Shell small; adult shell less than 7 mm. long.

Whorls shouldered at the summit.....*nicholsi*.

Whorls appressed at the summit.

Axial ribs on last whorl 15.....*mexicanum*.

Axial ribs on last whorl 32.....*nitens*.

BITTIUM (SEMIBITTIUM) ARMILLATUM Carpenter.

Plate 52, fig. 6.

Bittium armillatum CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 655.*Bittium armillatum* CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol 18, 1866, p. 276.

Shell broadly conic, rust brown. Nuclear whorls at least 3, apparently smooth. Post-nuclear whorls shouldered at the summit, marked by three strong spiral keels which are considerably narrower than the three spaces into which they divide the whorls between the sutures. In addition to the spiral sculpture the whorls are marked by slightly retractive axial ribs, which are about as strong as the spiral keels. Of these, 16 occur upon the fourth, 18 upon the fifth, 20 upon the sixth, 24 upon the seventh, and 32 upon the penultimate turn. The junctions of the axial ribs and the spiral cords form well-rounded tubercles, while the spaces inclosed between are well-impressed squarish pits. Sutures strongly constricted. Base moderately long, ornamented by six low, well-rounded, subequally spaced spiral cords. Aperture channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella moderately long, oblique, curved, and reflected; parietal wall covered with a moderately thick callus.

The type (Cat. No. 15653, U.S.N.M.) comes from the Lower Pleistocene deposits of Santa Barbara, California. It has nine post-nuclear whorls and measures: Length 9.5 mm., diameter 3.2 mm. Another specimen, also fossil (Cat. No. 195160, U.S.N.M.), comes from San Pedro, California.

BITTIUM (SEMIBITTIUM) PURPUREUM Carpenter.

Plate 52, figs. 1 and 3.

Cerithiopsis purpurca CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 660.*Cerithiopsis purpurca* CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 337.

Shell broadly elongate conic, wax-yellow, variously mottled and banded with chestnut brown. Nuclear whorls a little more than one, apparently smooth. Post-nuclear whorls marked by three strong spiral cords, which divide the space between the suture and the summit into three almost equal areas. The cord at the summit is very slightly below the summit and renders this strongly shouldered. In addition to the spiral sculpture, the whorls are marked by almost vertical, axial ribs which are nearly equal to the spiral cords in strength. Of these, 14 occur upon the first, 16 upon the second, 18 upon the third, 20 upon the fourth, 22 upon the fifth, and 25 upon the penultimate turn. The intersections of the spiral cords and the axial ribs form well-rounded tubercles, while the spaces inclosed between them are well-impressed squarish pits on all but the last; on this they are oblong, their long axes coinciding with the axial sculpture. Sutures strongly constricted, showing the peripheral cord on the later

whorls. Periphery of the last whorl marked by a slender, smooth cord, the space between which and the first supraperipheral cord is about as wide as that which separates the next two cords posteriorly and is crossed by the continuations of the axial ribs which terminate at its posterior border. Base marked by five subequally spaced spiral cords, of which the strongest is immediately below the periphery and is equal to the peripheral cord, while the next two in strength are at the columella; the two intervening are slender threads. Entire surface of spire and base crossed by numerous, rather strong lines of growth. Aperture broadly oval, decidedly channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella short, somewhat twisted, curved and reflected; parietal wall covered with a thick callus.

Doctor Carpenter's cotypes, four specimens (Cat. No. 14823, U.S.N.M.), come from Monterey and Santa Barbara, California. The best preserved has seven post-nuclear whorls and measures: Length 7.3 mm., diameter 2.5 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------|---|----------------------|
| 14823 | Monterey and Santa Barbara, California..... | 4 |
| 56010 | do..... | 3 |
| 32396 | Monterey Harbor, California..... | 2 |
| 32394 | Monterey, California..... | 5 |
| 56851 | do..... | 6 |
| 56004 | do..... | 17 |
| 56377 | do..... | 8 |
| 56016 | North side of Catalina Island, California (15 fathoms, gravel)..... | 2 |
| 56681 | San Miguel Island, California..... | 2 |
| 195166 | San Pedro Bay, California..... | 13 |
| 165487 | San Diego, California..... | 4 |
| 32302 | West Coast..... | 1 |

BITTIUM (SEMIBITTIUM) VANCOUVERENSE Dall and Bartsch.

Plate 53, fig. 3.

Bittium vancouverense DALL and BARTSCH, Dominion Geol. Survey, Memoir No. 14 N, 1910, p. 10, pl. 1, fig. 8.

Shell elongate-conic, grayish white outside and dark, purplish brown within. Nuclear whorls at least two, apparently smooth, worn in all specimens. Post-nuclear whorls slightly rounded, ornamented with three strong, equal, and equally spaced, nodulose, spiral keels, the first of which is a little below the summit. The spaces separating the spiral keels are of equal width. Immediately below the third keel is a strong, peripheral sulcus, which equals those between the spiral keels. In addition to the spiral sculpture, the whorls are marked by almost vertical, axial ribs which are not quite as wide as the spiral keels. These render the keels nodulose at their intersections. Of these ribs, 12 occur upon the first, 14 upon the second and third, 16 upon the fourth, 18 upon the fifth, 24 upon the sixth, and 30 upon the penultimate turn. The spaces inclosed between the spiral keels and the axial ribs are well-impressed, rounded pits. All

the tubercles are truncated on the posterior margin and slope gently anteriorly. Base of the last whorl moderately long, ornamented with seven spiral cords, of which the two immediately below the periphery are the strongest and broadest, while the two bounding the umbilical area are wider than those intervening. Sutures channeled. Aperture irregular, channeled anteriorly; posterior angle obtuse; outer lip thin, sinuous, showing the external sculpture within; columella stout, short, twisted, and reflected; parietal wall glazed with a moderately thick callus. The specimen figured has eight post-nuclear whorls and measures: Length 7.8 mm., diameter 2.7 mm.

Specimens of this species were dredged in 8 to 27 fathoms from Ucluelet to Ship Channel, Barclay Sound, Vancouver Island, British Columbia. Part of these are in the collection of the Dominion Geological Survey, and others are in the U. S. National Museum collection, Cat. No. 211545.

BITTIUM (SEMIBITTIUM) ATTENUATUM Carpenter.

Plate 54, figs. 1, 2, and 5.

Bittium attenuatum CARPENTER, Rep. Brit. Ass. Adv. Sci., 1864, p. 655;

=*Bittium* ? var. *esuriens* CARPENTER, Rep. Brit. Ass. Adv. Sci., 1864, p. 655;

=*Bittium* (? var.) *esuriens* CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 181;

=*Bittium* (? var.) *esuriens* CARPENTER, Journ. Conch., vol. 12, 1865, p. 242;

=*Bittium attenuatum* CARPENTER, Journ. Conch., vol. 12, 1865, pp. 242-243.

Shell elongate-conic, varying in color from plain white to brown, variously banded or maculated. Nuclear whorls two, moderately rounded, smooth. Post-nuclear whorls slightly rounded, ornamented with weak spiral bands which are best developed on the early whorls. These spiral bands are truncated anteriorly and slope gently to the posterior boundary. The early whorls have three spiral bands, of which the posterior, at the summit, is less strongly developed than the other two, which divide the remaining space between the sutures equally. On the middle whorls the posterior keel has a tendency to become divided, while on the later turns it becomes obsolete. In addition to the spiral sculpture, the whorls are marked by poorly developed, rounded, protractive, axial ribs which render their intersections with the spiral cords nodulose. Of these ribs, 12 occur upon the third and 14 upon each of the remaining turns upon which ribs are discernible. The spaces inclosed between the ribs and spiral bands are shallow, impressed, rectangular pits. In addition to the axial ribs, the whorls are marked by numerous fine lines of growth. Periphery of the last whorl marked by a spiral band, which is separated from the first band above the periphery by a sulcus as wide as the sulci on the spire. Base short, well rounded, marked by six

spiral keels, of which the first below the periphery is much larger than the rest, which are subequal and subequally spaced. Aperture ovate, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external markings within; columella short, very broad at base, oblique, and reflected.

Doctor Carpenter based his description upon two co-types (Cat. No. 15584, U.S.N.M.) collected at Monterey, California, and Neah Bay, Washington. One of these has ten post-nuclear whorls and measures: Length 10.2 mm., diameter 3 mm. The other has eight post-nuclear whorls and measures: Length 8.8 mm., diameter 2.9 mm. Doctor Carpenter's type of *B.* (? var.) *esuriens* is a young shell in a good state of preservation (Cat. No. 14832, U.S.N.M., fig. 2).

Bittium attenuatum is a quite variable form, the color ranging from white to chestnut brown at times, variously banded or maculated. The sculpture at times is quite feeble, at others very pronounced. The posterior truncation of the spiral cords and their gentle sloping anteriorly is characteristic of the species. The number of ribs is variable; in some specimens as many as twenty-four occur upon the last turn. There is also an occasional tendency to an intercalation of slender, spiral threads between the prominent keels.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------|--|----------------------|
| 32200 | Vancouver Island..... | 1 |
| 15584 | Neah Bay and Monterey (cotypes)..... | 2 |
| 23261 | Monterey, California..... | 6 |
| 23361 | do..... | 6 |
| 23728 | do..... | 1 |
| 32207 | do..... | 7 |
| 32224 | do..... | 3 |
| 55996 | do..... | 3 |
| 55997 | do..... | 4 |
| 55998 | do..... | 4 |
| 55999 | do..... | 3 |
| 56000 | do..... | 2 |
| 56844 | do..... | 5 |
| 56850 | do..... | 5 |
| 56852 | do..... | 5 |
| 56001 | do..... | 2 |
| 14832 | Monterey or Santa Barbara, California (type of <i>B.</i> (? var.) <i>esuriens</i>)..... | 1 |
| 56677 | San Miguel Island, California..... | 1 |
| 56907 | Catalina Island, California..... | 15 |
| 56908a | do..... | 3 |
| 158773 | do..... | 1 |
| 160076d | do..... | 1 |
| 160077a | do..... | 2 |
| 14849 | San Pedro, California..... | 3 |
| 153443a | do..... | 3 |
| 185363 | do..... | 1 |
| 195122 | do..... | 13 |
| 195123 | do..... | 3 |
| 195124 | Whites Point, San Pedro, California..... | 180 |
| 109513 | Terminal Island, San Pedro, California..... | 1 |
| 120678 | San Diego, California..... | 4 |
| 56665 | do..... | 2 |
| 160078 | do..... | 4 |
| 195121 | Foot of Ash Street, San Diego, California..... | 2 |
| FOSSIL. | | |
| 212023 | Lower San Pedro series, Deadman's Island, California..... | 2 |

BITTIUM (SEMIBITTIUM) ATTENUATUM BOREALE, new subspecies.

Plate 54, fig. 4.

Shell similar to *Bittium attenuatum*, but in every way larger and more robust. Sculpture very much stronger than in the typical form; the tubercles well developed on the last whorl, but much weaker than on the earlier ones.

The type and fourteen specimens (Cat. No. 211586, U.S.N.M.) come from Barclay Sound, 8–27 fathoms, Vancouver Island. The type has eight post-nuclear whorls and measures: Length 10.1 mm., diameter 3.5 mm. Eighteen additional specimens from the same locality are in the Dominion Geological Survey.

BITTIUM (SEMIBITTIUM) ATTENUATUM MULTIFILOSUM Bartsch.

Plate 54, fig. 3.

Bittium esuriens multifilum BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 179.

Shell similar to *B. attenuatum*, but having seven spiral keels between the sutures on the whorls of the spire instead of four; that is, a strong, intercalated spiral cord between each of the four primary keels.

The type (Cat. No. 127051, U.S.N.M.) comes from Whites Point, San Pedro, California. It has ten whorls and measures: Length 9.2 mm., diameter 3 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|--|----------------------|
| 56002 | Monterey, California..... | 1 |
| 32235 |do..... | 3 |
| 56907b | Catalina Island, California..... | 7 |
| 56908 |do..... | 1 |
| 195126 | San Pedro, California (50 fathoms)..... | 1 |
| ¹ 127051 | Whites Point, San Pedro, California..... | 1 |
| 195125 |do..... | 7 |

¹Type.**BITTIUM (SEMIBITTIUM) ATTENUATUM LATIFILOSUM**, new subspecies.

Plate 54, fig. 6.

Shell similar to *Bittium attenuatum*. Whorls a little higher between the sutures than in the typical form, with four spiral cords between the sutures, which are much broader than in typical *attenuatum*. The axial ribs are strong on the early whorls, but scarcely indicated on the last volutions. Shell usually mottled.

The type (Cat. No. 109509, U.S.N.M.) comes from Terminal Island, California. Two additional specimens (Cat. No. 153086, U.S.N.M.) come from San Pedro, California.

BITTIUM (SEMIBITTIUM) SUBPLANATUM, new species.

Plate 57, fig. 5.

Shell broadly elongate-conic, milk white. Nuclear whorls a little more than one, well rounded, smooth. The first of the post-nuclear whorls well rounded, marked by three spiral cords, one of which is at

the summit, another on the middle of the whorl, while the third is a little above the suture. The succeeding turns show four spiral cords, of which the one at the summit is a little less strong than the rest; the remaining three divide the space between the sutures into four equal parts. Beginning with the fourth whorl, intercalated cords make their appearance between the primary ones, so that on the last whorl we have an intercalated cord and sometimes two between all the primary cords; these, however, are never quite as strong as the principal ones. In addition to the spiral cords, the whorls are marked by decidedly curved, slender, well-rounded, almost vertical, axial ribs, which are scarcely indicated on the first turn, while 14 of them occur upon the second and third, 16 upon the fourth, 18 upon the fifth and sixth, 22 upon the seventh, 24 upon the eighth, and 26 upon the penultimate turn. The intersections of the spiral cords and axial ribs form weakly developed, rounded tubercles which are truncated on their posterior margin, while the spaces enclosed between them are very shallow quadrangular pits. Sutures strongly constricted. Periphery and base of the last whorl well rounded, marked by slender, spiral cords of which those immediately below the periphery are the strongest and are truncated on the posterior margin, sloping gently anteriorly. Of these cords, seven occur on the base of the type. Aperture rather large, irregularly oval, channeled anteriorly; posterior angle acute; outer lip thin, rendered sinuous by the external sculpture; columella decidedly oblique, strongly curved, and reflected.

The type (Cat. No. 160076, U.S.N.M.) is one of fifty specimens from Catalina Island, California. It has ten post-nuclear whorls and measures: Length 10.9 mm., diameter 3.8 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|--|----------------------|
| ¹ 160076 | Catalina Island, California..... | 50 |
| 213013 | U.S.B.F. station 2902, off Santa Rosa Island, California (53 fathoms, temperature 45°; sand and mud)..... | 59 |
| 213014 | U.S.B.F. station 2901, off Santa Rosa Island, California (48 fathoms, temperature 55°; mud)..... | 157 |
| 213015 | U.S.B.F. station 4552, off Point Pinos Light, California (66-73 fathoms; mud and rock)..... | 5 |
| 160077 ^d | Catalina Island, California..... | 3 |
| 14935 ^a | San Diego, California..... | 1 |
| 195154 | U.S.B.F. station 4309, 9 miles off Point Loma Light, California, (67-78 fathoms; fine sand and broken shell bottom)..... | 2 |
| 195155 | U.S.B.F. station 4340, off South Point, San Coronado Island, California (46-87 fathoms; fine gray sand)..... | 1 |
| 213016 | U.S.B.F. station 4343, off San Coronado Island, California (55-155 fathoms; sand)..... | 28 |
| 213017 | U.S.B.F. station 4348, 6 miles off Point Loma, California, (59-113 fathoms; sand)..... | 10 |
| 213018 | U.S.B.F. station 4350, off Point Loma, California (81 fathoms; sand; temperature 50°)..... | 6 |

¹ Type.

BITTIUM (SEMIBITTIUM) RUGATUM Carpenter.

Plate 56, figs. 4 and 5.

Bittium rugatum CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 17, 1866, p. 276;
=*Bittium asperum* CARPENTER, not Gabb, Ann. Mag. Nat. Hist., ser. 3, vol. 17,
1866, p. 276.

Shell elongate-conic, white. Nuclear whorls a little more than one, well rounded, smooth. Post-nuclear whorls appressed at the summit, decidedly overhanging, the early ones marked by two strong spiral cords on the anterior half between the sutures, and a third less strongly developed cord at the summit. On the third whorl a fourth spiral makes its appearance between the one at the summit and its neighbor; this fourth spiral soon increases in size, so that on the middle of the shell all four cords are practically of equal strength and spacing. On the last whorl a slender, intercalated cord appears between the anterior two. In addition to the spiral sculpture, the whorls are marked by strong, well-rounded, axial ribs, which are merely indicated on the first two whorls; on the third to sixth turn there are 14, on the seventh there are 16, on the eighth 18, and on the penultimate whorl there are 24. The intersections of the axial ribs and spiral cords form elongated tubercles which have their long axes parallel with the spiral sculpture. The spaces between the spiral cords and axial ribs are elongated, squarish pits. Sutures strongly constricted. Periphery of the last whorl marked by a channel which bears a slender cord. Base well rounded, marked by six spiral cords which grow successively weaker and more closely spaced from the periphery to the umbilical area. Aperture oval, channeled anteriorly; posterior angle acute; outer lip thin, rendered sinuous by the external sculpture; columella short, twisted, and reflected.

The specimen described and figured has ten post-nuclear whorls and measures: Length 10.5 mm., diameter 3.5 mm. It is one of six specimens (Cat. No. 7971, U.S.N.M.) from the post-Pliocene of Santa Barbara, California. Doctor Carpenter's type (Cat. No. 7154, U.S.N.M.) does not quite represent the norm of this species, the spiral cord at the summit being only feebly developed on the later turns and the basal sculpture being less strong than usual.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------|---|----------------------|
| 17154 | Lower Pleistocene, Santa Barbara, California..... | 1 |
| 16258 | Fossil, Santa Barbara, California..... | 4 |
| 7971 | Lower Pleistocene, Santa Barbara, California (described and figured)..... | 6 |
| 213019 | Lower Pleistocene, Santa Barbara, California..... | 24 |
| 109515 | Lower Pleistocene, Terminal Island, California..... | 1 |
| 186001 | Lower San Pedro Series, Deadman's Island, California..... | 27 |
| | Pleistocene, San Pedro, California..... | 6 |
| 195127 | Pleistocene, San Pedro Bay, California..... | 3 |
| 198761 | Pleistocene, Southern California..... | 2 |
| 148645 | Lower Pleistocene, San Diego, California..... | 20 |

¹ Type.

BITTIUM (SEMIBITTIUM) QUADRIFILATUM Carpenter.

Plate 58, figs. 2 and 3.

Bittium quadrifilatum CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 655.

Bittium quadrifilatum CARPENTER, Journ. Conch., ser. 3, vol. 5, 1865, p. 143.

Shell rather large, elongate-conic, chestnut brown, dull. Nuclear whorls two, well rounded, smooth, the first obliquely tilted. Post-nuclear whorls shouldered at the summit, moderately rounded, ornamented with four equal and subequally spaced spiral cords, which divide the space between the sutures into four subequal parts. The first of these cords is at the summit of the whorl. In addition to the spiral cords, the whorls are marked by moderately strong, rounded, vertical, axial ribs, of which 12 occur upon the first, 14 upon the second to fifth, 16 upon the sixth, 18 upon the seventh and the penultimate turn. The spiral cords cross the axial ribs as regular bands, their junctions forming elongated rounded tubercles, having their long axes parallel with the spiral sculpture, while the spaces inclosed between them are well impressed quadrangular pits with their long axes also parallel with the spiral sculpture. On the last whorl very faint, intercalated spiral threads appear between the cords. Sutures channeled, showing a faint trace of the subperipheral cord. Periphery of the last whorl marked by a rather broad channel which shows several faint spiral lirations. Base moderately long, somewhat concave, ornamented with seven subequal and subequally spaced, spiral threads. Aperture irregularly oval, channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella moderately long, somewhat twisted, and reflected.

The specimen described and figured is one of a lot (Cat. No. 46929, U.S.N.M.) from San Diego, California. It has the nucleus and nine post-nuclear whorls and measures: Length 11.5 mm., diameter 3.6 mm. Doctor Carpenter's type of this species (Cat. No. 14849, U.S.N.M.) which was collected by Doctor Cooper at San Diego, California, is a young specimen having seven post-nuclear whorls, measuring: Length 7 mm., diameter 3 mm. The fossil members of this species

in our collection average a little larger than the recent shells and have the base a little more strongly sculptured. Equivalentents of these, however, occur among the host of recent shells examined.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------|--|----------------------|
| 114849 | San Diego, California..... | 1 |
| 32223 | Monterey, California..... | 3 |
| 56003 |do..... | 1 |
| 160893 |do..... | 1 |
| 195157 | San Pedro Bay, California..... | 6 |
| 160080 | San Diego Bay, California (in mud on flats at low tide)..... | 7 |
| 73724 | San Diego, California (in mud adhering to sponges)..... | 14 |
| 55995 | San Diego, California..... | 49 |
| 32210 |do..... | 14 |
| 46929 | San Diego, California (described and figured)..... | 43 |
| 195158 | San Diego, California..... | 1 |
| 194388 |do..... | 2 |
| 32220a |do..... | 2 |
| 55612 |do..... | 30 |
| 109364c |do..... | 2 |
| 105569 | San Ignacio Lagoon, Lower California (mud flats, between tides)..... | 5 |
| FOSSIL. | | |
| 22819 | Santa Barbara, California (Lower Pleistocene)..... | 1 |
| 7154a |do..... | 1 |

¹ Type.

BITTIUM (SEMIBITTIUM) NICHOLSI, new species.

Plate 57, fig. 1.

Shell moderately large, broadly conic, light brown. Early nuclear whorls decollated, the last one smooth. Post-nuclear whorls strongly shouldered at the summit, well rounded, ornamented on the early turns by four spiral cords. Beginning with the third whorl, a fifth cord makes its appearance, halfway between the one at the summit and its neighbor, which rapidly develops until it equals the others in strength. In addition to the spiral sculpture, the whorls are marked by numerous, strongly retractive, axial ribs, of which 14 occur upon all the turns. The spiral cords pass over the axial ribs as bands and render the junctions of the cords and ribs tuberculate, the tubercles being elongate with their long axes coinciding with the spiral sculpture. The spaces inclosed between the spiral cords and axial ribs are very elongate, rectangular pits, with their long axes parallel with the spiral sculpture. Sutures strongly channeled. Periphery of the last whorl marked by a broad channel which shows several slender, spiral threads and the feeble continuations of the axial ribs. Base somewhat concave in the middle, marked by nine spiral cords, of which the two immediately below the periphery are equal and much stronger than the rest, which are also equal and equally spaced. Entire surface of spire and base crossed by numerous, slender lines of growth. Aperture oval, channeled anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within and some-

what wavy at the edge; columella very oblique, slightly twisted, and reflected; parietal wall glazed with a thin callus.

The type (Cat. No. 195163, U.S.N.M.) is a young specimen having six post-nuclear whorls and measures: Length 6.1 mm., diameter 2.8 mm. It comes from the Gulf of California.

BITTIUM (SEMIBITTIUM) NITENS Carpenter.

Plate 57, fig. 2.

Bittium nitens CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 618.

Bittium nitens CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 13, 1864, p. 479.

Shell elongate-conic, white, semitranslucent, variegated with rust brown, shiny. Nuclear whorls a little more than one, smooth. Early post-nuclear whorls with a decidedly sloping shoulder which extends from the middle of the whorl to the appressed summit; the later ones well rounded. The early whorls are ornamented with three spiral cords, of which one is at the summit, the second at the angle of the shoulder, and the third a little posterior to the suture. On the third post-nuclear whorl a fourth cord makes its appearance at the summit, increasing rapidly in size until it equals the other three. In addition to the spiral sculpture, the whorls are marked by somewhat irregular, variously sloping, moderately rounded, axial ribs, of which 12 occur upon the second, 10 upon the third and fourth, 12 upon the fifth, 14 upon the sixth and the penultimate turn. The junctions of the axial ribs and the spiral cords form well-rounded tubercles, which slope more abruptly posteriorly than anteriorly, while the spaces inclosed between them are rectangular pits, having their long axes parallel with the spiral sculpture. Sutures somewhat constricted. Periphery of the last whorl marked by a slender sulcus. Base short, rounded, marked by three equal spiral cords, of which two occur immediately below the periphery, while the third encircles the base of the columella. Entire surface of spire and base crossed by numerous lines of growth. Aperture subquadrate, channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, rendered sinuous by the external sculpture; columella oblique, slender, and somewhat revolute; parietal wall glazed with a thin callus.

The type (Cat. No. 4068, U.S.N.M.) comes from Cape San Lucas, Lower California. It has eight post-nuclear whorls, and measures: Length 5.7 mm., diameter 0.2 mm.

BITTIUM (LIROBITTIUM) INTERFOSSA Carpenter.

Plate 51, figs. 2 and 6.

- Rissoa interfossa* CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 656.
Cerithiopsis fortior CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 660.
Cerithiopsis fortior CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 337.
Rissoina interfossa CARPENTER, Proc. California Acad. Nat. Sci., vol. 3, 1866, p. 217.

Shell rather large and robust, white, sometimes light brown. Nuclear whorls small, two; the first obliquely tilted, smooth; the second with two strong spiral cords which divide the space between the sutures into three equal areas. Post-nuclear whorls appressed at the summit, strongly slopingly shouldered, ornamented with two strong spiral keels, which divide the space between the sutures into three equal areas, and very strong, vertical, axial ribs, 16 of which occur upon each of the turns. The intersections of the axial ribs and the spiral cords form strong elongated tubercles, the long axes of which coincide with the spiral sculpture. These tubercles slope more abruptly posteriorly than anteriorly. The intersections of the axial ribs and the spiral cords inclose shallow squarish pits. Sutures weakly impressed. Periphery of the last whorl marked by a strong keel to which the axial ribs extend feebly. This keel is a little nearer to the first post-peripheral keel than that is to its posterior neighbor. Base moderately long, marked by two very strong keels, which divide the space between the peripheral keel and the tip of the columella into three equal areas, the spaces between the keels being very deep and a little wider than the keels. Entire surface of spire and base, including the ribs and intercostal spaces, crossed by numerous, fine, closely spaced, spiral striations. Aperture irregular, channeled anteriorly; posterior angle obtuse; outer lip thick within, thin at edge, rendered sinuous by the external sculpture; columella stout, strongly twisted, and reflected; parietal wall glazed with a thick callus.

The specimen described and figured is one of a lot (Cat. No. 56906, U.S.N.M.) from Catalina Island, California, the type-locality. It has nine post-nuclear whorls, and measures: Length 8.3 mm., diameter 3.1 mm. The type is a much-worn young specimen having seven post-nuclear whorls, and measuring: Length 6.2 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|--|----------------------|
| 46166 | Monterey, California..... | 3 |
| 160891 | do..... | 1 |
| 195177 | do..... | 2 |
| 203677 | Santa Barbara, California..... | 1 |
| ¹ 224860 | Catalina Island, California..... | 1 |
| 23756 | do..... | 3 |
| 56906 | Catalina Island, California (described and figured)..... | 65 |
| 56907a | Catalina Island, California..... | 3 |
| 160076b | do..... | 3 |
| 153443 | San Pedro, California..... | 6 |
| 195164 | Whites Point, San Pedro Bay, California..... | 10 |
| 109516 | Terminal Island, California..... | 1 |
| 195165 | Pacific Beach, California..... | 1 |
| 162675 | La Jolla, California..... | 2 |
| 105591 | San Diego, California..... | 3 |

¹ Type.

BITTIUM (LIROBITTIUM) CATALINENSE Bartsch.

Plate 51, fig. 1.

Bittium catalinensis BARTSCH, Smiths. Misc. Coll. (Quarterly Issue), vol. 50, 1907, pt. 4, p. 28, pl. 57, fig. 13.

Shell elongate-conic, milk-white. Nuclear whorls a little more than one, marked by two strong spiral cords which divide the turns into three equal areas. Post-nuclear whorls shouldered at the summit, marked by three nodulose spiral keels; one of these, which is a little below the summit, is less strongly developed than the other two on all but the last turn; on this turn it is practically equal to the others. In addition to the spiral keels, the whorls are marked by rather strong, well-rounded axial ribs which are about two-thirds as wide as the spaces which separate them. Of these ribs, 16 occur upon the first to fifth, 18 upon the sixth and seventh, 20 upon the eighth, and 24 upon the penultimate turn. The intersections of the axial ribs and the spiral cords form strong cusp-like nodules, which are suddenly truncated posteriorly and slope gently to the succeeding cord anteriorly. The space between the summit and the truncated end of the first row of tubercles forms a strong shoulder. The spaces inclosed between the spiral keels and the axial ribs are moderately impressed rounded pits. Sutures strongly constricted, showing the greater part of the peripheral cord on all the turns. Periphery and base of the last whorl marked by five spiral cords which grow successively weaker from the periphery to the umbilical area. These cords are truncated on the posterior margin and slope gently anteriorly until they fuse with the general surface of the shell. Aperture irregular, channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella oblique, somewhat twisted; parietal wall glazed with a thin callus.

The type (Cat. No. 165232, U.S.N.M.) comes from the Pleistocene at Santa Barbara, California. It has nine and one-half post-nuclear whorls, and measures: Length 7.5 mm., diameter 2.8 mm. The present species occurs both recent and fossil. The recent shells are slightly slenderer than the fossil form.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|---|----------------------|
| ¹ 165232 | Santa Barbara, California, Lower Pleistocene..... | 1 |
| 2557 | do..... | 2 |
| 213020 | Deadmans Island (Lower San Pedro Series)..... | 1 |
| 23754 | Catalina Island, California..... | 2 |
| 195152 | Off Catalina Island, California..... | 1 |
| 4310 | Eight miles off Point Loma Light, California..... | 17 |

¹ Type.

BITTIUM (LIROBITTIUM) CATALINENSE INORNATUM, new subspecies.

Plate 51, fig. 3.

Shell similar to *Bittium catalinense*, but lacking the plain spiral keel in the suture.

The type (Cat. No. 195153, U.S.N.M.) comes from 40 fathoms off Catalina Island, California. It has ten post-nuclear whorls, and measures: Length 7.2 mm., diameter 2.3 mm. Another specimen (Cat. No. 193695, U.S.N.M.) is also from Catalina Island, while a third (Cat. No. 148649, U.S.N.M.) comes from the Lower Pleistocene deposits at San Diego, California.

BITTIUM (LIROBITTIUM) ORNATISSIMUM, new species.

Plate 52, figs. 4 and 5.

Shell elongate-conic, creamy white. Nuclear whorls one and one-half, marked by two slender threads which divide the space between the sutures into three equal parts. Post-nuclear whorls strongly shouldered at the summit, marked by three strong spiral keels which divide the space between the sutures into four almost equal parts. The space between the first of these keels below the summit and the summit is a little narrower than the rest. In addition to these three strong spiral keels, intercalated keels are present, the first of which is at the summit, while another occurs between each of the other keels. On the last whorl these attain a strength almost equal to that of the primary keels. In addition to this spiral sculpture, the whorls are marked by well-developed, slightly retractive, axial ribs, of which 14 occur upon the first and second, 15 upon the third, 16 upon the fourth, 18 upon the fifth and sixth, 20 upon the seventh, 22 upon the eighth, 28 upon the ninth and tenth, and 34 upon the penultimate turn. The intersections of the axial ribs and spiral keels form strong

cusps which are suddenly truncated posteriorly and slope gently anteriorly, the spaces inclosed between them being small, rounded pits. Sutures channeled. Periphery of the last whorl marked by a slender cord. Base moderately prolonged, ornamented by six spiral cords, of which the two immediately anterior to the periphery and the two at the base of the columella are decidedly stronger than the rest. Aperture rather large, channeled anteriorly; posterior angle acute; outer lip rendered sinuous by the external sculpture; columella stout, twisted, somewhat revolute, and reflected; parietal wall glazed with a moderately thick callus.

The type (Cat. No. 194413, U.S.N.M.) comes from Deadmans Island, San Pedro, California. It has lost the nucleus and probably the first two post-nuclear turns; the nine remaining measure: Length 12.1 mm., diameter 4 mm. A young specimen from the same lot, which furnished the description of the nucleus, has ten post-nuclear whorls, and measures: Length 9.2 mm., diameter 3.3 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------------|---|----------------------|
| ¹ 194413 | Deadmans Island, Lower San Pedro Series, San Pedro, California..... | 8 |
| 195162 | do..... | 2 |
| 109517 | Terminal Island, California..... | 2 |
| 11803 | Santa Barbara, California (Lower Pleistocene)..... | 1 |

¹ Type.

BITTIUM (LIROBITTIUM) MUNITUM Carpenter.

Plate 53, figs. 1 and 2.

Cerithiopsis munita CARPENTER, Rep. Brit. Ass. Adv. Sci. for 1863, 1864, p. 628 and p. 660.

Cerithiopsis munita CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 31.

Shell elongate-conic, yellowish white. Nuclear whorls a little more than one (with the sculpture abraded in all our specimens). Post-nuclear whorls strongly shouldered at the summit, marked by three strong, equal and equally spaced spiral keels, which are a little wider than the spaces that separate them. In addition to the spiral keels, the whorls are marked by somewhat retractive axial ribs, of which 18 occur upon the second, 20 upon the third, 24 upon the fourth and fifth, and 28 upon the penultimate. The intersections of the axial ribs and spiral keels form strong tubercles, while the spaces between them are well impressed, rounded pits. Sutures subchanneled. Periphery of the last whorl marked by a strong channel, across which the feeble continuations of the axial ribs extend. Base moderately long, marked by six strong spiral cords which grow successively weaker from the periphery to the umbilical area. In addition to the

above sculpture, the entire surface of the spire and base is crossed by numerous fine lines of growth and exceedingly fine, spiral striations. Aperture subquadrate, channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella short, stout, somewhat twisted, and reflected parietal wall glazed with a thin callus.

There are ten specimens of this species (Cat. No. 15501, U.S.N.M.) collected by Swan at Neah Bay, Washington, which bear the legend "type." One of these (fig. 1) has seven post-nuclear whorls, and measures: Length 7.8 mm., diameter 3 mm. Another (fig. 2) measures 7 mm. long.

BITTIUM (LIROBITTIUM) MUNITUM MUNITOIDE, new subspecies.

Plate 53, fig. 4.

This is the southern race of *Bittium munitum*. It differs from *B. munitum* proper in being smaller and in having many more ribs, as many as 40 occurring upon the last whorl. The type, one of 115 specimens (Cat. No. 152164, U.S.N.M.) from San Pedro, California, has ten post-nuclear whorls, and measures: Length 8.2 mm., diameter 2.8 mm. Another lot from Whites Point, San Pedro Bay, California, contains 106 specimens. Four specimens were dredged in 50 fathoms off San Pedro, California.

BITTIUM (LIROBITTIUM) ASPERUM Gabb.

Plate 56, fig. 3.

Turbonilla aspera GABB, Proc. Acad. Nat. Sci. Phila., 1861, p. 368;

=*Bittium asperum* GABB, Pal. California, ser. 2, p. 72, pl. 2, fig. 20, 1869;

=*Bittium barbarense* BARTSCH, Smiths. Misc. Coll. (Quarterly Issue), vol. 50, 1907, pt. 4, p. 28, pl. 57, fig. 15.

Not *Bittium?* *asperum* CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 17, p. 276, 1866; =*Bittium rugatum* CARPENTER.

Shell elongate-conic, creamy white. Nuclear whorls small, a little more than one, marked by two moderately strong, spiral cords, one a little posterior to the periphery and the other on the middle of the whorl, otherwise smooth. Post-nuclear whorls appressed at the summit, strongly, slopingly shouldered, the first marked by two spiral cords like those on the nuclear whorls, the second showing an intercalated cord between the two, leaving the posterior half of the whorls free of sculpture and with a strong, sloping shoulder. On the succeeding whorls the shoulder is crossed by one and two spiral cords, less strong than those anterior to them. In addition to the spiral sculpture the whorls are marked by somewhat curved, almost vertical axial ribs, which begin on the second whorl and rapidly increase in strength. There are 12 of these ribs on each of the second to ninth turns. The intersections of the axial ribs and spiral cords form

prominent cusps which are suddenly truncated posteriorly, and slope gently anteriorly until they fuse with the general surface of the shell. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by about nine feeble spiral cords of which the first two immediately below the periphery are the strongest. Aperture subquadrate, channeled anteriorly; posterior angle acute; outer lip rendered somewhat sinuous by the external sculpture; columella moderately long, twisted, and reflected; parietal wall glazed with a thin callus.

Gabb's type came from the Lower Pleistocene deposits at Santa Barbara, California. The specimen described and figured (Cat. No. 165231, U.S.N.M.) is a fossil from Santa Barbara. It has 10 post-nuclear whorls (having lost the nucleus and probably the first post-nuclear turn) and measures: Length 8.3 mm., diameter 2.9 mm.

Specimens examined.

| Catalogue No. | Locality. | Number of specimens. |
|---------------|--|----------------------|
| 165231 | Upper Pliocene, Fernando Formation, Bath-house Beach, Santa Barbara, California (described and figured). | 1 |
| 7970 | Lower Pleistocene, Santa Barbara, California..... | 2 |
| 166051 | do..... | 10 |
| 213012 | do..... | 13 |
| 195129 | Lower Pleistocene, Lower San Pedro Series, Deadman's Island, California. | 1 |
| 148650 | Lower Pleistocene, San Diego, California..... | 1 |

BITTTIUM (LIROBITTIUM) ASPERUM LOMAENSE, new subspecies,

Plate 56, fig. 2.

Shell similar to *B. asperum* Gabb, but differing in being uniformly smaller, more slender, and in having more ribs. A specimen of *B. asperum* with 10 post-nuclear whorls measures: Length 8.1 mm., while one of *B. a. lomaense* of the same number of whorls measures 7.1 mm. *B. a. lomaense* is a living representative of *B. asperum*, which is a post-Pliocene species.

The type (Cat. No. 195130, U.S.N.M.) and 21 specimens were dredged at U. S. Bureau of Fisheries station No. 4310, in 71-75 fathoms, off Point Loma Light, California, on gray mud and fine sand bottom. The type has ten post-nuclear whorls and measures: Length 7.1 mm., diameter 2.3 mm. Cat. No. 23744, U.S.N.M., contains 24 specimens dredged in 30 fathoms off Santa Catalina Island, California.

BITTTIUM (LIROBITTIUM) CERRALVOENSE, new species.

Plate 55, fig. 1.

Shell elongate-conic, white. Nuclear whorls one and one-half, having two cords which divide the space into three equal parts. Post-nuclear whorls appressed at the summit, decidedly overhang-

ing, marked on the first whorl by a strong, median keel and a feeble cord halfway between this and the suture, the space between the median keel and the summit forming a strongly sloping shoulder. On the third post-nuclear turn two slender spiral cords appear, one of which is at the summit and the other halfway between this and the median cord. On the fifth whorl an additional spiral cord is intercalated between the two on the shoulder. The cords on the shoulder and also the one anterior to the median grow rapidly in strength until finally, on the last volution, they are practically all equal. In addition to the spiral cords, the whorls are marked by moderately strong, decidedly curved, almost vertical, distant axial ribs. These are quite absent on the early whorls, being first indicated on the third post-nuclear turn. On the fourth there are 12, on the fifth to seventh there are 14, on the eighth 18, and on the penultimate turn 20. The intersections of the axial ribs and spiral cords form weak, elongated tubercles; the long axes of which coincide with the spiral sculpture, while the spaces inclosed between the two appear as very elongated, narrow pits. Sutures moderately constricted, showing a portion of the peripheral keel. Periphery of the last whorl marked by a keel about as wide as the strong spiral cords between the sutures. Base short, slightly rounded, marked by five spiral cords which decrease in size and spacing from the periphery to the umbilical area. Aperture subquadrate, channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, sinuous at the edge; columella moderately strong, oblique, somewhat twisted, and reflected; parietal wall glazed with a thin callus.

The type and 4 specimens (Cat. No. 96899, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station No. 2828, in 10 fathoms, on shell bottom, off Cerralvo Island, Gulf of California. The type has nine and one-half post-nuclear whorls and measures: Length 7.9 mm., diameter 2.8 mm.

BITTIUM (SEMIBITTIUM) LARUM, new species.

Plate 57, fig. 4.

Shell very regularly elongate-conic, light brown. Nuclear whorls at least two, worn. Post-nuclear whorls appressed at the summit, decidedly overhanging. The early post-nuclear whorls are marked by four equal and equally spaced spiral cords, the first of which is at the summit; these cords divide the space between the sutures into four equal parts. On the sixth whorl intercalated spiral cords make their appearance in the middle, between all the primary cords; these attain a little more than half the strength of the primary cords on the last turn. In addition to the spiral sculpture, the whorls are marked by moderately strong, almost vertical, axial ribs, of which 14 occur

upon all but the penultimate turn, which has 18. The intersections of the axial ribs and spiral cords form elongate tubercles, which have their long axis parallel with the spiral sculpture. The spaces inclosed between the axial ribs and spiral cords are rectangular pits on the early whorls and broad, incised lines on the later ones. Sutures slightly constricted. Periphery of the last whorl angulated, marked by a spiral cord. Base short, slightly concave in the middle, marked by six spiral cords which grow successively weaker from the periphery to the umbilical region. In addition to the above sculpture, the entire surface of spire and base is marked by fine lines of growth and numerous exceedingly fine, spiral striations. Aperture quadrangular, channeled anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within, rendered sinuous at the edge by the external sculpture; columella moderately strong, twisted, and reflected; parietal wall glazed with a thin callus.

The type and 2 specimens (Cat. No. 195156, U.S.N.M.) were dredged in 4 fathoms at San Pedro, California. The type has ten post-nuclear whorls and measures: Length 10 mm., diameter 3.3 mm.

BITTIUM OLDROYDÆ, new species.

Plate 51, fig. 5.

Shell very large, chestnut brown. (Nuclear whorls decollated in all our specimens.) Post-nuclear whorls moderately rounded, ornamented with three spiral keels, which are truncated on their posterior margin and slope gently anteriorly until they fuse with the general mass of the shell. These keels divide the space between the sutures into four almost equal parts, the space between the summit and the first keel being a little narrower than the rest. In addition to the spiral keels, the whorls are marked by slightly retractive axial ribs, of which 12 occur upon the second, 14 upon the third and fourth, 16 upon the fifth to seventh, 18 upon the eighth, 20 upon the ninth and tenth, and 22 upon the penultimate turn. These ribs extend from the summit to the suture. Their intersections with the spiral cords form strong, cusped nodules, which slope more abruptly anteriorly than posteriorly. The spaces inclosed between the spiral keels and the axial ribs are considerably wider than the ribs or cords and form squarish pits. Sutures strongly marked, showing a slender, smooth, peripheral cord (to which the axial ribs extend) on almost all the turns. Periphery and base of the last whorl well rounded, marked by six well-rounded spiral cords, which grow successively weaker, and a little more closely spaced from the periphery to the umbilicus. Entire surface of spire and base crossed by numerous slender axial lines of growth. Aperture moderately large, channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external

sculpture; columella stout, flexuose, and reflected; parietal wall covered with a thick callus.

The type (Cat. No. 196209, U.S.N.M.), which has lost the nucleus and probably the first two post-nuclear turns, has twelve whorls remaining, which measure: Length 13.3 mm., diameter 3.8 mm. The type was collected in drift in Lower California. Two other specimens (Cat. No. 195161, U.S.N.M.) come from Destruction Island, Washington. Cat. No. 198101, U.S.N.M., contains 2 specimens labeled "West Coast," without specific locality. The distribution of this species is rather peculiar.

Named for Mrs. Ida S. Oldroyd.

***BITTIUM FETELLUM*, new species.**

Plate 51, fig. 4.

Shell moderately large, elongate-conic, light yellow. (Nuclear whorls decollated in all our specimens.) Post-nuclear whorls well rounded, slightly shouldered at the summit, marked by three slender, spiral keels, which divide the space between the sutures into four equal areas. (In addition to the three spiral keels, there is a tendency in many of the specimens to have feeble, intercalated cords between the stronger ones.) The axial sculpture consists of decidedly curved, slender ribs, of which 20 occur upon the fourth post-nuclear whorl in the type, 22 upon the fifth, and about 36 upon the penultimate turn. The spaces inclosed between the ribs and the spiral cords are large, shallow, squarish pits on all the turns but the last; on this they are much longer than broad, their long axes coinciding with the axial sculpture. The intersections of the ribs and spiral cords form slender, sharp cusps. Sutures strongly constricted. Base of the last whorl moderately long, slightly curved, marked by four spiral cords, of which the two middle ones are equal and stronger than the others. Entire surface of spire and base marked by numerous strong lines of growth. Aperture large, channeled anteriorly; posterior angle obtuse; outer lip thin, rendered sinuous by the external sculpture; columella very oblique, curved, and reflected; parietal wall glazed with a thick callus.

The type and 28 specimens (Cat. No. 198617, U.S.N.M.) were dredged in 16 fathoms off Catalina Island, California. The type has lost the nuclear whorls; the seven remaining measure: Length 9.3 mm., diameter 3.5 mm.

***BITTIUM DECUSSATUM* Carpenter.**

Plate 52, fig. 2.

Cerithiopsis decussata CARPENTER, Cat. Mazatlan Shells, 1857, p. 445.

Shell elongate-conic, yellowish-white banded with reddish-brown at the base. Nuclear whorls decollated. Post-nuclear whorls marked by three strong, spiral keels, of which the first is slightly

below the summit and renders this decidedly shouldered. In addition to the spiral keels, the whorls are marked by axial ribs, of which 14 occur upon the second, 16 upon the third, 20 upon the fourth, 24 upon the fifth and sixth, 26 upon the seventh, and 28 upon the eighth and penultimate turns. The intersections of the axial ribs and the spiral cords form well-rounded tubercles, while the spaces inclosed between them are squarish pits. Sutures strongly constricted. Base of the last whorl rather long, marked by three prominent spiral keels and a fourth slender thread at the columella. Aperture irregular, channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella short, stout, twisted, and reflected; parietal wall covered with a thick callus.

The type is on tablet 2034, Liverpool collection, British Museum. It has nine post-nuclear whorls and measures: Length 4 mm., diameter 1.3 mm. Our figure is copied from a camera lucida sketch by Doctor Carpenter.

BITTIUM GIGANTEUM, new species.

Plate 55, fig. 2.

Shell elongate-conic, very large, white. Nuclear whorls decollated. Early post-nuclear whorls with a strongly sloping shoulder, marked by three spiral keels, one of which is at the summit, another median, and the other a little nearer the median than the suture. On the succeeding turns an additional cord makes its appearance, between the one at the summit and the median keel, soon gaining sufficient strength to equal the one at the summit. In addition to these spiral cords, the whorls are marked by strong, well-rounded, curved, retractive, axial ribs, of which 14 occur upon the second, 16 upon the third to fifth, 18 upon the sixth to tenth, and 22 upon the penultimate turn. The junctions of the axial ribs and spiral cords form well rounded tubercles, while the spaces inclosed between them are well impressed, squarish pits. On the last two whorls additional spiral cords make their appearance on either side of the median cord. Sutures very strongly impressed. Periphery of the last whorl marked by a channel across which the feeble continuations of the axial ribs extend. Base short, slightly rounded, marked by a cord immediately below the periphery and slender incised lines anterior to this. Aperture moderately large, subquadrate, channeled anteriorly; posterior angle obtuse; outer lip rendered sinuous by the external sculpture; columella short, almost straight, and reflected; parietal wall covered with a thick callus.

The type and additional specimens (Cat. No. 14935, U.S.N.M.) come from the post-Pliocene of San Diego, California. The type has 12 post-nuclear whorls (having lost the nucleus and probably

two of the first post-nuclear turns) and measures: Length 18.8 mm., diameter 0.5 mm. An additional specimen (Cat. No. 195128, U.S.N.M.) comes from the Pleistocene of San Pedro, California.

BITTIUM CASMALIENSE, new species.

Plate 55, fig. 3.

Shell very large and robust, white. Nucleus and early post-nuclear whorls decollated. Post-nuclear whorls marked by four equal and almost equally spaced, strong, spiral cords which divide the space between the sutures into four almost equal areas. The first of these cords is at the summit. In addition to the spiral cords, the whorls are marked by strong, well rounded, almost vertical, axial ribs, of which 14 occur upon the second, 16 upon the third and fourth, 18 upon the fifth, 20 upon the sixth, while upon the penultimate and last of the remaining turns they become obsolete and irregular. The axial ribs are fully twice as strong as the spiral cords and the intersections of the two form well rounded, elongate tubercles, the long axes of which coincide with the spiral sculpture. The spaces inclosed between the spiral cords and axial ribs are very deeply impressed, oval pits on the early whorls, while on the later ones they are shallow, rectangular pits. Sutures moderately constricted, showing a portion of the peripheral cord. Periphery of the last whorl well rounded, marked by a well rounded, slender, spiral cord. Base well rounded, marked by a single cord a little less strong than the peripheral, and a little nearer the peripheral cord than that is to the cord posterior to it. Aperture fractured, channeled anteriorly; posterior angle obtuse; columella stout and somewhat twisted.

The type (Cat. No. 165279, U.S.N.M.) has the last seven whorls and measures: Length 18 mm., diameter 6 mm. It comes from the Fernando Formation, Lower Pliocene, at the railroad cut, 1 mile north of Schumann, Santa Barbara County, California.

BITTIUM ARNOLDI, new species.

Plate 56, fig. 1.

Shell very large, broadly elongate-conic, white. (Nucleus and early post-nuclear whorls decollated.) The remaining whorls with appressed summit, marked by four strong, spiral cords which divide the space between the sutures into four equal parts. The first of these cords is at the summit. The spaces between the strong spiral cords are divided by intercalated spirals which are well developed, but not quite as strong as the primary cords. On the last turn two of these intercalated spirals occur between all but the third and fourth below the summit, where three are present. In addition to the spiral sculpture, the whorls are marked by moderately strong, curved, well rounded, axial ribs, of which 14 occur upon the third

and fourth, 16 upon the fifth to seventh, and 20 upon the penultimate turn. The intersections of the axial ribs and the spiral cords form narrow, elongate tubercles the long axes of which coincide with the spiral sculpture. The spaces between the spirals appear as broad, strongly incised lines. Sutures moderately impressed. Periphery of the last whorl marked by a spiral cord equal to the stronger cords between the sutures. Base well rounded, ornamented with 10 subequal and subequally spaced spiral cords. Aperture moderately large, channeled anteriorly; posterior angle obtuse; columella stout, twisted, oblique, and reflected.

The type (Cat. No. 165265, U.S.N.M.) has the last eight post-nuclear whorls, which measure: Length 16.8 mm., diameter 7 mm. It comes from the Fernando Formation, Lower Pliocene, at the Waldorf asphalt mine, 3 miles southeast of Guadaloupe, Santa Barbara County, California.

Named for Dr. Ralph Arnold of Pasadena.

BITTIUM MEXICANUM, new species.

Plate 58, fig. 1.

Shell elongate-conic, brown. Nuclear whorls decollated. Post-nuclear whorls well rounded, appressed at the summit, marked on the first four turns by four spiral cords which divide the space between the sutures into four equal parts; the first of these cords is at the summit. The first basal cord becomes apparent in the suture of all the turns and gives the shell the appearance of having five cords between the sutures on the spire. Beginning with the fifth whorl, a slender, spiral cord appears immediately below the cord at the summit and increases rapidly in strength until, on the last whorl, it is about half as strong as the cord at the summit. Another intercalated cord begins on the sixth whorl, between the fourth cord and the basal cord. In addition to the spiral sculpture, the whorls are marked by slender, rounded, axial ribs, of which 20 occur upon the third, 16 upon the fourth to sixth, and 30 upon the penultimate turn. Intersections of the axial ribs and spiral cords form low, rounded tubercles, while the spaces inclosed between them are rectangular pits, having their long axes parallel with the spiral sculpture on all but the last whorl; on this they are squarish pits. Sutures strongly constricted. Periphery of the last whorl marked by a channel. Base moderately long, concave, marked by six feeble, spiral cords, grouped in two series of three, one of which is immediately below the periphery and the other surrounds the base of the columella. Aperture irregularly ovate, channeled anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within, rendered sinuous by the external sculpture; columella oblique, somewhat twisted, and reflected.

The type (Cat. No. 126774, U.S.N.M.) comes from the Gulf of California. It has lost the nucleus. The eight remaining turns measure: Length 6.1 mm., diameter 2.1 mm.

EXPLANATION OF PLATES.

All of the figures are enlarged about eight times. The measurement cited after each species is the actual length of the specimen.

PLATE 51.

- FIG. 1. *Bittium (Liobittium) catalinense*; type; 7.5 mm.; p. 402.
 2. *Bittium (Liobittium) interfossa*; type; 6.2 mm.; p. 401.
 3. *Bittium (Liobittium) catalinense inornatum*; type; 7.2 mm.; p. 403.
 4. *Bittium* (subgenus?) *fetellum*; type; 9.3 mm.; p. 409.
 5. *Bittium* (subgenus?) *oldroydæ*; type; 13.3 mm.; p. 408.
 6. *Bittium (Liobittium) interfossa*; 8.3 mm.; p. 401.

PLATE 52.

- FIG. 1. *Bittium (Semibittium) purpureum*; Cat. No. 56004, U.S.N.M.; p. 391.
 2. *Bittium* (subgenus?) *decussatum*; type; 4 mm.; p. 409.
 3. *Bittium (Semibittium) purpureum*; cotype; 7.3 mm.; p. 391.
 4. *Bittium (Liobittium) ornatissimum*; type; 12.1 mm.; p. 403.
 5. *Bittium (Liobittium) ornatissimum*; 9.2 mm.; p. 403.
 6. *Bittium (Semibittium) armillatum*; type; 9.5 mm.; p. 391.

PLATE 53.

- FIG. 1. *Bittium (Liobittium) munitum*; cotype; 7.8 mm.; p. 404.
 2. *Bittium (Liobittium) munitum*; cotype; 7 mm.; p. 404.
 3. *Bittium (Semibittium) vancouverense*; cotype; 7.8 mm.; p. 392.
 4. *Bittium (Liobittium) munitum munitoide*; type; 8.2 mm.; p. 405.
 5. *Bittium (Bittium) panamense*; type; 14 mm.; p. 386.
 6. *Bittium (Bittium) johnstonæ*; type; 7.9 mm.; p. 387.

PLATE 54.

- FIG. 1. *Bittium (Semibittium) attenuatum*; cotype; 8.8 mm.; p. 393.
 2. *Bittium (Semibittium) attenuatum* (type of *B. esuriens*.); p. 393.
 3. *Bittium (Semibittium) attenuatum multifilosum*; type; 9.2 mm.; p. 395.
 4. *Bittium (Semibittium) attenuatum boreale*; type; 10.1 mm.; p. 395.
 5. *Bittium (Semibittium) attenuatum*; cotype; 10.2 mm.; p. 393.
 6. *Bittium (Semibittium) attenuatum latifilosum*; type; 10 mm.; p. 395.

PLATE 55.

- FIG. 1. *Bittium (Liobittium) cerralvoense*; type; 7.9 mm.; p. 406.
 2. *Bittium* (subgenus?) *giganteum*; type; 18.8 mm.; p. 410.
 3. *Bittium* (subgenus?) *casmaliense*; type; 18 mm.; p. 411.

PLATE 56.

- FIG. 1. *Bittium* (subgenus?) *arnoldi*; type; 16.8 mm.; p. 411.
 2. *Bittium (Liobittium) asperum lomaense*; type; 7.1 mm.; p. 406.
 3. *Bittium (Liobittium) asperum*; 8.3 mm.; p. 405.
 4. *Bittium (Semibittium) rugatum*; type; 12 mm.; p. 397.
 5. *Bittium (Semibittium) rugatum*; 10 mm.; p. 397.

PLATE 57.

- FIG. 1. *Bittium* (*Semibittium*) *nicholsi*; type; 6.1 mm.; p. 399.
2. *Bittium* (*Semibittium*) *nitens*; type; 5.7 mm.; p. 400.
3. *Bittium* (*Stylidium*) *eschrichtii icelum*; type; 15 mm.; p. 388.
4. *Bittium* (*Semibittium*) *larum*; type; 10 mm.; p. 407.
5. *Bittium* (*Semibittium*) *subplanatum*; type; 10.9 mm.; p. 395.

PLATE 58.

- FIG. 1. *Bittium* (subgenus?) *mexicanum*; type; 6.1 mm.; p. 412.
2. *Bittium* (*Semibittium*) *quadriplatum*; type; 7 mm.; p. 398.
3. *Bittium* (*Semibittium*) *quadriplatum*; 11.5 mm.; p. 398.
4. *Bittium* (*Stylidium*) *eschrichtii*; 14 mm.; p. 387.
5. *Bittium* (*Stylidium*) *eschrichtii montereyense*; type; 13.8 mm.; p. 389.



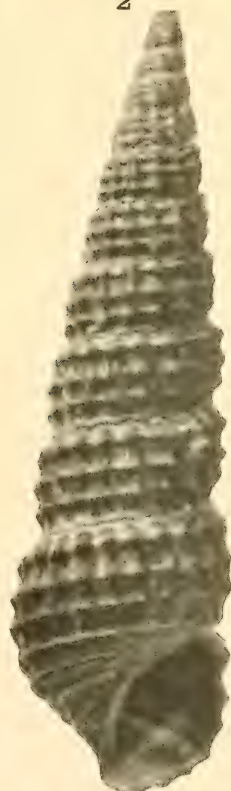
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WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM.

FOR EXPLANATION OF PLATE SEE PAGE 413.



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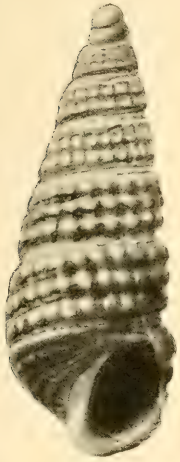
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WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM.

FOR EXPLANATION OF PLATE SEE PAGE 413.



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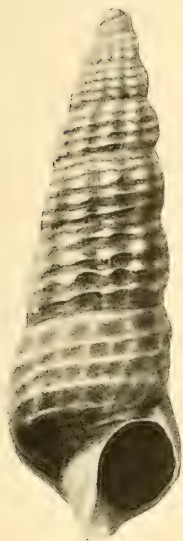
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WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM.

FOR EXPLANATION OF PLATE SEE PAGE 413.



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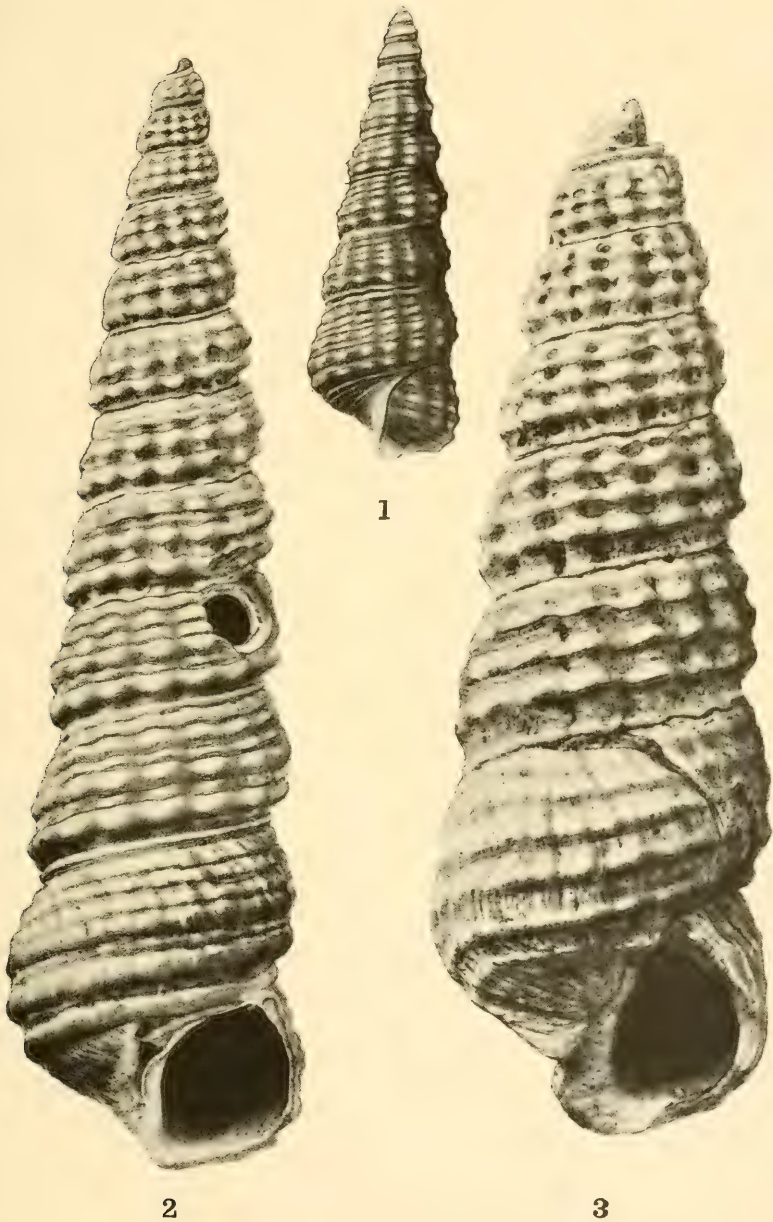


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WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM

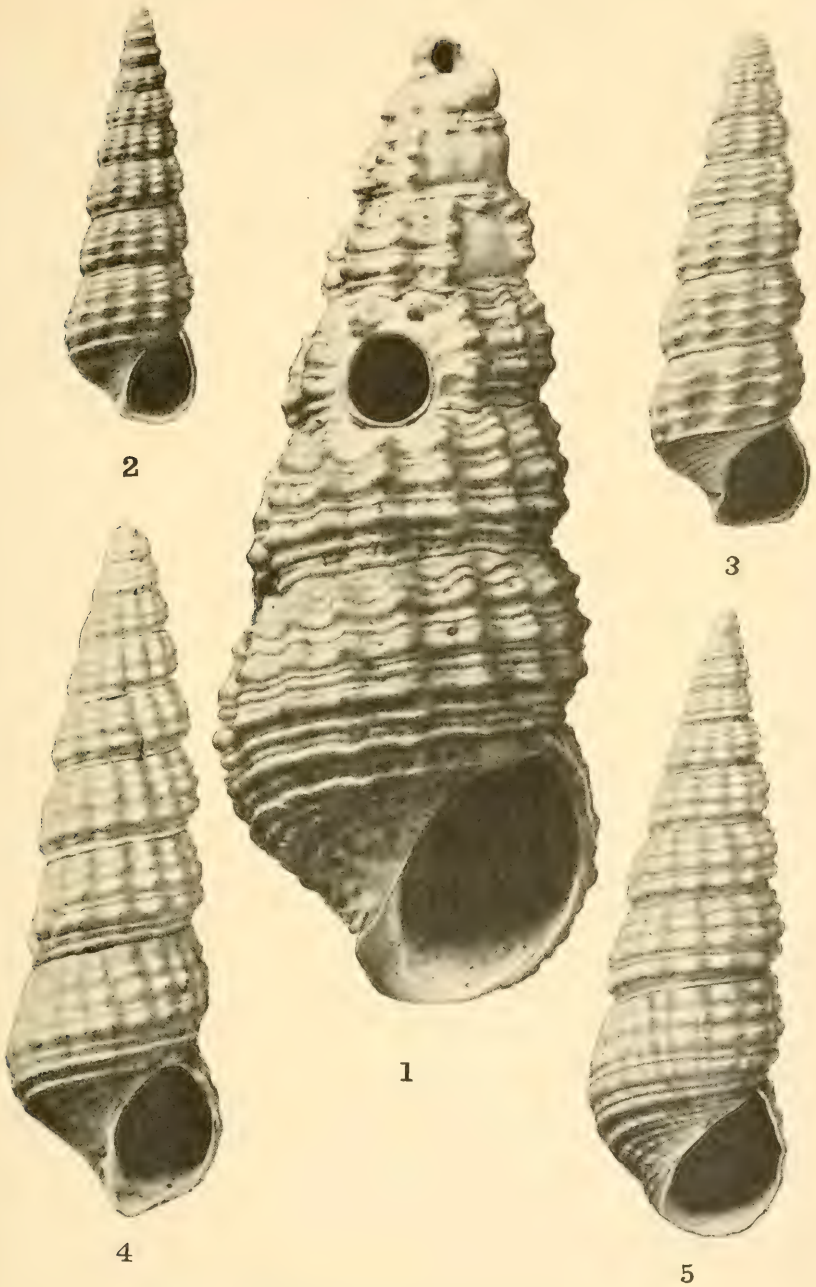
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WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM.

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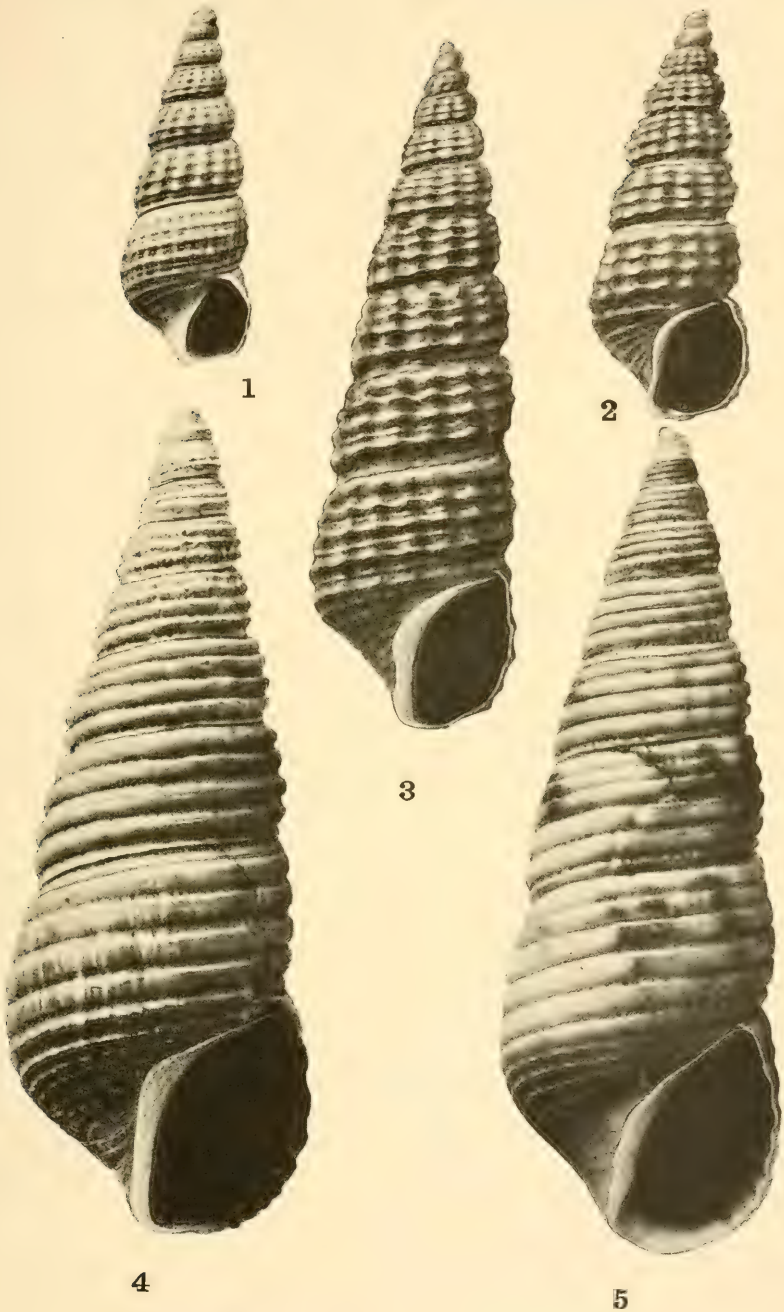
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WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM.

FOR EXPLANATION OF PLATE SEE PAGE 414.



WEST AMERICAN MOLLUSKS OF THE GENUS BITTIUM.

FOR EXPLANATION OF PLATE SEE PAGE 414.

NEW GENERA OF STARFISHES FROM THE PHILIPPINE
ISLANDS.

BY WALTER K. FISHER,
Of Stanford University, California.

The new genera and species of starfishes described in this paper were obtained in the region of the Philippine Islands by the U. S. Fisheries steamer *Albatross* during her cruise of 1907-1910. These species will be fully illustrated and described in greater detail in the final report on the collection, now in course of preparation.

Family PORCELLANASTERIDÆ.

BENTHOGENIA, new genus.

Related to *Thoracaster* Sladen, but differing in having cribriform organs between all the marginals, in having the dorsal surface of distal half of ray one continuous cribriform organ, in having the cribriform organs of interbrachium merged into one, in the spiniferous distal superomarginals, and in the presence of a large spiniferous terminal plate, dorsal in position. No odd interradiial marginal. Superomarginals increasing in size very gradually to the sixth, which is considerably larger than the rest and meets its fellow in median line of ray; beyond this point all superomarginals in contact. Cribriform organs 29 or 30, the distal ones rudimentary and the 11 of the interbrachium merged into one (as far as middle of sixth superomarginal); structure papilliform. Adambulacral plates with a numerous furrow series and numerous smaller spinelets on surface. Actinal interradiial areas extensive, covered with small spaced spinelets. Intermediate plates extend nearly to end of ray. Abactinal paxillæ large, crowded.

Type.—*Benthoenia cribellosa*, new species.

BENTHOGENIA CRIBELLOSA, new species.

Rays 5. $R = 78$ mm., $r =$ about 30 mm., $R =$ about 2.6 r ; breadth of ray at base, about 34 mm., at sixth superomarginal, 12 mm. Over

half of ray formed by superomarginals which meet in median line. Superomarginals massive, increasing in size from the first to sixth, which is decidedly larger than the rest and meets its fellow on dorsal median line; next 6 plates decreasing slightly, higher than wide, and bearing on the rounded dorsolateral angle a stubby conical spine; final 3 or 4 plates decreasing rapidly in size and covered by the big, elliptical, very convex spiniferous terminal plate, margined by a fimbriate channel. Inferomarginals lower than superomarginals and beyond the sixth plate not corresponding to them, but near tip of ray alternating, there being one more in the series. Cribriform organs spiniform and in the interbrachial arc, continuous without a break as far as the middle of the sixth or enlarged superomarginals, except for a slight wedge-shaped area in the middle of the lower edge of each inferomarginal. In each interbrachium 11 fused cribriform organs, the odd one over the median interradiial suture. The sixth supero- and inferomarginals have a median vertical bare space about as wide as the adjacent cribriform organs, which from here on rapidly narrow, and from the twelfth plate on may be said to be rudimentary. These separated cribriform organs extend upon the dorsal surface of ray and fuse with those of opposite side so that the whole area from the limit of paxillæ to terminal plate and between the two dorsal rows of spines is a thick continuous mat of spinelets, absolutely identical with the lateral cribriform organs, and a fimbriate channel leads on either side from this area along the lower edge of the terminal plate. The total number of lateral organs is: Rays $9+9$ +interbrachium $11=29$. This varies to 30, as some rays have an additional small one at tip. The distal organs are of course rudimentary.

Paxillæ large, fairly high, crowded, those on rays largest, decreasing in size toward center of disk. The larger paxillæ have 15 to 20 peripheral and 5 to 15 central spinelets, cylindrical and slightly knobbed at tip. Papulæ in radial areas at base of ray and adjacent portion of disk.

Actinal interradiial areas large, covered with spaced short slender bluntly pointed spinelets, which increase in length toward margin. The plates extend in a narrow area nearly to end of ray. Adambulacral plates longer than wide with 7 or 8 compressed, basally webbed furrow spines on a curved margin, and on surface of plate 10 to 12 much shorter spinelets, similar to the actinal intermediates, in about two series. Furrow very narrow. Mouth plates prominent and with wide suture. Marginal spines 12, the innermost abruptly enlarged into a flattened conspicuous lanceolate tooth, the others subsimilar to adambulacrals. Suborals about 15 to a plate, in two series, small except inner two, which form a series just back of the teeth. Madreporic body a little more than its own diameter from

margin, flat, with transverse striæ, which have near the periphery numerous blunt spiniform protuberances resembling paxillar spines.

Type-locality.—Station 5513, off northern Mindanao, lat. $8^{\circ} 16' 45''$ N.; long. $124^{\circ} 02' 48''$ E.; 505 fathoms; gray mud and fine sand.

Type.—Cat. No. 28655, U.S.N.M.

Family ASTROPECTINIDÆ.

ANTHOSTICTE, new genus.

Near *Tethyaster* but distinguished by the presence of very deep marginal fascioles, the absence of a regular midradial series of enlarged paxillæ, the extension of the gonads to end of ray, and the character of the paxillæ, which are tall and slender. Superomarginal plates without specialized spines; inferomarginals with a single transverse row of small flattened, sharp, appressed spines; fascioles between marginals very deep, lined with small spinelets and in continuation of the actinal fasciolar channels. Abactinal plates stellate, the shaft of paxilla tall, slender, and crowned by a floriform group of slender spinelets; papulæ all over abactinal surface. Actinal intermediate plates extending nearly to end of ray, and traversed, between marginals and adambulaerals, by deep channels; no enlarged actinal intermediate spines. Adambulacral plates with a very prominent furrow angle and an astropectinoid armature; no enlarged subambulacral on distal portion ray; fascioles between the plates shallow and not lined with spinelets, as in *Sideriaster*. Tufts of gonads extending to end of ray. Madreporic body not concealed. Superambulacral plates large. Tube feet pointed, with simple rod-like deposits at tip. Small spiniform abactinal pedicellariæ.

Type.—*Anthosticte aulophora*, new species.

ANTHOSTICTE AULOPHORA, new species.

Rays 5. $R=162$ mm., $r=34$ mm., $R=4.76+r$; breadth of ray at base, 40 mm., at tenth superomarginal, 29 mm. Disk moderate, rays long, rather narrow beyond interbrachium, tapering gradually to a bluntly pointed extremity. Abactinal surface covered with tall, slender-pediceled paxillæ springing from a 6-lobed (stellate) plate, these without definite order on center of disk and midradial region, but elsewhere in oblique transverse rows parallel to interradius. On the ray these series are slightly spaced, and consecutive plates of a row barely touch. In the midradial area the plates sometimes touch or are separated. Summit of pedicel crowned by a floriform group of 15 to 20 peripheral, and 5 to 15 or even more central, terete blunt spinelets, the latter often in a compact group resembling a pedicellarian apparatus, the former radiating like the rays of a composite flower. On most of the paxillæ 2 to 4 central spinelets are slightly modified with broader tips, and form actual pedicellariæ. Papulæ

distributed all over abactinal surface, as in *Dipsacaster* (not absent from midradial line or center of disk), single, 5 or 6 about each plate.

Marginal plates of the two series corresponding, with unusually deep fasciolar channels separated by thin high ridges, each of which is composed of the elevation of a combined superomarginal and inferomarginal plate and is thinner than the intervening channels. The height of this ridge above the bottom of the channel equals about one-half the dorsoventral dimension of the combined marginal plates. Superomarginals forming a rounded bevel as in *Tethyaster subinermis*, covered with short, clavate, papilliform spinelets, becoming slenderer on edge of grooves. Spinelets in grooves very numerous and delicate. Superomarginals, about 80.

Inferomarginals projecting slightly beyond superomarginals on outer part of ray, and forming a rounded bevel to actinal surface, being about one and one-half times wider than upper series. They are covered with a transverse series of 2 to 5 flat, lanceolate, sharp, appressed spinules and numerous shorter, slenderer, slightly flattened, blunt spinelets, which are very much longer than those of superomarginals. The spinelets lining the deep fascioles are similar to those of upper series.

Actinal interradiial areas fairly large, but rather abruptly narrowing at base of ray, along which two series of intermediate plates extend two-thirds of its length, while one series continues nearly to the extremity. Rather deep channels lead from the marginal fascioles to the fascioles between adambulacral plates, these being separated by single rows of intermediate plates. The marginal and adambulacral plates do not correspond, however. At the base of furrow the latter are slightly more numerous, while in the middle third, the former; distally they correspond. The high keel of the intermediate plates which forms the ridges between the channels is covered with spinelets, directed toward ambitus, and similar to those of inferomarginals.

Adambulacral plates astropectinoid, with an acute furrow angle, bearing a compressed blunt saber-shaped spine, and on either side of this, two strongly compressed rather slender blunt spines. Sometimes a third is added, making the total 5 to 7. Surface of plate with 5 to 7 more cylindrical, slender, blunt spines, one forming a series with the second lateral furrow spines, the rest disposed in about two longitudinal series behind this, the laterals of the first series often standing on margin and making on either side the supernumerary furrow spines. The plates are wider than long, well spaced, with a shallow channel between, over which extend several small terete spinelets belonging to the transverse margins of plates. First two plates much compressed.

Mouth plates prominent, densely covered with spines, increasing in length toward inner end of plate, where, directed over actinostome,

is a cluster of teeth. Marginals 7 or 8, distally with flat side to furrow, but at inner end of plate more knife-shaped and with edge thereto.

Madreporic body exposed, medium-sized, with fine radiating striæ. The ridges near center bear low tubercular prominences. It is situated about one-third R from margin.

Gonads disposed in independent tufts attached to the abactinal integument on either side of the median radial area and extending to end of ray. Ampullæ strongly two-lobed. Tube feet pointed, with deposits at the tip in the form of small, simple, straight, curved, or irregular rods. Superambulacral plates well developed.

Type-locality.—Station 5420, between Cebu and Bohol, 127 fathoms.

Type.—Cat. No. 28656, U.S.N.M.

Remarks.—The genera *Moiraster*, *Tethyaster*, *Sideriaster*, and *Anthosticta* agree in having unarmed supermarginals, inferomarginals with a few small enlarged spines, naked madreporite, large actinal interradial areas, and intermediate plates far along ray, marginal and actinal fascioles, true paxillæ, stellate abactinal plates, an astropectinoid adambulacral armature, and probably also in having the single papulæ uninterrupted all over the dorsal surface. The first two seem to be a little more closely related than either is to the last two, while *Sideriaster* and *Anthosticta* are possibly also nearly related. Unfortunately there is but one species in each genus and it is difficult to ascertain what characters are of generic importance. Applying the standards used in other and larger genera, *Anthosticta* differs from *Tethyaster* chiefly in having very deep marginal fascioles, gonads to the end of the ray, no midradial series of enlarged paxillæ, and taller, more delicate paxillæ. The last is probably of no generic importance, but may be. Its special points of agreement in addition to the characters listed above are the deposits in the tube feet (not recorded for *Moiraster* and *Sideriaster*) and shallow interadambulacral fascioles.

Anthosticta differs from *Sideriaster* Verrill in having very deep marginal fascioles, shallow interadambulacral fascioles, no distally enlarged subambulacral spine. Neither the deposits in the tube feet nor the gonads of *Sideriaster* are described—one of the unfortunate results of drying types. The fascioles between the adambulacral plates, which I examined in the type-specimen, form one of the most striking features of the genus. They are densely lined with small delicate spinelets, and are therefore similar to marginal fascioles. Such is not the case in *Anthosticta*, *Tethyaster*, or *Moiraster*.

The distribution of gonads and deposits of tube feet are unknown in *Moiraster*. Kœhler describes the marginal fascioles as "peu profonds" while Sladen says they are deep, but the discrepancy is only apparent, for Sladen knew no genera with very deep fascioles, such as *Dipsacaster*. *Anthosticta* differs from *Moiraster* in respect to the marginal fascioles, and the thin elevated intervening ridges of the marginal plates. The inferomarginal and actinal spinelets of *Antho-*

stictæ are slender, and not flat, spatulate, and chisel-shaped. No pedicellariæ are described for *Moiraster*. If the gonads are found to extend to the end of the ray, it may become necessary to unite the two genera, although the difference in the marginal fascioles will remain. The paxillæ of *Moiraster* are probably lower than those of *Anthostictæ*, and less delicate. The character of the gonads is important, and is apparently very reliable for generic groups, but not for higher ones.

It seems better to keep *Anthostictæ* separate rather than to unite it with another genus, especially as it is not at all evident into which of the three groups it would go with the least disturbance.

The following table recapitulates the characters mentioned above. Will some one enlighten us concerning the gonads and tube feet of *Moiraster* and *Sideriaster*?

Comparison of the characters of Anthostictæ, Tethyaster, Sideriaster, and Moiraster.

| Genus. | Gonads extend to end of ray. | Gonads confined to proximal half of ray. | Marginal fascioles deep. | Adambulacral fascioles shallow. | Deposits in tube feet. | Distal subambulacral spines enlarged. | Paxillæ tall; pedicel slender. | Paxillæ rather low; pedicel stout. | Midradial row of enlarged paxillæ. | Abactinal plates stellate. |
|--------------------------|------------------------------|--|--------------------------|---------------------------------|------------------------|---------------------------------------|--------------------------------|------------------------------------|------------------------------------|----------------------------|
| <i>Anthostictæ</i> | × | — | × | × | × | — | × | — | — | × |
| <i>Tethyaster</i> | — | × | — | × | × | — | — | × | × | × |
| <i>Sideriaster</i> | (?) | (?) | — | — | (?) | × | × | — | — | × |
| <i>Moiraster</i> | (?) | (?) | — | × | (?) | — | × | — | — | × |

Family GONIASTERIDÆ.

PONTIOCERAMUS, new genus.

Stellate, with a large disk and relatively short rays. Related to *Plinthaster* Verrill, but differing in having the surface of the abactinal plates perfectly smooth, not covered with minute bosses, in having the plates of the papular areas low-tabulate, and the adambulacral plates with an angular furrow margin armed with numerous short stubby spinelets; no enlarged subambulacral spine on distal part of ray. Abactinal and marginal plates bordered by a single series of small granules, the latter also with some on lateral face of ray, all flush with level of plate. Last few superomarginals in contact medially. Actinal intermediate plates reaching far along ray, closely granulate, and with small bivalved excavate pedicellariæ about as high as wide. Adambulacral plates proximally very narrow, distally becoming wider; with a large subambulacral toothed bivalved pedicellaria, and 10 or 11 furrow spinelets in angular series. No smaller secondary abactinal plates.

Type.—*Pontioceramus grandis*, new species.

PONTIOCERAMUS GRANDIS, new species.

Rays 5. $R=160$ mm., $r=70$ mm., $R=2.3$ r; breadth of ray at mid-interbrachium, 80 mm. Disk very large, arcuately pentagonal and produced into short pointed rays. Abactinal plates numerous, with a very smooth and slightly convex surface, on the radial region regularly hexagonal, and on center of disk and in about 9 longitudinal (radial) series distinctly tabulate, each tabulum surrounded by 6 papulae, the area of tabulate plates reaching about two-fifths R . The papular areas are proximally considerably wider than the area of obviously tabulate plates. Interradial plates flat, irregularly four to six-sided. All abactinal plates surrounded by a single series of flat squarish granules, set in membrane and flush with surface of plate, those on the radial plates hard to see, and larger on the lateral than on the transverse margins of tabulum.

Marginal plates conspicuous. Superomarginals (30 to a ray) form an even bevel in interbrachium, but on ray a rounded angle, being there somewhat wider than high. Inferomarginals on the contrary encroach more conspicuously upon actinal surface in interbrachium than on ray, but like the superomarginals the angle between lateral and ventral surface is more pronounced on ray. Superomarginals with one, and inferomarginals with two or three series of small flush granules forming an inconspicuous border, and in addition a variable number of scattered granules on the lateral face of plates, all flat and sunken flush with the level of plates.

Actinal intermediate plates very numerous, those nearest furrow largest, and the only ones at all regularly arranged. They are closely granulate, the granules flat and immersed in thin membrane. The plates next to adambulacrals bear one or two small rather delicate bivalved pedicellariae, whose denticulate jaws are slightly wider than high (the larger ones) or as wide as high (smaller) and fit into slight depressions when open.

Adambulacral plates proximally long and narrow, very gradually widening on outer half of R , until near tip; beyond the last actinal intermediate plates they are as wide as long. Each plate is angular toward furrow, the angle being sharper deep in furrow than on margin, and is usually adoral to the middle of plate, varying in position between the middle and adoral margin of plate. Furrow spinelets 11 or 12, stout, short, round-tipped or blunt, much flattened, those near the angle of margin with edge to furrow, the others with flat side thereto. The aboral spinelet of the series is the broadest and stoutest, and often the adoral spinelet is similarly enlarged. The spinelets are subequal in length, or the median slightly the shorter. The actinal surface proximally is wide enough for only one longitudinal series of unequal granules, but as the plate widens more

are added, until distally the plates have an even granular surface, like that of actinal plates. Proximally most of the plates have a large bivalved denticulate pedicellaria, the jaws much wider than high. This occupies a third or a fourth the length of a plate.

Mouth plates small, triangular with a fairly straight furrow margin, with nine or ten spinelets, the innermost heaviest. Surface covered with spaced stout granuliform spinelets.

Madreporic body small, near center of disk and about as large as surrounding plates. Ridges radiating and coarse.

Type-locality.—Station 5273, off western Luzon, 27 miles southwest Corregidor Light; 114 fathoms; mud, shells, and coral sand.

Type.—Cat. No. 28657, U.S.N.M.

Remarks.—This genus differs from *Circeaster* in lacking the abruptly larger abactinal plates of rays, in having smooth marginals, and regular tabulate radial plates; and from *Lydiaster* in the character of abactinal, marginal, and adambulacral plates. *Lydiaster* is more nearly related to *Circeaster* than to *Pontioceramus*. *Ceramaster* is distinguished by the wholly granulate tabulate abactinal plates and *Eugoniaster*, which is perhaps the most nearly related form, has the abactinal plates arranged without regularity although "tabulate," and the adambulacral plates are of uniform width throughout.

LITHOSOMA, new genus.

Related to *Iconaster* Sladen, but differs in having the regular longitudinal radial series of abactinal plates completely surrounded by granules, not on the lateral edges only, and in having the subambulacral granulation short and spaced from the furrow comb, not crowded and graduated into the furrow armature. All plates smooth and bordered by a single series of granules, the plates of papular areas sensibly elevated. Small spatulate excavate pedicellariæ on both surfaces. Disk large, rays long, slender, and beyond base of ray composed only of marginal plates abactinally.

Type.—*Lithosoma actinometra*, new species.

LITHOSOMA ACTINOMETRA, new species.

Rays 5. $R=155$ mm., $r=42$ mm., $R=3.7$ r; breadth of ray at base, 49 mm., at eighth superomarginal 19 mm. Disk large, rays narrow; interbranchial arcs very open, the disk being arcuate pentagonal and produced at the corners into the long slender rays, composed abactinally of the marginal plates only. All plates smooth, porcelain-like, bordered by a single complete series of granules flush with the general surface; only the adambulacral and mouth plates with granules on surface. Marginal plates block-like massive, the superomarginals, 40 in number, in contact along median line beyond the seventh to ninth, and encroaching conspicuously upon dorsal surface, being wider than high. Marginal granules small,

being immersed in a membrane which nearly or quite obscures the outlines. Inferomarginals correspond with superomarginals proximally; distally they alternate. Proximally they bear on the actinal surface one to several very small spatulate excavate pedicellariæ with narrow smooth jaws.

Abactinal plates hexagonal, in regular radial and parallel series, smooth except for scattered minute elevations (not granules) and bordered by a single complete series of flat immersed granules, squarish or oblong in shape. Papulæ in a petaloid radial area, 6 about each plate. Here the plates are sensibly elevated, although not at all markedly tabulate. If somewhat higher they would be called tabulate. No secondary, smaller, intermediate plates. Small scattered abactinal pedicellariæ.

Actinal intermediate plates not very regular either in shape or arrangement but four- or five-sided, very smooth and with numerous small pedicellariæ, especially near furrow. They extend slightly beyond middle of R.

Adambulacral plates with slightly curved furrow margin, bearing proximally 6 to 8, farther along ray 9 or 10, short, blunt, granuliform, subequal spinelets, the mesial more or less compressed with edge to furrow, the lateralmost somewhat thicker and prismatic or flattened with side to furrow. Border of plate with a row of unequal subconical immersed granules, and several on the surface, usually forming a longitudinal series spaced from furrow comb. One or two small pedicellariæ usually present, often taking the place of several granules or surrounded by a smooth area. Mouth plate small, with 8 furrow spinelets and a granular actinal surface.

Madreporic body hexagonal, one-fourth minor radius from center of disk. Furrow narrow; tube feet with strong disks.

Type-locality.—Station 5272, western Luzon, 25.5 miles southwest Corregidor Light, lat. 14° N.; long. $12^{\circ} 22' 30''$ E.; 118 fathoms; mud, shells, and coral sand.

Type.—Cat. No. 28658, U.S.N.M.

Remarks.—Abactinally this species resembles somewhat a *Plinthaster* with long slender rays, but has perfectly smooth marginals. Barring this it would bear to *Plinthaster* much the same relation that *Nymphaster* does to *Ceramaster*. The actinal intermediate plates, in contradistinction to those of *Plinthaster*, are smooth, not granulate, and the smaller secondary abactinal plates which are variously developed in *Plinthaster* are absent. The genus seems to be most nearly related to *Iconaster*. It differs from *Astroceramus*, another relative, in lacking the coarse marginal and actinal granules and tubercles, and the specialized, robust subambulacral spines. In some species of *Astroceramus* the adambulacral armature approaches that of the Hippasteriinae.

As in *Iconaster* the only spines are those of the furrow margin. The animal is hard, smooth, of a stony or porcelain texture, and of conspicuous size.

ATELORIAS, new genus.

Goniasteridæ with unequal marginals, the supermarginals the larger and defining entire angular ambitus; with all the plates granulate, and covered with thin soft membrane leaving each plate distinct; abactinal plates flat, numerous, extending to tip of ray; papulæ in radial petaloid areas; adambulacrals with an angular furrow series and subambulacral granules; actinal interradiar areas large; disk large, rays slender. Entrenched small upright two-jawed pedicellariæ on abactinal, marginal, actinal intermediate, and adambulacral plates. No specialized spines; the furrow spinelets the only ones present.

Type.—*Atelorias anacanthus*, new species.

ATELORIAS ANACANTHUS, new species.

Rays 5. $R=205$ mm., $r=43$ mm., $R=4.76$ r.; breadth of ray at mid interbrachium, 53 mm., at middle of R, 14 mm. Disk large, thin, with wide interbrachial arcs. Rays very long, slender, thin, with an angular margin formed entirely of supermarginal plates. No specialized spines; all plates covered with hemispherical granules immersed in a thin membrane which partly obscures them, and fills up the interstices but which leaves the outlines of plates distinct. Small excavate pedicellariæ with two jaws slightly higher than wide, and usually with depressions in the membrane into which they fit when open, are present on plates of both surfaces.

Abactinal plates numerous, very slightly convex or flat, hexagonal on papular areas but elsewhere irregularly hexagonal, pentagonal, squarish or roundish, and reaching terminal plate. Plates not at all tabulate but sensibly higher on the petaloid radial papular areas; papulæ 5 or 6 about each plate, and inconspicuous, not extending far along ray. All plates covered with hemispherical granules, sunken in soft membrane, and with a pedicellaria.

Supermarginals about 80 to a ray encroaching conspicuously upon abactinal area and with a nearly flat upper surface; throughout wider than long. They encroach upon actinal surface about one-half as far as upon abactinal and thus form the margin of ray. The convexity of the lateral angle of plate causes the margin of ray to appear scalloped except near extremity. Inferomarginals proximally considerably wider, and beyond interbrachium only slightly wider than the actinal surface of supermarginals, and entirely actinal in position; surface very slightly convex. Both series with the characteristic granules and pedicellariæ.

Actinal interradial areas large, irregularly disposed, nearly flat, granulated, and with pedicellariæ. They extend about to the middle of R.

Adambulacral plates with angular furrow margin but the angle nearer the adoral side, so that the facets are very unequal. Spinelets 10 to 12, rather short, round-tipped or truncate, in a crowded series, the longest on the angle and compressed in a plane transverse to furrow, the others gradually shortening and with flat side to furrow. Actinal surface of plates with crowded low conical granules and occasionally a pedicellaria.

Mouth plates nearly flat, coarsely granulate, with 16 to 18 marginal robust spinelets, increasing in size toward inner angle. The furrow surface of each plate has a shallow vertical depression for first tube foot.

Madreporic body one-third minor radius from center. Tube feet with strong disks; ampullæ double.

Type-locality.—Station 5655, Gulf of Boni, Celebes; 608 fathoms; gray mud, fine sand.

Type.—Cat. No. 28659, U.S.N.M.

Remarks.—The new genus is quite unlike any other and probably belongs in the Leptogonasterinæ, although further study may warrant placing it in the Goniasterinæ. It is somewhat intermediate. The large overhanging superomarginals and flat granulate membrane-invested plates, which are however distinct, are the most trenchant features of the genus.

Family PTERASTERIDÆ.

HYMENASTERIDES, new genus.

In general structure similar to *Hymenaster* but with two kinds of adambulacral plates alternating; (1) prominent plates bearing a transverse series of 3 rather long slender spines, and (2) nonprominent plates with only 1 spine. Tube feet in 4 series, the feet of the outermost series corresponding to the nonprominent plates. Combined mouth plates produced actinally into a cone, the apex of which is about the middle of median suture. Two suboral spines.

Type.—*Hymenasterides zenognathus*, new species.

HYMENASTERIDES ZENOGNATHUS, new species.

Diagnosis.—Paxillar area raised above the actinolateral membrane which forms an even narrow border; paxillæ in 9 longitudinal series, 5, or laterally, as many as 7 spines to a paxilla, one being longer than the rest; no visible muscle-fibres; scattered spiracula. Prominent adambulacrals with 3 slender membrane invested sacculate spines; nonprominent with one, each of which is opposite a tube foot of outer series. Mouth plates conical actinally with 2 suborals, and 3 or 4

marginals. Fourteenth actinolateral spine the longest. $R = 36$ mm., $r = 22$ mm., $R = 1.64$ r. Breadth of ray, over all, 21 to 25 mm.; of paxillar area alone, 17 to 21 mm.

Description.—The paxillar area is sharply defined from the lateral fringe, or actinolateral membrane, which is interradially deeply indented and follows the contour of the raised supradorsal membrane. Thus the actinolateral membrane forms a narrow border of nearly uniform width, and the spines do not project beyond the edge. They are clearly visible as the membrane is translucent. The supradorsal membrane is thin and translucent, without visible muscle-fibres, and with small rather widely spaced inconspicuous spiracula, which are not in definite areas, but sometimes form irregular lines. With the exception of an interradiial area they are pretty uniformly distributed all over the membrane. Membrane everywhere rough with the points of the paxillar spinelets, of which there are usually 5 (laterally sometimes 7) to a paxilla. The latter are in 9 quincuncial longitudinal series. Each paxilla springs from a cruciform or 4-lobed base, the lobes overlapping those of 4 other plates leaving quadrate or lozenge-shaped papular areas. The pedicels are longest on the lateral paxillæ; those of midradial series about half as long as the laterals, and the spines, which are webbed, are in all cases longer than the pedicels. One spine is usually longer and stouter than the others. The spines are three-edged or triradiate in cross section. The papulæ (1 to an area) are attached to the pedicels. The valves guarding the osculum have a truncate summit and are strengthened by about 12 spines, of which the 5 or 6 median are longest. About 8 other spines, much shorter, form a comb just back of the valves, and are attached to the same pedicel. The membrane at the base of the fans is pierced by scattered spiracula, and that between the fans has numerous spiracula in short irregular lines. The supradorsal membrane is dotted with numerous very small whitish spots of unequal size, due probably to groups of gland cells. There are rather large well-spaced brownish rings or spots on the outer half of R.

Ambulacral furrow wide; tube feet, with small disks, in 4 longitudinal series. Adambulacral plates of two sorts, prominent and nonprominent. The former project farther into furrow and bear an oblique transverse series of 3 slender spines invested in membrane which forms a small sacculus at tip. The outer spine is the longest (equals the length of 5 plates at base of furrow), the other two decreasing slightly in length. The innermost often projects between 2 feet of the outermost series. The nonprominent plate corresponds to a tube foot of the outermost series, is set back slightly, and bears only 1 spine, which stands in the same longitudinal series (with reference to long axis of ray) with the outermost spine of the prominent plates, and is of about the same length

as this spine. Aperture papillæ short, broadly ovate, with a membranous envelope produced into a short blunt sacculus. The calcareous part is only about one-fourth the length of the adjacent subambulacral spine, and there is no difference between the papillæ of the two sorts of plates. The apertures are narrow and not completely covered by the papillæ. The first adambulacral plate, sometimes prominent, sometimes nonprominent, has 2 equal or unequal spines and a large aperture papilla immersed in the actinolateral membrane.

Mouth plates small and very high, the combined pair produced actinally into a conical eminence, the apex of which is situated at the middle of the median suture. The height of this extraordinary beak or cone equals the interradial diameter of the pair of plates. From the blunt point at the top the plates slope straight and steeply to the actinostomial margin, which is produced into a slight beak, but in the opposite direction the plates diverge, leaving an open suture, and the margin of the plates is arcuate and nearly perpendicular. Marginal spines 3 or 4, the lateral-most the strongest and longest, situated on a slight angle of the margin and directed across mouth of furrow. The innermost spine which is well spaced from the median beak of actinostomial margin is nearly as long as the lateral-most and the 1 or 2 intermediate spines are somewhat shorter. Suborals 2, nearly like the subambulacrals and situated in a line parallel to and near median suture, on the actinostomial face of the cone.

Actinolateral membrane translucent forming a broad margin which decreases in width evenly from interradial angle. The fourteenth spine is the longest, and is the first to meet the free edge of membrane. The first is articulated to the second adambulacral. The spines do not meet interradially their fellows of adjacent ray, but leave a narrow wedge-shaped area. The length of this wedge (the apex touching mouth plates) is about half the extent of the free edge of one ray measured along edge of actinolateral membrane. This actinolateral membrane is nearly flat.

Madreporic body globular, and without a paxilla on its surface.

Type-locality.—Station 5623, Molucca Passage between Gillolo and Makyan Islands, 272 fathoms; fine sand, mud.

Type.—Cat. No. 28660, U.S.N.M.

TWO AMPHIBIANS, ONE OF THEM NEW, FROM THE CARBONIFEROUS OF ILLINOIS.

By ROY L. MOODIE,
Of the University of Kansas, Lawrence

The Lacoë collection in the United States National Museum contains examples of two interesting amphibians, one of them a new species, from the Mazon Creek shales. A new labyrinthodont from Kansas has recently been described by the writer from the same collection.¹ The two forms discussed in the present paper are representatives of the salamander-like Branchiosauria and the reptile-like Microsauria. They are members of the families Branchiosauridæ and Amphibamidæ.

Some years ago Mr. David White told the writer of an interesting salamander in the collection of Mr. Lacoë and it was with very great interest that the writer received the specimen which, with the others, was sent through the courtesy of Mr. C. W. Gilmore, to whom I express my hearty thanks.

The little salamander-like fossil is a member of the species *Eumicrerpeton parvum* Moodie, which had been founded, before the specimen was received, on material from Yale University. The name and a discussion of the alimentary canal were published last spring.² The additional specimen from the National Museum serves to substantiate the genus and species, *Eumicrerpeton parvum*, and shows more clearly characters which are distinct from *Micrerpeton*, the genus to which the present form is most nearly related. The National Museum specimen (No. 4400, U.S.N.M.), like those from Yale, shows almost perfectly the entire length of the alimentary canal (fig. 1). The specimen is almost as perfectly preserved as was that of *Micrerpeton caudatum* Moodie.

When the nodule containing the fossil was received the tail was embedded in matrix, but by careful use of the hammer and chisel it was possible to lay bare the whole tail, the tip of which ends on the

¹ Proc. U. S. Nat. Mus., vol. 39, 1911, p. 489.

² Amer. Nat., vol. 44, June, 1910, pp. 367-375.

very edge of the nodule. This was at once perceived to be precisely similar to that of the previously studied examples from Yale. The skull structure, the intermediate position of the pineal foramen, the epiotic notch, and the shape of the skull are so exactly similar to those of the Yale specimens that the form is unhesitatingly referred to the same species.

Most interestingly, too, the present specimen has the alimentary canal almost as perfectly preserved as in the other two specimens, so that the three specimens of this species now known all show the alimentary canals. The present specimen is, however, much more developed than the other two if we may judge from the relative sizes and the proportions of the various parts of the body. There is not the slightest trace of branchiæ in any of the specimens. The matrix does not preserve the skeletal elements as well as does the hard rock from Saxony in which Doctor Credner found such excellently preserved branchiæ.

The National Museum specimen is nearly half as long again as the smallest of the Yale specimens, and the skull is proportionately longer and wider. There is preserved an impression of the anterior edge of both clavicles as has been described for the Yale specimens. No other portion of the pectoral girdle is preserved. The right humerus is imperfectly preserved, as is also the right femur and tibia; other than these the fossil is merely an impression.

The skull is so nearly like what has been described for the Yale specimens that additional description is unnecessary.¹ The pineal foramen is quite large and lies on a line which cuts the orbits into equal longitudinal parts. The inter-orbital space is about equal to the long diameter of the orbit, as in the Yale specimens. Traces of sclerotic plates are observed in the left orbit, but they are quite imperfect.

The alimentary canal is unlike that described for the Yale specimens² in that the intestine is longer and much more convoluted. It lies in five longitudinal folds and ends in an enlarged cloaca near which are the impressions of two glands which may be the posterior ends of the oviducts, as has been suggested for the Yale specimens, but it is rather peculiar that all three specimens should

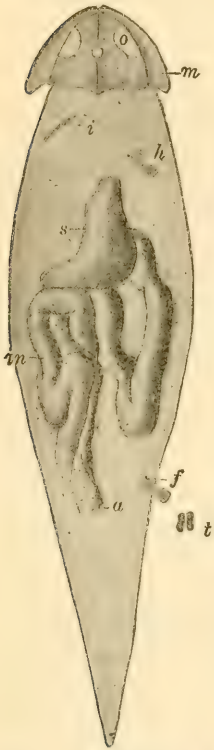


FIG. 1.—A DRAWING OF THE SPECIMEN OF EUMICROREPETON PARVUM MOODIE (CAT. NO. 4400, U. S. N. M.). *a* = ANUS; *f* = FEMUR; *h* = HUMERUS; *i* = INTERCLAVICLE; *in* = INTESTINE; *m* = MANDIBLE; *o* = ORBIT; *s* = STOMACH; *t* = TIBIA AND FIBULA. $\times 2$.

¹ Kans. Univ. Science Bulletin, vol. 5, 1911.

² Amer. Nat., vol. 44, June, 1910, p. 368.

be females. Like the Yale specimens the œsophagus is displaced and partially obscured. The creatures undoubtedly fed on small plants and animals much as do our recent salamanders. The alimentary tract is preserved fully extended.

The impression of the tail is, unfortunately, too imperfect to show traces of the lateral lines.

Measurements of the specimen of Eumicrerpeton parvum Moodie (Cat. No. 4400, U.S.N.M.).

| | mm. |
|--|------|
| Length of entire animal..... | 45 |
| Length of skull..... | 6 |
| Width of skull..... | 9 |
| Transverse diameter of the orbit..... | 1.50 |
| Long diameter of the orbit..... | 2.25 |
| Interorbital space..... | 2.50 |
| Diameter of pineal foramen..... | .50 |
| Length of body from back of skull to pelvis..... | 22 |
| Greatest width of body..... | 9 |
| Length of tail..... | 16 |
| Width of tail at base..... | 5 |
| Length of humerus..... | 3 |
| Length of femur..... | 2.50 |
| Length of tibia (fibula?)..... | 1.75 |
| Length of stomach..... | 7 |
| Width of stomach..... | 3 |
| Length of intestine (estimated)..... | 56 |
| Width of intestine..... | 1 |

AMPHIBAMUS THORACATUS, new species.

The genus *Amphibamus* was the first known of the Mazon Creek Amphibia to which Cope, in 1865, ascribed the species *grandiceps*. It is interesting that the latest discovery of forms from Mazon Creek should be an additional species of this genus. The specimen referred to is No. 4306 of the U. S. National Museum. It formed a part of the Lacoe collection. The fossil is rather poorly preserved, but the remains are present on both halves of the nodule, so that considerable has been made out as to its structure.

The chief diagnostic characters which will at once distinguish the species are, the elongate arm, the large interclavicle, the shape of the vertebra, and the triangular skull.

The portions of the animal which are preserved are: the impression of the skull with one orbit; the right humerus and radius (ulna?); the interclavicle; the left clavicle; a single vertebral centrum, with portions of others; and traces of the ventral scutellæ. These remains are so intermingled with fragments of plants that it has been quite difficult to distinguish bone impressions from plants. This has, however, been successfully accomplished by whitening the fossil with ammonium chloride when the texture of the fossils serve

to distinguish the one from the other. Parts of the plants have been converted into or destroyed by galena and kaolin, as have also parts of the bones, so that the task has been doubly difficult. There can be no doubt, however, that the observations recorded below are correct. The position of the arm in relation to the pectoral girdle and the position of the girdle in relation to the skull impression first called attention to the possible presence of a fossil amphibian.

There is little to be said about the skull. It is merely an impression in the nodule. It is triangular in form, with the snout an acute angle. The angle is, however, exaggerated by the compression to which the fossil has been subjected. The right side of the skull lies over a portion of some plant. The animal is preserved on its back, so that this gives a good opportunity for a study of the pectoral girdle, which is partially preserved. The interclavicle is very large; and from this the species has been given its name (*thoracatus*=armed with a breastplate). The interclavicle is an exaggerated "T," with the stem very short. The anterior margin is curved and ends in a rather sharp, elongate point. The posterior spine is quite short and sharp pointed, having a length of only four millimeters. The element recalls, in a measure, the same element of *Branchiosaurus*, although it is much more expanded anteriorly and has a shorter spine. In these respects it resembles more nearly a reptilian interclavicle. The element is quite smooth.

The clavicle is of the simple triangular form so characteristic of the *Microsauria*. It is somewhat displaced backward, and its inner margin is slightly obscured.

The humerus is elongate, apparently cylindrical, and with expanded ends. It resembles very closely the humerus of *Amphibamus grandiceps*, although its proportions are much greater than in that species. Its length is almost equal to the length of the skull, while in *A. grandiceps* the length of the humerus is only one-half that of the skull.

The radius (ulna?) resembles in its general proportions those of the humerus. It is a more slender, lighter bone. The impression of the other bone of the forearm is obscured.

A portion of a single vertebral centrum is preserved. It is from the posterior end of the dorsal series. It is, apparently; amphicoelous. Its height is about one-half greater than its length. The neural spine is obscured.

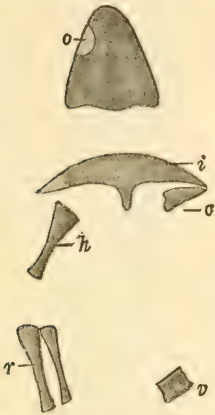


FIG. 2.—DRAWING OF THE SPECIMEN OF AMPHIBAMUS THORACATUS MOODIE (CAT. NO. 4306, U. S. N. M.). *c*=CLAVICLE; *h*=HUMERUS; *i*=INTERCLAVICLE; *o*=ORBIT; *r*=RADIUS (ULNA?); *v*=VERTEBRA. $\times 1$.

Measurements of the type of Amphibamus thoracatus Moodie (Cat. No. 4306, U.S.N.M.).

| | <i>mm.</i> |
|---|------------|
| Length of entire specimen as preserved..... | 60 |
| Length of skull impression..... | 18 |
| Greatest width of same..... | 15.5 |
| Long diameter of right orbit..... | 4 |
| Transverse diameter of same..... | 3 |
| Transverse width of the interclavicle..... | 14 |
| Long diameter of same..... | 7 |
| Long diameter of clavicle..... | 9 |
| Greatest transverse diameter of same..... | 3 |
| Length of humerus..... | 10 |
| Greatest diameter of same..... | 4 |
| Least diameter of same..... | 1.5 |
| Length of radius (ulna?)..... | 11 |
| Length of vertebral centrum..... | 2 |
| Width of same..... | 3 |



NEW MOLLUSKS OF THE GENUS *ACLIS* FROM THE NORTH ATLANTIC.

By PAUL BARTSCH,

Assistant Curator, Division of Mollusks, U. S. National Museum.

This little paper embraces descriptions of a number of new forms which were dredged in rather deep water off the Atlantic coast of North America by Dr. W. H. Rush, U. S. N., and the U. S. Bureau of Fisheries steamers *Fish Hawk* and *Albatross*. The one coming from New England has been known for some time, but has been confused with the European *Aclis walleri* Jeffreys, under which name it has appeared in lists. In this connection, it would be well to mention that *Aclis striata* Verrill is not an *Aclis*, but a Pyramidellid, belonging to the genus *Odostomia*, subgenus *Menestho*.

ACLIS DALLI, new species.

Plate 59, fig. 1.

Shell slender, very elongate-conic, milk-white, vitreous. Nuclear whorls not differentiated from the rest. Early post-nuclear whorls well rounded; the later half strongly inflated; all strongly appressed at the summit, the appressed portion appearing as a slightly differentiated color band at the summit of the whorls. The entire surface of the shell is sculptured only by exceedingly fine incremental lines. Sutures very strongly constricted. Periphery of the last whorl and the moderately long base well rounded, smooth. Aperture large, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin and semitransparent; columella moderately long, curved and reflected.

The type (Cat. No. 94288, U.S.N.M.) was dredged by Doctor Rush at his station 34 in 780 fathoms on coral mud bottom off Cuba. It has 17 whorls and measures: Length 7.8 mm., diameter 1.7 mm.

Named for Dr. W. H. Dall.

ACLIS CUBANA, new species.

Plate 59, fig. 2.

Shell small, slender, elongate-conic, milk-white. Nuclear whorls two, the first very much inflated, strongly rounded, and larger than

the early post-nuclear whorls. Post-nuclear whorls well rounded, appressed at the summit, sculptured with somewhat irregular, feebly developed axial ribs, of which 18 occur upon the first and second, 20 upon the third and fourth, and 22 upon the penultimate turn. Sutures strongly constricted. Periphery of the last whorl marked by a very feeble, slender spiral cord. Base short, well rounded; marked by the feeble continuations of the axial ribs. Aperture very broadly ovate; posterior angle obtuse; outer lip very thin, showing the external sculpture within; columella very slender, decidedly curved and feebly revolute.

The type (Cat. No. 94290, U.S.N.M.) was dredged by Doctor Rush at his station 34 in 780 fathoms on coral mud off Cuba. It has 8 whorls and measures: Length 4 mm., diameter 1.1 mm.

ACLIS RUSHI, new species.

Plate 59, fig. 3.

Shell small, elongate-conic, white. Nuclear whorls two, well rounded, smooth. Post-nuclear whorls inflated, appressed at the summit, sculptured with fine incremental lines and an occasional impressed varical streak. In addition to this there appear five very fine subobsolete raised spiral threads between the sutures which lend the surface a very weakly malleated appearance. Sutures very strongly constricted. Periphery of the last whorl well rounded. Base moderately long, narrowly umbilicated, well rounded, marked like the spire. Aperture large, decidedly effuse anteriorly, with a patulous expansion covering the posterior half of the outer lip; posterior angle obtuse; outer lip thin, the portion immediately anterior to the patulous part forming a claw; columella very long, oblique, and very strongly reflected.

Two specimens of this species (Cat. No. 82973, U.S.N.M.) were dredged by Doctor Rush in 150 to 200 fathoms, off Fowey Rocks, Florida Straits. The type has eight whorls and measures: Length 2.7 mm., diameter 1.2 mm.

Named for Dr. W. H. Rush.

ACLIS FLORIDANA, new species.

Plate 59, fig. 5.

Shell small, elongate-conic. Nuclear whorls one and one-half, well rounded. Post-nuclear whorls marked by a strong sloping shoulder which extends over the posterior fourth of the whorls between the sutures. This shoulder is limited anteriorly by a quite strong carina. The anterior three-fourths of the whorls between the sutures are well rounded, strongly constricted at the suture, and appear sculptured by several very feeble spiral lines. The axial sculpture consists of incremental lines and an occasional varical streak.

Sutures very strongly constricted. Periphery of the last whorl and the moderately long base well rounded, marked like the spire. Aperture with the posterior angle obtuse (outer lip fractured; anterior portion of the columella lost); parietal whorl covered with a moderately thick callus which joins the columella with the posterior angle of the aperture.

The type (Cat. No. 82973a, U.S.N.M.) was dredged by Doctor Rush in 150 to 200 fathoms, off Fowey Rocks, in Florida Straits. It has eight whorls and measures: Length 2.9 mm. (if the aperture were complete the shell would probably measure 3 mm.), diameter 1 mm. This form is nearest related to *A. bermudensis* Dall and Bartsch, but can be separated from it at once by its much greater size as well as detail sculpture.

ACLIS BERMUDENSIS Dall and Bartsch.

Plate 59, fig. 4.

Aclis bermudensis DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 278.

A figure of this species, which has been already described, is added for purposes of comparison.

ACLIS VERRILLI, new species.

Plate 59, fig. 6.

Shell acicular, yellowish-white. Nuclear whorls four, well-rounded, with strongly impressed sutures, smooth, forming a slender apex to the spire. Post-nuclear whorls well-rounded, appressed at the summit, sculptured by six feeble, poorly defined, somewhat irregular spiral threads and numerous incremental lines, the combination of the two lending the surface of the spire a feebly malleated surface. In addition to the above sculpture the surface is marked with irregularly disposed varical lines. Sutures strongly impressed. Periphery of the last whorl well rounded. Base moderately long, well rounded, narrowly umbilicated, marked by seven feeble and irregularly placed spiral lines, its surface having the same aspect as that of the spire. Aperture rather large; somewhat effuse anteriorly, posterior angle somewhat obtuse; outer lip patulous, columella oblique, slightly curved and strongly revolute.

The type (Cat. No. 44811, U.S.N.M.) has eleven whorls and measures: Length 4.6 mm., diameter 1.7 mm. It was dredged by the U. S. S. *Fish Hawk* at station 894 in 365 fathoms, bottom temperature 40°, off Marthas Vineyard, Mass. One specimen (Cat. No. 44808, U.S.N.M.) from U. S. S. *Fish Hawk* station 892, 487 fathoms, off Marthas Vineyard. One specimen (Cat. No. 44809, U.S.N.M.) from station 1093, 349 fathoms, bottom temperature 40°, off Marthas Vineyard. Two specimens (Cat. No. 78161, U.S.N.M.) from station 2710, 984 fathoms, southeast of Nantucket. One speci-

men (Cat. No. 151887, U.S.N.M.) from U. S. S. *Albatross* station 2547; 390 fathoms, 40 miles south of Marthas Vineyard.

The present species has been listed from the Atlantic coast under the name of *Aclis walleri* Jeffreys. It is not at all closely related to this form; *walleri* is much smaller; much more narrowly elongate-conic and has a much wider umbilicus.

The type of *walleri* described by Jeffreys¹ is in the U. S. National Museum (Cat. No. 182214) and measures: Length 3.3 mm., diameter 1.2 mm.

Named for Prof. A. E. Verrill.

ACLIS CAROLINENSIS, new species.

Plate 59, fig. 7.

Shell acicular. Nuclear whorls two, well rounded, smooth. Early post-nuclear whorls gently rounded on the posterior two-thirds between the sutures and abruptly on the anterior one-third. The later more evenly rounded; sculptured with numerous fine incremental lines and by feeble, somewhat irregular, raised, slender spiral threads. The combination of the incremental lines and the spiral threads lends the surface of the whorls a somewhat malleated appearance. In addition to the above sculpture varical lines appear at irregular intervals. Sutures strongly impressed. Periphery of the last whorl obliquely angled. Base moderately long, strongly but narrowly umbilicated, well rounded, sculptured like the spire with spiral striation, incremental lines and about six obsolete raised spiral threads. Aperture large, decidedly effuse anteriorly, the basal portion patulous; posterior angle obtuse; outer lip thin; columella strongly curved, expanded and revolute.

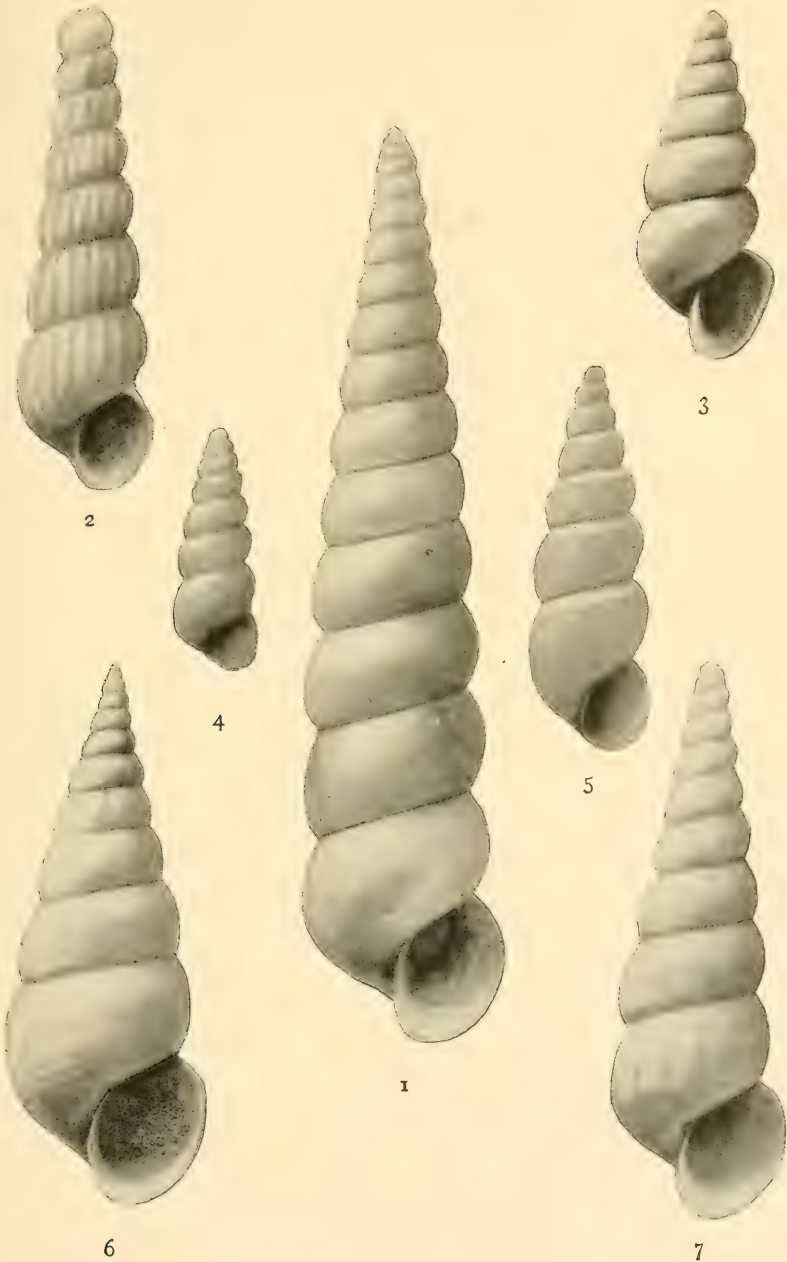
The type (Cat. No. 83743, U.S.N.M.) was dredged by the U. S. S. *Albatross* at station 2595 in 63 fathoms, sandy bottom, bottom temperature 75°, 22 miles east-southeast of Hatteras, North Carolina. It has ten whorls, and measures: Length 4.7 mm., diameter 1.3 mm.

EXPLANATION OF PLATE 59.

All of the figures are enlarged about 16 times. The measurement cited after each species is the actual length of the specimen.

- Fig. 1. *Aclis dalli*; Type; 7.8 mm., p. 435.
2. *Aclis cubana*; Type; 4.0 mm., p. 435.
3. *Aclis rushi*; Type; 2.7 mm., p. 436.
4. *Aclis bermudensis*; Type; 2.1 mm., p. 437.
5. *Aclis floridana*; Type; 2.9 mm., p. 436.
6. *Aclis verrilli*; Type; 4.6 mm., p. 437.
7. *Aclis carolinensis*; Type; 4.7 mm., p. 438.

¹ British Conchology, vol. 4, pp. 105-6, and figured in vol. 5, pl. 72, fig. 4.



SHELLS OF THE GENUS ACLIS.

FOR EXPLANATION OF PLATE SEE PAGE 438.

DESCRIPTIONS OF NEW HYMENOPTERA. 2.

By J. C. CRAWFORD,

Assistant Curator, Division of Insects, U. S. National Museum.

In this paper 15 new species are described. Many of these were received from the correspondents of the Bureau of Entomology, U. S. Department of Agriculture, for identification, and are of economic importance so that the early publication of their descriptions is necessary in order that the names may be used in economic bulletins.

The comparative measurements used in the description of the new species were made with an eye-piece micrometer used in the number two eye-piece in the binocular microscope.

Superfamily PROCTOTRYPOIDEA.

Family SCELIONIDÆ.

TELENOMUS BENEFACTOR, new species.

Female.—Length about 1.25 mm. Head and thorax black; antennæ brown; legs, including coxæ, flavo-testaceous; pedicel much longer than the first joint of the funicle; first and second joints of funicle slightly longer than broad, the first somewhat longer than the second; third and fourth subquadrate, fifth broader than fourth but not as broad as the next joint, still forming a part of the club; club much broader than the joints of the funicle; head about twice as broad as long; the occiput somewhat flattened; face smooth, the ocellar triangle and caudad of it minutely reticulated, and with scattered, minute, setigerous punctures; mesoscutum and scutellum basally, distinctly rather closely and minutely punctured; apex of scutellum smooth and polished; inflexed sides of pronotum reticulate down to coxæ; mesopleuræ, except a small area at lower front margin, smooth; metapleuræ longitudinally striate on lower half; first segment of abdomen not striate at base; second segment striate basally, the basal half of the striæ large, the apical half finer; abdomen longer than head and thorax together (as 27 is to 17); second segment longer than greatest width (as 14:10).

Male.—Length 0.75 mm. Similar in sculpture to the female; antennæ light brown, the scape and pedicel flavus; pedicel slightly longer than first joint of funicle; second joint of funicle longer than broad, the third subquadrate, the rest transverse; apical joint slightly longer than broad; face almost up to ocelli, cheeks and rear of head almost to upper end of eye flavo-testaceous; segment one of abdomen at sides showing short striæ, second segment slightly broader than long, with short striæ at base; apical segments deflexed, the external genitalia extruded and pointing ventrad.

Habitat.—Gebelein, Egyptian Soudan.

Host.—Eggs of *Tabanus taenicla* P. de Beauvoir.

Types and paratypes in the British Museum (Natural History).

Paratype.—Cat. No. 13688, U.S.N.M.

Described from two females and six males reared by Mr. H. H. King, July 14, 1909, and sent by the Entomological Research Committee (Tropical Africa) for the British Government.

The female of this species is easily separated from that of *T. tabani* Mayr by the lack of striæ at the base of the first abdominal segment; in *tabani* the head and thorax together are as long as the abdomen.

TELENOMUS KINGI, new species.

Female.—Length about 0.75 mm. Black; antennæ and legs, including coxæ, brown; the knees, bases, and apices of tibiæ and the tarsi paler; pedicel much longer than joint one of funicle; joints one and two of funicle slightly longer than broad, the following joints subquadrate; club four jointed, not very much enlarged; head twice as broad as long; head smooth, ocellar triangle with a few scattered, very minute, punctures; mesoscutum polished and with sparse punctures, each puncture bearing a silky white hair; scutellum with similar still sparser punctures, the apical portion smooth; inflexed sides of pronotum along lower margin reticulated; mesopleuræ mostly smooth; abdomen as long as the head and thorax together; first segment of abdomen striate for almost half its length; second segment striate at base; medially a few indistinctly carried beyond the others; striæ somewhat longer than those on first segment; segment two subquadrate, very slightly longer than greatest width (as 7:6).

Male.—Unknown.

Habitat.—Khor Arbat, Egyptian Soudan.

Host.—Eggs of *Tabanus kingi* Austin.

Described from eight specimens reared by Mr. H. H. King, "13. 4. 1910," and sent by the Entomological Research Committee (Tropical Africa) of the British Government.

Type and paratypes in the British Museum (Natural History).

Paratype.—Cat. No. 13687, U.S.N.M.

This species is distinguished from *T. tabani* Mayr by being smaller, with less distinct sculpture of the vertex and mesonotum, and by the short, more uniform striæ on the base of the second abdominal segment.

Named in honor of Mr. H. H. King, who collected the material.

TELENOMUS GOWDEYI, new species.

Female.—Length about 2 mm. Black; coxæ and femora black, tibiæ medially dusky, rest of legs dark testaceous; antennæ brown, the club 5 jointed, base of scape testaceous; pedicel longer than first joint of funicle, first joint of funicle longer than wide, the following joints subquadrate; face along lower inner orbits and the front, reticulate, rest of face smooth and polished; mesoscutum with fine punctures; scutellum smooth; metanotum finely rugose; propodeum coarsely rugose; smooth area around insertion of abdomen extending dorsally to front of propodeum making a conspicuous triangular area; wings slightly dusky; abdomen smooth, the first segment at base longitudinally striate; the second segment over twice as long as wide; segments 1–5 in length in the following ratio: 1:6:4:4:4.

Male.—Length about 1 mm. Similar to the female, the antennæ and legs entirely testaceous; pedicel and joints 1–3 of funicle subequal in length; second segment of abdomen about twice as long as wide; following segments hardly showing.

Habitat.—Entebbe, Uganda, Africa.

Type.—Cat. No. 13653, U.S.N.M.

Paratypes in the British Museum (Natural History).

Many specimens reared from the eggs of *Anaphe infracta*, by C. C. Gowdey and sent by him under number 1325.

In the female the apical segments of the abdomen are often retracted, so that only segments 1–3 show.

Named for Mr. C. C. Gowdey.

Superfamily CHALCIDOIDEA.

Family TORYMIDÆ.

TORYMUS MONTSERRATI, new species.

Female.—Length about 2.5 mm.; ovipositor about 1.5 mm. Green, the propodeum and abdomen more brassy; head finely reticulate and with scattered large setigerous punctures; scape testaceous, pedicel light brown, flagellum dark brown; mesoscutum with fine transverse irregular rugulæ, appearing almost as irregular punctures; axillæ and postscutellum with fine thimble-like punctures; the whole mesonotum with scattered setigerous punctures; propodeum with a very fine reticulation of raised lines; veins brown, the stigmal knob sessile;

coxæ green; femora behind, except tips, green; in front dark brown; rest of legs testaceous; abdomen finely reticulated.

Male.—Length about 2 mm. Similar to the female, the tibiæ brown.

Habitat.—Montserrat, West Indies.

Type.—Cat. No. 13658, U.S.N.M.

Two female and three male specimens sent by Mr. Ballou bearing the additional data "Lime Plot I, March, 1910."

Family ENCYRTIDÆ.

Genus TANAOSTIGMODES Ashmead.

In addition to the difference in venation the males of this genus are also separated from *Tanaostigma* (according to the only male known), by the branches of the antennæ being short, not reaching the club, and by the fifth joint of the funicle being less than twice as long as the fourth.

TABLE OF FEMALES.

| | |
|---|-------------------------------|
| 1. Mostly dark brown or black..... | 2 |
| Largely yellow, sometimes tinged with brown..... | 3 |
| 2. Head entirely dark, scutellum much longer than broad..... | <i>tychii</i> Ashmead |
| Head with yellow bands, scutellum only slightly longer than broad, abdomen with scattered appressed hairs..... | <i>slossonæ</i> , new species |
| 3. Dorsum infuscated with brown, scutellum much longer than broad; marginal vein much longer than stigmal; stigmal longer than postmarginal..... | <i>howardi</i> Ashmead |
| Head and thorax lemon yellow, dorsum of abdomen somewhat brownish; scutellum hardly longer than broad; marginal vein hardly longer than stigmal; stigmal and postmarginal subequal..... | <i>tetartus</i> , new species |

TANAOSTIGMODES SLOSSONÆ, new species.

Female.—Length about 2 mm. Deep brown or brownish-black; face below level of eyes yellow; the oral region somewhat infuscated; a yellow line between eyes, above level of insertion of antennæ, which is about as broad as the black stripe below it; sides of scrobes, a longitudinal stripe on scape, broad lower posterior orbits of eyes for over two-thirds the height of eyes, small spot on upper edge of prepectus, and a narrow line along upper edge of mesopleuræ, light yellow; antennæ brown, the joints of funicle slightly wider than long, the first slightly shorter than the pedicel; head and thorax closely, finely punctured, the punctures almost thimble-like; abdomen with shallow punctures somewhat resembling reticulations by raised lines; whole insect with scattered spicule-like hairs; parapsidal furrows meeting before reaching rear of mesoscutum and continuing as a single line; scutellum slightly longer than broad (as 37:30); pleuræ more brownish, legs light brown; wings hyaline, veins testaceous; marginal vein twice as long as stigmal, the latter slightly longer than postmarginal (30:15:12).

Male.—Length about 1.5 mm. Similar to the female, the scape entirely yellowish; first joint of funicle not longer than the two-ring joints combined; second joint of funicle not twice as long as first; third about as long as one and two together; fourth about as long as two plus three; fifth shorter than three and four together, sixth about as long as third; club distinctly three segmented, about one and one-half times as long as last joint of funicle.

Habitat.—Biscayne Bay, Florida.

Type.—Cat. No. 13660, U.S.N.M.

Three females and one male, two of the females collected by Mrs. Annie Trumbull Slosson, for whom the species is named.

TANAOSTIGMODES TETARTUS, new species.

Female.—Length 1.75 mm. Yellow, including the antennæ and legs, the abdomen above somewhat infuscated; head and thorax closely punctured, the thorax with scattered black hairs, each at point of insertion surrounded by a very small brown spot; parapsidal furrows toward rear faint, apparently meeting at apex of mesoscutum; scutellum hardly longer than broad (29:25); marginal vein slightly longer than stigmal, the latter and the postmarginal subequal (30:15:15); legs with scattered black hairs; sculpture of abdomen resembling reticulations by raised lines.

Male.—Unknown.

Habitat.—Barbados, West Indies.

Type.—Cat. No. 13661, U.S.N.M.

Four specimens sent in by Mr. H. A. Ballou under number 7, with the additional data "On Hibiscus," May 25, 1909.

Family PTEROMALIDÆ.

Tribe RHAPHITELINI.

HABROCYTUS PIERCEI, new species.

Female.—Length about 4 mm. Bluish green, antennæ brown, scape testaceous; pedicel shorter than first joint of funicle; facial quadrangle one-third wider than long; distance from a line joining lower margins of eye to side of clypeus slightly over half the length of eye; left mandible with third tooth at apex broad, blunt; head, dorsum of thorax, including propodeum between the lateral folds, and the pleuræ with thimble-like punctures; pronotum rounded in front; lateral folds of propodeum broad, deep, the carina at the outer edge of these folds extending back on the neck of the propodeum; neck of propodeum with a large basal fovea on each side; median carina on propodeum indistinct; marginal and postmarginal veins subequal, the stigma shorter; femora green; the bases and apices of femora, trochanters in part, and the tibiæ and tarsi, testaceous; segment one of abdomen almost as long as segments 2-4 combined;

fifth segment distinctly longer than fourth, sixth still longer; segments 7 and 8 combines twice as long as 5.

Male.—Unknown.

Habitat.—Tallulah, Louisiana.

Host.—*Anthonomus grandis* Boheman.

Described from four specimens reared by Division of Southern Field Crops of the Bureau of Entomology, U. S. Department of Agriculture. The type and one paratype have Hunter number 1326, collected October, 1909, in lot I 44 *n* and issued March 14 and 22, 1910, respectively. Two paratypes have Hunter number 1934, one collected December 16, 1909, in lot V 1 *a* 33, and issued March 1, 1910; the others collected November 29, 1909, from lot V 1 *a* 22 and issued November 29, 1909.

Type.—Cat. No. 13685, U.S.N.M.

This species resembles *H. phycitidis* and *H. thyridopterigis*, but in both these species the fourth segment of the abdomen is as long as the fifth.

Named for Mr. W. Dwight Pierce, of the Bureau of Entomology, U. S. Department of Agriculture.

Tribe PTEROMALINI.

Genus ZATROPIS Crawford.

When this genus was originally described only the female was known. Since then the opposite sex has turned up in the type species as well as in the new species described below. The male has the antennæ very like those of the female and with three ring joints, a character which readily separates these males from the males of the genus *Catolaccus* and allied genera.

ZATROPIS DEUTERUS, new species.

Female.—Length about 2 mm. Head and thorax brassy green, with fine thimble-like punctures; abdomen bluish green; eyes in dead specimens red-brown; pubescence of head and thorax spicule-like, each hair in a puncture surrounded by a flat polished space; scape and pedicel light testaceous; funicle brown; first joint of funicle about as long as pedicel, following joints of funicle successively slightly shorter; propodeum between the lateral carinæ with shallow thimble-like punctures; median carina distinct; laterad of lateral folds, the surface indistinctly sculptured; neck of propodeum short, finely transversely wrinkled; postmarginal vein about half as long as marginal, the stigmal slightly shorter than the postmarginal; veins light testaceous or whitish; legs, except coxæ, yellowish.

Male.—Length about 1.5 mm. Similar to the female, except in secondary sexual characters.

Habitat.—Antigua, West Indies.

Host.—A cecidomyid larvæ injuring cotton.

Type.—Cat. No. 13659, U.S.N.M.

Many specimens sent by Mr. Ballou, some under note number 901, others without note number.

Family EULOPHIDÆ.

Subfamily ENTEDONINÆ.

Genus PLEUROTROPIS Foerster.

PLEUROTROPIS TELENOMI, new species.

Female.—Length about 1.25 mm. Face below furrow green; rear of head and thorax æneous; scutellum greenish; propodeum blue-green; base of abdomen deep blue, the rest of the abdomen æneous; legs brown, with metallic reflections; tarsi, except apically, whitish; face below V-shaped furrow smooth, except along inner orbits; antennæ green; rear of head with shallow thimble-like punctures; mesoscutum very finely reticulated; posteriorly the rugulæ becoming longitudinal; scutellum laterally with fine longitudinal striæ, the disk smooth; metanotum smooth; propodeum smooth, medially, with two carinæ converging anteriorly and between these a less distinct carina; lateral carinæ distinct; petiole finely rugose; abdomen smooth.

Male.—Length about 1 mm. Similar to the female; head and thorax brassy, the propodeum green, the abdomen purplish; the head below furrow rather coarsely reticulate, above it more finely reticulate; the sculpture of the mesonotum stronger; legs, including coxæ, brown; the space between the two medial carinæ of the propodeum with three indistinct carinæ.

Habitat.—Entebbe, Uganda, Africa.

Type.—Cat. No. 13652, U.S.N.M.

Paratypes in the British Museum (Natural History.)

Many specimens reared from the eggs of *Anaphe infracta* by Mr. C. C. Gowdey, together with *Telenomus gowdeyi*, on which it must be a secondary parasite. The area between the two medial carinæ on the propodeum varies in showing from one to three indistinct carinæ, the type-specimens being as given in the above descriptions. The color also varies considerably especially in the male, being at times very similar to the description given for the female.

Genus HORISMENUS Walker.

In working with these minute forms it is necessary to use the highest magnification of the Zeiss binocular microscope to see certain of the characters such as the sculpture of the first segment of the abdomen.

The following table using in part characters not mentioned by Dr. W. H. Ashmead will separate the females of the species known to

occur in the West Indies. All of Doctor Ashmead's species from the West Indies were described in the genus *Holcopelte*¹ a genus which later Doctor Ashmead considered a synonym of *Horismenus*.

- | | | |
|--|-------------------------------------|---|
| 1. Coxæ white..... | <i>productus</i> Ashmead. | |
| Coxæ not white..... | | 2 |
| 2. Scape white..... | | 3 |
| Scape not white..... | | 7 |
| 3. Face above transverse furrow with weak thimble-like punctures medially, the sides and ocellar triangle smooth, without such punctures; scutellum faintly reticulated; lateral carinæ of scutellum not meeting medially at apex of scutellum; median carina of scutellum not reaching apex.... | <i>cupreus</i> Ashmead. | |
| Face above transverse furrow, usually including ocellar triangle with thimble-like punctures or ocellar triangle reticulated..... | | 4 |
| 4. Scutellum reticulate..... | | 5 |
| Scutellum smooth; first segment of abdomen smooth..... | <i>balloui</i> , new species. | |
| 5. First segment of abdomen punctured..... | | 6 |
| First segment of abdomen reticulate..... | <i>nigroaeneus</i> Ashmead. | |
| 6. Prepectus closely punctured..... | <i>apantelivorus</i> , new species. | |
| Prepectus not punctured..... | <i>cockerelli</i> , new species. | |
| 7. Segment one punctured..... | <i>metallicus</i> Ashmead. | |
| Segment one reticulate..... | <i>nigrocyaneus</i> Ashmead. | |

HORISMENUS BALLOUI, new species.

Female.—Length about 1.5 mm. Deep green, scape and legs except coxæ, white; face above transverse furrow with shallow thimble-like punctures; pedicel shorter than first joint of funicle; mesocutum finely reticulate; scutellum smooth; pleuræ almost smooth; prepectus punctured; petiole hardly longer than broad; segment one of abdomen smooth, about as long as the following segments combined.

Male.—Length about 1 mm. Similar to the female, except in secondary sexual characters.

Habitat.—St. Kitts, West Indies.

Type.—Cat. No. 13654, U.S.N.M.

Three female and two male specimens received from Mr. H. A. Ballou, bearing the additional record "No. 17, L. oleæ on *Spathodea* 14/2/10."

Named for Mr. H. A. Ballou.

HORISMENUS APANTELIVORUS, new species.

Female.—Length about 2 mm. Dark greenish æneous, the scape and legs, except coxæ, white; face above transverse furrow with thimble-like punctures, the ocellar triangle finely reticulate; mesoscutum reticulate, scutellum and axillæ reticulated with impressed lines; median elevation of propodeum narrow, not as wide as the depressions on either side of it; pleuræ smooth, prepectus with fine

¹ Journ. Linn. Soc., Zool., vol. 25, 1894, p. 169 et seq.

thimble-like punctures; first segment of abdomen punctured apically, hardly as long as the succeeding segments combined.

Male.—Length about 1.75 mm. Similar to the female, the scape dark brown with metallic luster, the femora slightly infuscated with brown.

Habitat.—Kingston, Jamaica.

Host.—*Apanteles* (sens lat.), sp.

Type.—Cat. No. 13655, U.S.N.M.

Eight female and three male specimens bearing the Bureau of Entomology, U. S. Department of Agriculture, number 5755, the note stating that the specimens were reared by Prof. T. D. A. Cockerell.

HORISMENUS COCKERELLI, new species.

Female.—Length about 2.25 mm. Green, scape and legs, except coxæ, white; first joint of funicle slightly longer than pedicel; second and third joints of funicle longer than wide; face above transverse carina with thimblelike punctures; ocellar triangle finely reticulate; mesoscutum reticulate, scutellum and axillæ with a reticulation of impressed lines; pleuræ, including prepectus, smooth; median elevation of propodeum wider than the depressions on either side of it; petiole hardly longer than wide; first segment of abdomen punctured apically, about as long as the succeeding segments together.

Male.—Length 2 mm. Similar to the female. The type-specimen lacking the antennæ beyond the pedicel.

Habitat.—Kingston, Jamaica.

Host.—*Apanteles* (sens lat.), sp.

Type.—Cat. No. 13656, U.S.N.M.

Five female and one male specimen bearing the U. S. Department of Agriculture Bureau of Entomology Number 5516, the note stating that the specimens were reared by Prof. T. D. A. Cockerell.

Named for Prof. T. D. A. Cockerell.

Subfamily TETRASTICHINÆ.

TETRASTICHUS ANTIGUENSIS, new species.

Female.—Length about 1.5 mm. Green, the legs, except coxæ, testaceous; the antennæ yellowish, pedicel about as long as first joint of funicle; head finely lineolated, the face above antennæ with large punctures; pronotum finely rugoso punctate, mesonotum with finely longitudinal impressed lines; median area of mesoscutum with a single row of large punctures along the parapsidal furrows; meta-notum rugulose, about half as long as the propodeum; propodeum with a strong median carina and laterally a carina curving outward, these lateral carina centrad of the spiracles; area between the lateral carinæ with thimblelike punctures, space surrounding spiracles

smooth; prepectus, metapleuræ and hind coxæ exteriorly, with thin-blelike punctures; abdomen distinctly shorter than head and thorax combined.

Male.—Length about 1 mm. Similar to the female.

Habitat.—Antigua, West Indies.

Host.—*C. floridensis*.

Type.—Cat. No. 13657, U.S.N.M.

Sent by Mr. Ballou under No. 60 with the date 16/2/09.

This species closely resembles *T. punctifrons* Ashmead, which in addition to the difference in color also has the abdomen slightly longer than the head and thorax together, the propodeum hardly longer than the metanotum and the metanotum with punctures similar to the propodeum.

TETRASTICHUS OVIVORUS, new species.

Female.—Length about 1.4 mm. Dark green, abdomen beyond first segment ænous; legs, including coxæ, light testaceous; antennæ brown, scape and pedicel testaceous; joints of funicle elongate, the first much longer than the pedicel; median and lateral lobes of mesoscutum finely reticulated with impressed lines; sculpture of axillæ more obscure; of scutellum consisting of fine longitudinal lines; median lobe of mesonotum slightly wider than long; scutellum as long as the mesoscutum and as wide between outer pair of grooves as long; median groove of mesoscutum and discal pair of grooves of scutellum well marked; metanotum almost as long as propodeum, both finely roughened; median carina on propodeum distinct; abdomen slightly longer than head and thorax combined, finely reticulated beyond the first segment, not strongly depressed, the sheaths of the ovipositor showing.

Male.—Length about 1 mm. Similar to the female, the first joint of the funicle hardly longer than the pedicel and not as long as the second.

Habitat.—Entebbe, Uganda, Africa.

Host.—Eggs of *Conchyloctenia parummaculata*.

Type in British Museum (Natural History).

Paratype.—Cat. No. 13686, U.S.N.M.

Described from two female and two male specimens reared by Mr. C. C. Gowdy and transmitted by the Entomological Research Committee (Tropical Africa) of the British Government.

Subfamily EULOPHINÆ.

SYMPIESIS FELTI, new species.

Female.—Length about 2 mm. Head deep purplish, the clypeal area green; abdomen brown with green along the sides; face smooth except medially above clypeus, where it is roughened; antennæ sit-

uated well above a line connecting the lower margins of the eyes; antennæ dark brown, scape except tip whitish; pedicel not half as long as first joint of funicle; joints of funicle elongate, the first longer than the second, the third and fourth subequal and shorter than the second; middle lobe of mesonotum and scutellum reticulate with raised lines; lateral lobes of mesonotum reticulate outwardly, the inner margins smooth and with a few setigerous punctures; axillæ smooth, shiny; disk of metathorax smooth, with a median carina; propodeum with a median and lateral carinæ, and slightly back of the middle a transverse one; between the spiracles smooth, laterad of the spiracles with setigerous punctures; neck of propodeum at sides with a flattened plate-like process extending over the base of the coxæ; postmarginal vein almost twice as long as stigmal; marginal vein not much longer than submarginal and not twice as long as postmarginal; legs light testaceous; abdomen smooth, quite hairy at base.

Male.—Unknown.

One specimen from Hudson Falls, New York, May 27, 1910, with the number a2034, reared from *Agromyza melanopyga* in fern leaves.

Type.—Cat. No. 13651, U.S.N.M.

Received through the Bureau of Entomology, from Dr. E. P. Felt, after whom it is named.

NEW TROPICAL MILLIPEDS OF THE ORDER MEROCHETA, WITH AN EXAMPLE OF KINETIC EVOLUTION.

By O. F. COOK,

Of the United States Department of Agriculture, Washington.

EVOLUTION OF USELESS CHARACTERS IN MILLIPEDS.

The adaptive characters of the higher animals and plants, corresponding to differences of habits and external conditions of existence, have furnished the principal arguments for the theory that evolutionary changes of organisms are brought about by the selective action of the environment. A special evolutionary interest attaches to the structural diversities of lower groups like the millipeds because they enable the theory of selection to be tested by application to large series of biological facts.

In comparison with the specialized differences of habits, habitats, and food requirements found among the members of the higher classes of plant and animal life, the millipeds may be said to have an almost complete ecological unity. Nearly all the members of the group have essentially the same habits and live in closely similar environments. They pass their lives buried in the humus layer of the soil or among the dead leaves or other decaying vegetable matter that furnishes their food. With such uniformity of external conditions the influences of natural selection should be expected to work in the same direction, so that the structural unity of the group would be preserved.

The facts do not correspond with this inference from the theory of selection. Elaborate structural specializations have taken place among the millipeds, quite as elaborate as in groups exposed to the selective requirements of specialized external conditions. Darwin and many other writers have argued that evolution would not continue in a group of organisms that remained in a uniform environment. Evolutionary progress in the development of new characters is supposed to be called forth by adaptive response to the stress of external conditions. The theory that selection is the cause of evolution implies that new characters must be useful, but a very large part of the evolution of the millipeds represents the production of characters that seem to be quite useless in any environmental relation.

In a recent number of these Proceedings Gerrit S. Miller, jr., has described examples of divergent evolution under uniform environments in the color characters of the Malayan species of mouse-deer. These are small, nocturnal, forest creatures whose inconspicuous habits might be compared with those of the millipeds.¹

It is the regular rule for related species of millipeds to show such differences of color, not only in neighboring regions, but often in the same localities. With the millipeds the general uniformity of habits makes it also apparent that such nonadaptive differences are not limited to small details of color or proportion, but include elaborate structural specializations, characters of families and orders, as well as of species and genera.

While there can be no absolute certainty that any particular specialization of a milliped or of any other creature is entirely useless, and always has been, the range of speculation regarding the adaptive value of characters is greatly narrowed because of the general uniformity in the habits of the group, a uniformity that must be supposed to have existed in the past as well as in the present. The general relation of natural selection to the evolution of the millipeds is not determined by the usefulness or uselessness of some particular character, but is to be judged from the larger and more general fact that the structural differentiation of the members of the group is out of all proportion to their environmental differences.

Even if it were to be admitted that natural selection had accomplished all that has been claimed for it in the evolution of special characters in specialized environments, as in some of the higher groups, such theories would still be inadequate to account for elaborate diversification among the members of lower groups that have continued in essentially the same environments. General facts of the ecology of whole orders or classes of animals and plants can be appreciated, of course, only by those who have detailed familiarity with such groups. The public can consider only the special cases that may be adduced as illustrations. The example of kinetic evolution afforded by the new Porto Rican milliped does not differ essentially from many other examples of useless structural differences already specified, but this case affords an unusually definite evidence of the uselessness of a very elaborate structural specialization.²

The animal described below belongs to a cosmopolitan tropical group (*Stylodesmoidæ*) characterized by a peculiar roughening of the dorsal surfaces of the segments by a dense felt of short hairs. Small particles of earth are caught and matted into the hairs, so that

¹ G. S. Miller, jr., The Mouse-Deer of the Rhio-Linga Archipelago: A Study of Specific Differentiation under Uniform Environment, Proceedings of the U. S. National Museum, vol. 37, 1910, pp. 1-9.

² O. F. Cook, Evolutionary Inferences from the Diplopoda, Proc. Ent. Soc. Washington, vol. 5, No. 1, 1901, p. 14.

the animal gains not merely a protective coloration, like the surrounding soil, but a firmly attached coating of the actual soil material.

From the evolutionary standpoint the hairy covering that holds the soil particles may be considered as an adaptive character of the same general class as protective colorations and mimetic resemblances. It certainly renders the earth-covered animals much more difficult to collect for scientific purposes than members of other families with clean surfaces. An experiment with one of these earth-covered types (*Stylodesmus*) in Liberia showed that the unpracticed eye could detect the creatures only with great difficulty against their natural background of earth, even after the location of the specimens had been quite definitely pointed out. After my friends had been told how many specimens were under a particular leaf they often took several minutes to find them.

Yet there is nothing to indicate that other families of millipeds have suffered any evolutionary advantage or disadvantage from the lack of the protective covering. There is a very wide range of colors and combinations. Some are black, some white, some with inconspicuous grays and browns. Bright yellows, reds, purples, and even blue shades, are also found that might be considered as sexual attractions or warnings to enemies, were it not for the fact that the animals are all completely eyeless and nocturnal in their habits.

The new Porto Rican milliped¹ is of interest quite apart from the question of the protective value of the earthy covering, which it shares with many related genera. If natural selection by external agencies were needed to bring about changes of characters, no further evolution of the dorsal surfaces of these hairy earth-covered millipeds would be expected after the object of protective coloration had been so perfectly attained. Different environments could make no new demands for more adequate protection, for in this respect the creatures are equally well adapted for every environment in which their other limitations would enable them to exist. They can assume completely the color and texture of any kind of soil in which they may happen to live. And yet evolution has continued to go on underneath this covering of earth.

It seems impossible to imagine that any use can attach to the elaborate and highly specialized lobing of the margins of the segments, the peculiarity that distinguishes the new Porto Rican milliped from the two closely related West Indian genera, *Tridesmus* and *Docodesmus*. For animals with naked surfaces such lobing would involve a practical change in the outlines of the segments and the general appearance of the body, that might be of significance in relation to the external environment, but in the actual case extensive changes

¹ See p. 465.

in the forms of the segments underneath the earthy covering have produced no apparent external result. The hairs that clothe the surfaces of the segments project into the narrow incisions and bridge them over, so that the adherent layer of earth is not interrupted. The gaps in the margins of the segments are narrower than the deeper parts of the incisions, as if to keep the outlines of the segments and the general form of the body unmodified. The practical result is quite the same as though the margins of the segments had remained entire, as in the related genera. It would be difficult to imagine a more gratuitous evolutionary change, by which the structure of the segments could be so elaborately modified with so little effect upon the external form or environmental relations of the body as a whole.

It would be rash to insist upon a generalization from any one example of a useless evolutionary change, or even from any one group of animals in which such examples are so abundant as among the millipeds. But if detailed study of many other groups convinces one that the great majority of the differences that distinguish the species and genera are of the same generally useless, nonadaptive character, it becomes impossible to avoid the inference that evolutionary change is not at all limited to the characters subject to the selective action of the natural environment.

That selection may interfere to retard or forbid the spread of a harmful variation among the members of a species is easy to understand, but no concrete explanation has been offered to show how selection can call forth a new character or even bring about any increased development of a character already in existence. Selection is able, undoubtedly, to raise the average of expression of any preferred character in a species or other group of organisms, either wild or domesticated, by restricting reproduction to lines of descent in which the preferred character is expressed with the greatest regularity. Yet such an increase in the regularity of expression of a character is not the same as the production of a new character or an increase in the development of a character beyond a previous maximum. If further selection be applied to the progeny of individuals selected for the expression of a certain character, still higher degrees of expression may sometimes be found, but this does not prove that the increased expression represents a new character, or that it is due to selection. The same degree of expression might have been found by wider selection among the members of the parent group.

The idea that natural selection is the actuating cause of evolutionary progress lacks evidence of fact and force of logic. The wide range of diversity found everywhere among the freely interbreeding members of wild species forbids the assumption that the intraspecific differences are all of adaptive value or that the natural tendency is toward a stable, uniform expression of characters. The general

facts of diversity and interbreeding support the opposite view that evolutionary change of characters in species is a spontaneous, kinetic process, independent of the selective action of the environment.¹

Recognizing evolution as an antecedent fact, the influence of natural selection can be understood, for it represents the power of the environment to determine the directions that evolutionary progress may take. It is plain that natural selection must favor the expression of characters that prove useful, and forbid or restrict the expression of those that prove harmful. That such a regulation of the characters of a species by the standards of the environment may profoundly affect the subsequent course of evolution is also easy to understand, without supposing that selection actuates the progressive development of the new characters.

The causes of evolution are to be sought, not in the environment, but in the organization of species as groups of individually diverse, freely interbreeding organisms. The results of the evolutionary process, as shown in such groups as the millipeds, indicate that variations not only occur but become established in expression as new characters without having any direct adaptive value for selection to work upon. Thousands of differences between species, genera, families, and orders have come into existence while the environment of the group as a whole has remained practically unchanged. Instead of evolution being limited to the adaptive characters that are fostered by selection there seems to be full liberty of change in all directions that are not too harmful to the environmental interests of the species.

A NEW GENUS FROM PORTO RICO.

The following is a formal description of the animal discussed in the preceding section:

IOMUS, new genus.

Type.—*Iomus incisus*, new species, from Porto Rico.

Diagnosis.—Related to *Tridesmus* Cook, also from Porto Rico, and to *Docodesmus* Cook from St. Vincent, but with the margins of the carinæ deeply incised, the last segment reduced and concealed, the broad trilobed apex exceeded by large subclavate dorsal processes of the penultimate segment.

Description.—Body small, oblong, abruptly rounded at the ends, about four times as long as broad; dorsum rather strongly convex, the carinæ depressed nearly in the direction of the dorsal arch. Dorsum with four longitudinal rows of dorsal tubercles, enlarged into subclavate processes on posterior segments.

Head concealed and compressed under the expanded first segment, facing ventrad; vertex covered to the level of the antennæ with a

¹ O. F. Cook, Methods and Causes of Evolution, Bull. 136 Bureau of Plant Industry, U. S. Department of Agriculture, 1908.

rounded shield of rough black integument; posterior corner somewhat excavate to accommodate the antenna; clypeus of thin, transparent, white, finely rugulose integument, with four equidistant punctuations below; labrum indistinctly tridentate with a transverse row of eight small, setiferous punctuations.

Antennæ rather long and slender, but distinctly clavate and strongly geniculate at joint 4; joint 3 slightly longer than 1 and 2 taken together; joint 5 the longest, about twice as long as joint 4 and about three times as long as 2, 6, or 7. Surface of all the joints densely hirsute with short hairs; joints 4-6 with a single long bristle near the end on the outer face. (See fig. 1.)

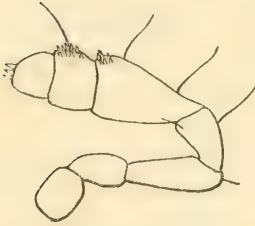


FIG. 1.—*IOMUS INCISUS*. ANTENNA.

First segment distinctly narrower than the second, triangular flabellate, the anterior margin rounded, the posterior very oblique on each side, transverse for a short distance in the middle. Anterior half of dorsal surface occupied by 10 radiating areas separated by

slightly impressed grooves above and below; not incised like the other segments. Posterior part of segment above with 10 tubercles arranged in two transverse rows of four and six; anterior tubercles equidistant, posterior with the inner tubercles very close together and the outer remote from the others.

Second segment with carinæ broadened outward to embrace the first segment, anterior margin entire, lateral margin with two deep incisions, posterior margin with two more shallow incisions. Third segment with carinæ somewhat broader than the fourth, but with anterior and lateral margins similarly incised.

Segments with four longitudinal rows of dorsal tubercles, three tubercles to each row; tubercles of two median rows larger and more regularly placed than those of outer rows, the anterior tubercle somewhat enlarged and projecting forward on anterior segments, the posterior tubercle enlarged and projecting backward on posterior segments. The outer rows well separated from the inner, somewhat curved or oblique, the middle tubercle of the row always largest and somewhat higher up than the posterior tubercle.

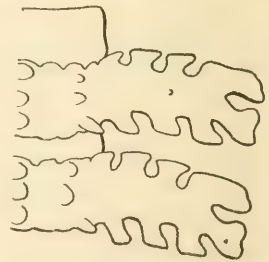


FIG. 2.—*IOMUS INCISUS*. CARINÆ OF SEGMENTS 8 AND 9.

Carinæ nearly as broad as the body cylinder, over twice as broad as long; lateral margin with a deep oval incision near the middle; anterior and posterior margins with three or four similar smaller incisions, nearly closed by the connivent angles of the lobes, but with a broad sinus. (Fig. 2.)

Repugnatorial pores indicated by a small elevation at the base of the posterior lobe of the carina of segments 5, 7, 9, 10, 12, 13, 15-18; these segments also lack a distinct conic tubercle near the middle of the carina, present on other segments. (Fig. 2.)

Supplementary margins divided into minute oblong plates, over twice as long as broad, the distal end entire and rounded.

Anterior subsegments separated by a very deep and abrupt transverse constriction; surface very minutely reticulate-punctate, the markings arranged in transverse rows on the posterior part of the subsegment, the last row very regular and elongate.

Segments 17-19 with last tubercle of dorsal row enlarged into a papilliform or cylindric process projecting obliquely backward; process of segment 18 largest.

Last segment reduced and almost completely covered from above, exceeded by the produced carinae and dorsal processes of segment 19; setiferous apex of segment covered with a broadly rounded median lobe, with a smaller and more pointed lobe on each side, also two distinct setiferous tubercles farther down along the posterior margin. Anal valves nearly flat. Last sternum broadly rounded with two minute setiferous tubercles, the apex not produced.

Sterna very narrow, scarcely as wide as the articulations of the legs; surface smooth, with a rather slight longitudinal and a more distinct transverse impression.

Legs rather slender, joint 2 over twice as long as joint 1, about two-thirds as long as joint 3; joints 4 and 5 short, subequal, rather robust, about as broad as long; joint 6 very slender, longer than joint 3.

Gonopods with a large hollow, clypeate basal joint closing over the small apical joint. Basal joint, viewed from in front, with a rounded-triangular outline, tuberculate near the outer angle and with a small notch near the lower inner angle; broadly and deeply emarginate on the posterior face. Second joint with three simple plates, two narrow on the anterior side and one on the posterior, shorter, broader, and more strongly incurved at apex. The longer anterior plates cross the median line. (Figs. 3 and 4.)

Pocock says that the sterna of *Docodesmus* are "as large as in *Polydesmus*" and that the sternum of the eighth segment is "furnished in front with a pair of tubercles tipped with a brush of hairs, a somewhat similar tubercle being noticeable upon the coxa of the anterior legs of this somite." The sterna of *Iomus* are much narrower than in *Polydesmus* and show no indications of such tubercles either on segment 8 or elsewhere. The sternum of the third segment of the female has a slight transverse ridge and a very broadly trian-



FIG. 3.—*IOMUS INCISUS*. GONOPODS, ANTERIOR SIDE.

gular process in the middle fitting closely against the strongly compressed, square-cornered, thin-edged, basal joints of the legs.

The last segment of *Docodesmus* is larger than in *Iomus* and with two large tubercles on its upper surface, as well as having the posterior border trilobate, but in *Iomus* the tubercles end with segment 19, the last segment having no exposed surface for the accommodation of such tubercles, only the lobed margin being exerted beyond the rim of segment 19. In *Tridesmus* also the last segment is distinctly exposed behind the posterior edge of the penultimate segment.

IOMUS INCISUS, new species.

Type-specimen.—Cat. No. 806 U.S.N.M., collected near Mayaguez, Porto Rico, November 30, 1899, by O. F. Cook.

Length of male 10.5 mm., width 2.8 mm.; female 12.5 mm. by 3.4 mm.

Color of dorsal surfaces black, also the vertex of the head, the under surfaces of the first segment and carinæ and the sides of the segments below the carinæ. Sterna, legs, antennæ, lower half of head, anal valves and preanal scale, whitish or hyaline.



FIG. 4.—*IOMUS INCISUS*. GONOPODS, POSTERIOR SIDE.

Head strongly depressed, much exceeded by the projecting margins of the first segment. Vertex rather strongly convex, sulcus rather deep, surface strongly granular-hispid like the surfaces of the segments. Clypeus smooth and

nearly flat, with three rather sharp teeth in a shallow emargination subtended by ten or twelve widely separated setæ arranged in two rows.

First segment distinctly narrower than the second, but over three times as long in the middle line; anterior margin entire, nearly transverse in the middle, with a shallow notch on each side near the lateral corner.

Segments with dorsal surface densely hispid with minute subcapitate hairs, matted with adherent particles of earth; removal of these shows a granular-uneven surface without distinct markings other than the dorsal tubercles and the marginal lobes. Median rows of tubercles as far from each other as from the lateral rows.

Posterior segments abruptly narrowed from about the seventeenth; the posterior dorsal tubercles distinctly enlarged, those of segments 17–19 forming oblique cylindric-conic processes, largest on segment 18, those of segment 19 set close together, projecting horizontally.

Last segment with a short decurved apex distinctly exceeded by the enlarged posterior tubercles of segment 19; dorsal black, rough-

ened surface of segment slightly produced into a broad median lobe and two smaller lateral lobes; apex proper narrow, smooth and white, slightly decurved, scarcely exceeded by the broad median lobe.

Anal valves horizontal, smooth, slightly convex, with distinctly raised margins, though not very prominent. Preanal scale very broadly triangular rounded, not produced in the middle, with a small setiferous tubercle on each side.

Seven adult animals were obtained, three males and four females, all in one locality a few miles to the northeast of Mayaguez, along the road toward Las Marias.

The type of *Tridesmus sectilis* (Berlin Museum, No. 900) was probably collected near Mayaguez where Krug resided. *Iomus* is apparently more common than *Tridesmus*, for no additional specimens of the latter genus have been obtained during two visits to Porto Rico. A second specimen has been reported, however, from Utuado, by Professor Silvestri, who describes it as a second species of *Tridesmus*, *T. portoricensis*.¹

Other specimens of *Iomus* from Barrio Plata and from Bayamon were supposed at first to represent the same species, but more detailed examination shows definite differences that appear to require taxonomic recognition. As the specimens from the other localities are all females, only preliminary diagnoses can be offered.

IOMUS PLATANUS, new species.

Type-specimen.—Cat. No. 807, U.S.N.M., collected in Barrio Plata, Porto Rico, November, 1899, by O. F. Cook.

Closely similar to *I. incisus*, but somewhat more robust, the females attaining 13.5 mm. by 3.7 mm.

First segment with anterior margin more convex than in *I. incisus*, and slightly but distinctly scalloped.

Middle rows of dorsal tubercles distinctly closer to each other than to the outer rows, instead of at equal distances, as in *I. incisus*.

These differences may appear rather small, but they are quite definitely shown in all the members of the two series of specimens.

Eleven adult female specimens and one immature male were collected under a rotting log. The male specimen has 18 segments and 26 pairs of legs, and measures 5.5 mm. by 1.8 mm. Sternum of segment 7 unmodified; carinae notched as in adult, but the dorsal tubercles somewhat less pronounced; repugnatorial pores more distinct. This specimen is of interest as showing that *Tridesmus* does not represent a younger stage of *Iomus*, a question naturally suggested by the close external resemblance of the two genera.

¹ F. Silvestri, Myriapoda from Porto Rico and Culebra, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 577 August, 1908.

IOMUS OBLIQUUS, new species.

Type-specimen.—Cat. No. 808, U.S.N.M., collected near Bayamon, Porto Rico, November, 1899, by O. F. Cook.

Closely similar to *I. incisus* and *I. platanus*, but slightly more slender, the female measuring about 13.5 mm. by 3.4 mm.

First segment with anterior margin more transverse in the middle than in *I. incisus*, but also more distinctly scalloped than in *I. platanus*.

Dorsal tubercles of middle rows distinctly closer to each other than to the outer rows, but the posterior tubercles of the middle rows much farther apart than the anterior, so that the rows appear distinctly oblique, or converging forward, especially on segments near the middle of the body. On the anterior segments the anterior tubercles of the middle rows are distinctly enlarged. The same tendency is shown to a slight extent in *I. incisus*, while in *I. platanus* the middle tubercle of the inner rows are often somewhat larger than the others as in the outer rows. In the present species the enlarged anterior tubercles are united with two broad median lobes of the margins of the subsegments. There are two somewhat smaller lobes on each side separated by notches like those of the margins of the carinæ. The raised margins project somewhat forward and are more prominent in this species. The surface of the segments shows a suggestion of division into areas by very slight impressed lines. The carinæ appear shorter and somewhat more widely separated than in *I. platanus*, and the marginal incisions are somewhat deeper and more open.

The wider separation of the posterior tubercles of the inner rows in this species may be considered as an approximation to the arrangement of the outer rows, in the same way that the tendency to the enlargement of the middle tubercles of the inner rows in *I. platanus* approximates the specialization of the middle tubercle of the outer rows.

A single female specimen was found on limestone rocks near Bayamon. The color is a deep brown, not completely black, as in the other species, and especially in *I. platanus*.

SYNOPSIS OF WEST INDIAN GENERA OF CHYTODESMIDÆ.

The Chytodesmidæ are more nearly related to the African families Styloidesmidæ and Hercodesmidæ than to the true Cryptodesmidæ of South America. The gonopods agree with those of the African families in having the basal joint large and clypeate to contain the small folded terminal joint, but the segments lack the huge dorsal processes that characterize the African families. The slight development of the dorsal tubercles gives these West Indian genera a superficial resemblance to a third African family, the Pterodesmidæ, but the gonopods are of entirely different patterns in the two groups.

Carinæ divided by deep incisions into numerous lobes; lateral margin with two lobes. Genus *Iomus*, type *I. incisus* Cook, from Porto Rico.

Carinæ with dorsal areas separated only by shallow grooves and notches.

Dorsum strongly and evenly convex, with three transverse rows of convex smooth rounded or polygonal areas; lateral carinæ narrow, depressed, the pores large and distinct. Genus *Chytodesmus*, type *C. laqueatus* (Karsch), from Cuba.

Dorsum slightly convex, with indistinct transverse or radiating, roughened or hispid areas; lateral carinæ broad, nearly horizontal; pores very small.

Poriferous carinæ with four marginal areas or lobes, the others with three; posterior area not strongly enlarged; last segment rather long, truncate at apex, with a distinct rounded lobe on each side. Genus *Docodesmus*, type *D. vincentii* (Pocock), from St. Vincent.

All the carinæ with three marginal areas except at posterior end of body; posterior area much enlarged and somewhat produced on poriferous segments; last segment very small, triangular rounded at apex, entire. Genus *Tridesmus*, type *T. sectilis* Cook, from Porto Rico.

NOTE ON SOUTH AMERICAN CHYTODESMIDÆ.

Another member of the Chytodesmidæ was recognized several years ago in the Berlin Museum among the specimens from Bogota, Colombia, included by Peters in his composite species *Cryptodesmus alatus*. The repugnatorial pores open on a special tubercle near the posterior corner of the carinæ, as in the West Indian genera *Docodesmus* and *Tridesmus*. It differs from these West Indian relatives in the very small size of the body and the very slight and poorly defined dorsal sculpture, consisting of a few large rectangular or polygonal areas. The following characters are described from notes and figures drawn at Berlin:

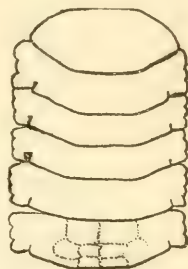


FIG. 5.—STICTODESMUS CREPER. SEGMENTS 1-6. DORSAL VIEW

STICTODESMUS CREPER Cook.

Stictodesmus creper Cook, Brandtia, p. 20, June, 1896.

Body composed of 19 segments, length 4.2 mm., width about 0.8 mm., being the smallest of the specimens originally assigned by Peters to his *Cryptodesmus alatus*.

First segment much narrower than the second, not completely concealing the head and the distinctly clavate antennæ; shape of segment subelliptic, or broadly fusiform, much more nearly symmetrical than usual; a line connecting the lateral angles would nearly bisect the segment. (See fig. 5.)

Segments with two rows of somewhat distinct dorsal areas on each side of the impressed median line; other areas not distinct.

Lateral carinæ less than half as wide as the body-cylinder, deeply grooved and notched in the middle of the otherwise entire posterior

margin; lateral margin slightly impressed and notched to form four rounded lobes on poriferous segments, three lobes on other segments; posterior corners of carinæ narrower than the anterior, not produced backward except on posterior segments. (See figs. 5 and 6.)

Repugnatorial pores rather large, opening toward the side, near the margin of the carina, just in front of the sinus between the third and fourth lobes.

Last segment rather broadly triangular, projecting far beyond the small and slightly produced carinæ of the penultimate segment. (See fig. 6.)

A NEW GENUS FROM ST. PAUL DE LOANDA.

A report was published in 1893 on a small collection of myriapoda obtained from the U. S. National Museum by Mr. Heli Chatelaine at St. Paul de Loanda, West Africa.¹ The specimen to be described

below was not included when the others were sent to me for identification, perhaps because it was broken into so many pieces. It did not come to my attention until five or six years afterwards, when descriptions and figures were prepared, to await another long delay in publication.

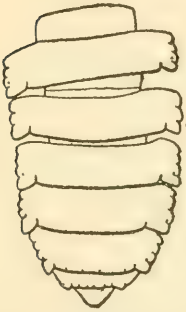


FIG. 6.—STICTODESMUS
CREPER. SEGMENTS
13-19. DORSAL VIEW.

Though the antennæ and most of the legs have been lost, the structural characters of the segments and of the copulatory apparatus show that the animal represents, not only a new generic type, but one that is not closely related to any other hitherto described. The habit is quite similar to that of the other West African and American genera belonging

to the family Pterodesmidæ, but the resemblance proves to be a merely superficial analogy, another of the numerous approximations in external characters between millipeds that belong to unrelated families.

Notwithstanding the flattened dorsum and the broad wing-like carinæ, the affinities of the new genus lie with the Stylodesmidæ, Hercodesmidæ, Chytodesmidæ, and other related families that have the basal joint of the gonopods very large and hollowed out to contain and conceal the much smaller and more complicated distal joint. This feature seems to be diagnostic of a cosmopolitan natural group often confused with the South American family Cryptodesmidæ.

In addition to the large clypeate basal joint of the gonopods, the Stylodesmidæ and their allies are characterized by the prominent positions of the repugnatorial pores, which are borne on special lobes, processes, or tubercles, whereas the pores of the Pterodesmidæ, though seldom or never really absent, as at first supposed, are ex-

¹ Proc. U. S. Nat. Mus., vol. 16, 1893, p. 703.

tremely small and are often quite remote from the margins of the carinæ.

The bodies of the *Stylodesmidæ* and most of their allies are characterized by the strongly convex dorsum and strongly decurved carinæ, which contrast with the flat, depressed bodies and horizontal carinæ of the *Pterodesmidæ* and related types, but this new form shows that no general distinction in the shape of the body can be maintained. It is one of those forms that are usually called aberrant, because they do not readily find places in previous classifications. The study of this type has led to a comparison of members of several other groups and a review of the pertinent literature. It has also been necessary to consider the characters of some undescribed forms that were accessible for comparison.

The new genus is named in honor of Mr. Chatelaine, not only because he collected the specimen on which it is based, but in recognition of his services to science in the study of the language and customs of the natives of Angola, as shown in his writings on these subjects.¹

CHATELAINEA, new genus.

Plate 60, figs. 1a-1n.

Type.—*Chatelainea pterodesmoides*, new species.

Body rather small, oblong, depressed, the segments with broad, nearly horizontal carinæ.

First segment large, projecting in front of the head; subflabelliform, about twice as broad as long, widest near the middle, twice as wide as the head; anterior margin evenly curved, divided by fine notches and radiating impressed lines into 10 subequal lobes; lateral angles rounded.

Segments plane or somewhat concave above, the carinæ slightly elevated; dorsal surface covered with minute hairs and irregular granules or tubercles, becoming definitely raised areas along the margins of the carinæ and in the middle of the dorsum.

Lateral carinæ with three or four deep notches in the posterior border and one or two in the lateral border, deeper on poriferous segments. The lobes between the notches form convex areas distinct from the more irregularly roughened remainder of the surface. The anterior margin is bordered by a narrow raised ridge. (Pl. 60, fig. 1a.)

Repugnatorial pores located on the dorsal surface at the base of the posterior lateral lobe of the carina, which is more deeply notched and more prominent above on poriferous segments. Poriferous lobe shorter than the others on anterior segments, but longer on posterior,

¹ Folk Tales of Angola, Kimbundu Grammar, etc.

and finally extended into a long tooth with an oblique or backward direction. (See pl. 60, fig. 1n.) Pore formula probably normal, but, with so many of the segments separated, all that can be definitely ascertained is that segment 7 has pores, and also the last nine segments of the body, with the exception of segments 14 and 20.

Supplementary margin well developed, consisting of a row of oblong or broadly spatulate appendages, those of the ventral side broader and with truncate entire margins, those of the dorsal side distinctly angled in the middle and with the margins very minutely toothed. (See pl. 60, figs. 1f and 1g.)

Posterior segments gradually narrowed, the last three more abruptly, and with the margins more deeply lobed; the posterior margins more deeply notched or toothed, and the poriferous lobes of the carinæ produced into long recurved spines.

Last segment small, conic, not concealed under the penultimate; the decurved apex ending in a small truncate tubercle, not definitely indicated in the drawing. (Pl. 60, fig. 1n.) Anal valves rather flat, the surface minutely granular but without distinct tubercles.

Preanal scale very broadly triangular, the lateral edges distinctly concave; apex rounded in the middle, but produced on each side into a distinct papilliform tubercle, bearing a long bristle. (Pl. 60, fig. 1i.)

Sterna narrow, with a distinct, but rather narrow and shallow median groove, and a broader and deeper transverse groove; no spines at the bases of the legs. (Pl. 60, fig. 1c.)

Legs rather slender; joint 2 nearly as long as joint 3, slightly exceeded by joint 6; joint 5 nearly twice as long as joint 4 and half as long as joint 6. (Pl. 60, fig. 1h.)

Copulatory legs with a large clypeate basal joint inclosing and concealing the complicated terminal joint. (Pl. 60, figs. 1j, k, l, and m.) The basal joint has a strong tooth near the middle of the posterior border. The upper part of the basal joint, as seen on the mesial face (pl. 60, fig. 1m) has a large depression to accommodate the strongly recurved terminal spine of the apical joint which bends backward toward the depression. Anterior margin of rim of aperture with a triangular median process. (Pl. 60, fig. 1j.)

CHATELAINEA PTERODESMOIDES, new species.

Type-specimen.—Cat. No. 802, U.S.N.M., collected by Heli Chate-laine at St. Paula de Loanda. Accession 23,400.

Length of male probably about 18 mm.; width 3.5 mm.

Color of alcoholic specimen a dull slightly reddish brown, paler below. As in *Stylodesmus* and other related forms, the finely hispid or pilose surface doubtless holds small particles of earth that lend the living animal the exact color of the soil in which it happens to live.

Head small and depressed, facing nearly ventral, concealed far under the projecting margin of the first segment. Vertex rather obscurely and irregularly granular, with a rather distinct rounded prominence at each of the posterior corners, behind the antennæ; surface pilose like that of the segments. Clypeus rather long and narrow, distinctly emarginate on the sides, with a rather broadly sloping transverse ridge; surface nearly smooth, scarcely pilose, labrum narrow, smooth, with a shallow emargination and three rather sharp teeth.

Antennæ rather slender, moderately pilose; second joint over twice as long as the first and somewhat exceeding the third; other joints lost.

First segment distinctly narrower than the second, over half as long as broad, widest in front of the middle. Dorsal surface strongly convex in the posterior part, concave in front, the anterior margin distinctly upturned; irregularly granular, more even on the marginal areas; densely and very minutely pilose.

Second and following segments with three lateral lobes or areas and three or four posterior, the latter separated by larger notches. Surfaces of lobes rather evenly convex, the remainder of the surface roughened with low irregular granules.

Posterior segments somewhat gradually narrowed from about the sixteenth. Carinæ rather more strongly upturned than on the middle segments and with the poriferous posterior lobe produced into a long oblique spine bearing the pore near the base. Posterior margin more distinctly scalloped in the middle than on anterior and middle segments. Segments 18 and 19 have the two middle tubercles of the posterior margin specially enlarged.

Last segment distinctly projecting beyond segment 19 in the middle, though evidently exceeded by the long poriferous tubercles of segment 19, incomplete in this specimen, as the figure indicates. Surface less uneven than on preceding segments, but still distinctly granular and pilose. Two minute setiferous tubercles along the lateral margins on each side below the apex.

RELATIONSHIPS OF THE FAMILY CRYPTODESMIDÆ.

The difficulty of assigning *Chatelainea* to a satisfactory place in the classification is due, in large measure, to the confusion that has been allowed to gather around *Cryptodesmus*, the genus to which some writers might refer *Chatelainea*. This name belongs, in reality, to a little-known South American milliped, but has been used for many and very diverse species from all parts of the tropical world. It is generally considered that the tropical forms referred to the genus *Cryptodesmus* or to the family Cryptodesmidæ constitute a distinct group, but most writers have hesitated to recognize the true extent

of the structural diversities inside this group, perhaps because of the uncertainty that still attaches to the original genus *Cryptodesmus* and the family Cryptodesmidæ.

Comparison of African material with the original specimens of *Cryptodesmus* in the Berlin Museum showed that the reference of African species to this genus was without warrant, and the presence of many constant structural differences among the members of a rich African fauna led to the recognition of a considerable series of new genera, and finally to the grouping of these genera into families. It was also found that some of the tropical American millipeds were much more related to the African genera than the first species that Peters assigned to *Cryptodesmus*, so that some new American genera were established and assigned, provisionally at least, to African families.

As the American fauna becomes better known it appears more and more probable that the original genus *Cryptodesmus* stands well apart from the other members of the series of forms usually associated with it. Indeed, in Pocock's recent treatment of the Central American millipeds in the *Biologia Centrali-Americana* a new family Peridontodesmidæ is established for the genus that seems to be more nearly related to *Cryptodesmus* than any other member of the Central American fauna. The first segment of *Peridontodesmus* is not expanded as in *Cryptodesmus* and the carinæ are broader and more deeply notched, but such differences would not be considered very serious if other features were alike.

It may be that the rough outlines of the first and last segments of the type of *Cryptodesmus* shown on pl. 60, figs. 2a and 2c, will help to explain the tendency to look upon any 20-segmented tropical milliped with a large first segment as a relative of *Cryptodesmus*, and to show at the same time that such conclusions are generally unwarranted. Apart from the broadly expanded first segment, the original type of *Cryptodesmus* does not show any tendency toward either of the two forms of specialization that characterize most of its supposed relatives. The segments do not have radiating marginal areas as in the Pterodesmidæ, nor enlarged dorsal tubercles, crests, or processes as in the Stylodesmidæ, Hercodesmidæ, and Chytodesmidæ. The repugnatorial pores are equally unspecialized. They are not located on the anterior part of the segment as in the Pterodesmidæ, nor on a special lobe or tubercle as in the Stylodesmidæ and their allies, but are located near the margin on a slight elevation, somewhat as in *Scytonotus*. The segments have simple piliferous tubercles as in *Peridontodesmus* and *Scytonotus*, and in the pore characters also there is more agreement with these genera than with the Pterodesmidæ or the Stylodesmidæ. There would seem to be better justification for the recognition of the family Scytonotidæ than for the

family Peridontodesmidæ. *Scytonotus* is a specialized type that certainly stands well apart from the now rather numerous genera of true Polydesmidæ in the structure and sculpture of the segments, as well as in the numerous and highly specialized secondary sexual characters. This has been recognized by Attems in his System der Polydesmiden, where our North American *Scytonotus* is associated with members of the South American family Trachelodesmidæ, though the lack of any true relationship is admitted. The structure of the gonopods of *Scytonotus* is also peculiar in that the basal joint is unusually large and somewhat hollowed out to accommodate the second joint. Though the specialization is not carried to any such extent as in the Stylodesmoid series, the analogy is suggestive. In *Peridontodesmus*, according to Pocock, the basal joints of the gonopods are fused together, a unique condition, as far as known, in the entire order.

A NEW SOUTH AMERICAN GENUS RELATED TO CRYPTODESMUS
AND PERIDONTODESMUS.

The relations between *Peridontodesmus* and *Cryptodesmus* appear to be very close, both in the characters of the segments and in the more significant features of the structure of the gonopods. A Brazilian species described by Attems as *Cryptodesmus pusillus*, though not as similar to *C. olfersii* as its author supposed, is at least to be considered as a member of a related genus. A comparison of Attems's description and figures of *Cryptodesmus pusillus* with notes and drawings made from the type-specimen of *C. olfersii* shows several important discrepancies, though not such as to destroy the probability of family relationship with *Cryptodesmus*.

The body of *C. pusillus* is much smaller and more slender, seven times as long as wide (7 mm. by 1 mm.), instead of about four times (11 mm. by 2.5 mm.), in *C. olfersii*. The segments appear to be relatively longer and narrower than those of *C. olfersii* and the body is said to be broader in front, while that of *C. olfersii* is somewhat narrowed, with the first segment not as wide as the second.

The antennæ of *C. olfersii* are distinctly clavate. Those of *C. pusillus* are large and robust, but the terminal joints are not strongly thickened.

First segment of *C. pusillus* is much more expanded than in *C. olfersii*, semicircular in shape, two-thirds as long as broad; that of *C. olfersii* transversely elliptic, less than half as long as broad. Anterior margin even in both species, bordered in *C. olfersii* by a simple row of flattish granules; smooth in *C. pusillus*, with twenty yellow lobes of the inner tissues showing through the transparent chitin.

Carinæ of *C. pusillus* very angular and with the posterior corners produced; those of *C. olfersii* narrowed and rounded. The delicate,

transparent lateral margins of the anterior carinæ of *C. pusillus* are produced into distinct teeth, each with a large projecting bristle, instead of rather obscurely and unevenly sinuate-dentate as in *C. olfersii*. Posterior margins with fewer and less distinct teeth than in *C. olfersii*.

The segments of *C. pusillus* are distinctly convex in the middle, and the adjacent tubercles of the anterior row run together to form a transverse ridge. Neither of these features was noted in *C. olfersii*, the segments of which have three regular transverse rows of simple granules, each provided with a short hair.

Repugnatorial pores in *C. pusillus* located in distinct furrows that separate the bases of the marginal teeth, in front of the first tooth before the posterior corner. In *C. olfersii* there is no such distinct development of the marginal teeth, and the pores are located on a slight broad elevation, rather close to the margins of the segments.

APOMUS, new genus.

Such differences would seem to require the recognition of a distinct genus, for which the name *Apomus* is proposed, with *Apomus pusillus* (Attems) as the type. Though the specialization of the first segment in *Apomus* is carried even farther than in *Cryptodesmus*, the gonopods are distinctly of the same peculiar pattern as those of Pocock's *Peridontodesmus flagellatus* from Guatemala.

NOTES ON THE SOUTH AMERICAN GENUS CHONODESMUS.

The genus *Chonodesmus*, based on *Cryptodesmus alatus* Peters, from Bogota, Colombia, has been referred to the African family Pterodesmidæ on account of a very close approximation in the form and ornamentation of the segments, and the location of the repugnatorial pores in the anterior part of the carina. Nevertheless, it is possible that *Chonodesmus* belongs to the true *Cryptodesmidæ* or to the *Peridontodesmidæ*, if these groups are distinct. The situation of the repugnatorial pores at the side of a small elevation is much as in *Peridontodesmus* and the gonopods are quite complicated, much more so than those of any of the African genera of *Pterodesmidæ*. The first segment is much shorter than in *Cryptodesmus* and *Apomus*, being less than one-third as long as broad, and the posterior margin is nearly transverse, instead of being turned forward at the sides. The following notes and figures were drawn from the type-specimen in the Berlin Museum.

CHONODESMUS ALATUS (Peters).

Cryptodesmus alatus PETERS, Monatsber. königl. Akad. Wiss. Berlin, 1864, p. 621.

Chonodesmus alatus COOK, Brandtia, p. 23, June, 1896.

Antennæ rather short and robust, distinctly clavate; joints 5 and 6 subequal, much larger than the others; joint 2 only slightly longer

than joints 1, 3, 4, and 7, which are subequal in length. Surfaces of all the joints rather densely hirsute with rather short hairs. Outer side of joints 5 and 6 with a large rounded prominence bearing numerous sense-cones. (Fig. 7.)

First segment suberescentic, very short and broad, only slightly exceeded by the second segment. Anterior margin evenly rounded, lateral corners rather sharp, but scarcely produced; posterior edge with a distinct median emargination and a much slighter and broader emargination on each side of the middle. Surface covered with numerous small convex areas, about twenty along the anterior margin, those of the posterior margin somewhat larger and less numerous. (Fig. 8.)

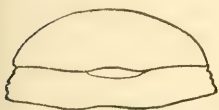


FIG. 8.—CHONODESMUS ALATUS. SEGMENTS 1 AND 2. DORSAL VIEW.

Dorsal surface of the segments occupied by three transverse rows of convex, piliferous areas, smaller and more regular than those of the carinæ. Margins of carinæ divided by radiating impressed lines into broad, slightly angled or rounded lobes, four on the lateral edge and four or five on the posterior. (Fig. 9.)

Repugnatorial pores not opening on the margins of the carinæ, but at the side of a small elevation near the base of the second lateral area, somewhat in front of the transverse middle of the carina.

Last segment with apex rather broadly rounded, only slightly exceeding the broad, triangular projections of the carinæ of the penultimate segment. (Fig. 10.)

It was on this specimen that Peters evidently relied in drawing his description of *Cryptodesmus alatus*, and he stated in particular that his measurements, 11 mm. by 2.7 mm., applied to the largest of the specimens. All the other characters that Peters gives in the original description apply to this individual.



FIG. 10.—CHONODESMUS ALATUS. SEGMENTS 18-20. DORSAL VIEW.

It was on this specimen that Peters evidently relied in drawing his description of *Cryptodesmus alatus*, and he stated in particular that his measurements, 11 mm. by 2.7 mm., applied to the largest of the specimens. All the other characters that Peters gives in the original description apply to this individual.

In the second species of *Chonodesmus*, *C. regularis*, the dorsum is more convex and the carinæ less horizontal, the piliferous dorsal areas are more equal in size, more regularly placed on the dorsal surface, and provided with longer hairs. The body measured 8 mm. by 2.2 mm., but may not have been mature, as only 19 segments were counted.



FIG. 7.—CHONODESMUS ALATUS. ANTENNA.

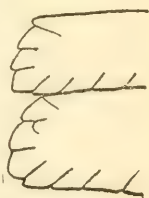


FIG. 9.—CHONODESMUS ALATUS. SEGMENTS 4 AND 5. DORSAL VIEW.

A NEW SPECIES OF PERIDONTODESMUS FROM GUATEMALA.

The small size of the first segment is the most striking external feature that differentiates *Peridontodesmus* from *Cryptodesmus*. Pocock considers this as a primitive character in justifying the erection of a family, but it seems more reasonable to look upon the peculiarities of this segment as specializations in both cases.

PERIDONTODESMUS PURULICUS, new species.

Another species of *Peridontodesmus*, not studied by Pocock, has the first segment less reduced, scarcely narrower than the rounded anterior corners of the second segment, and with the lateral corners less pointed than in the species studied by Pocock, though more specialized in other ways. The teeth that border the anterior margin of the first segment are of different sizes, five or six near the lateral corners being much larger than those farther toward the middle.

The antennæ are distinctly clavate, but not geniculate; joints 1-5 short and robust, increasing in length and diameter; joint 6 about twice as long as joint 5, more than twice as long as joint 7; joint 3 scarcely longer than joints 2 and 4 instead of much longer, as in *P. flagellifer*. These proportions are also widely different from those found in *Scytonotus* where joint 3 is the longest, and joints 4 and 5 are nearly as long as joint 6.

The dorsal tubercles are reduced so that the segments are nearly smooth, though beset with three transverse rows of long hairs. Poriferous segments have the carinæ dark brown like the middle of the body, while segments without pores have yellowish carinæ.

The gonopods end in three prongs, somewhat as in *P. flagellifer*, with the short inner prong sharply decurved, as in that species, but not so much exceeded by the relatively short and straight outer prong. Middle prong expanded into a short, incurved plate, truncate-emarginate at apex, and with the corners produced into small teeth. The long retrorse basal prong of *P. flagellifer* is replaced by a large rounded ventral prominence with a pencil of compact bristles on its distal slope. Female genitalia broadly clavate globose, the apical surface with a deep transverse groove.

This species may be called *Peridontodesmus purulicus*. The type is deposited in the U. S. National Museum (Cat. No. 809), a male specimen collected at Purula, Baja Verapaz, Guatemala, by O. F. Cook in June, 1904, measuring 8 mm. by nearly 2 mm.

The bearing of these new forms upon the classification of *Chatelainea* lies in the fact that their characters connect *Cryptodesmus* with the American series represented by *Peridontodesmus* and *Scytonotus*, and perhaps even with the true Polydesmidæ, rather than with the African and other tropical types which it has been customary to refer to the genus *Cryptodesmus* or to the family Cryptodesmidæ.

In other words, the true Cryptodesmidæ of South America have no close relationship with the African families Pterodesmidæ and Stylodesmidæ.¹

THE SYSTEMATIC POSITION OF CHATELAINEA.

Though the structure of the gonopods shows that the affinities of *Chatelainea* undoubtedly lie with Stylodesmidæ and Hercodesmidæ, rather than with the Pterodesmidæ, the radical difference in the form of the body forbids the reference of the genus to either of the related African families, both of which are characterized by strongly convex segments, strongly depressed carinæ, and longitudinal ridges of large dorsal tubercles or processes.

Chatelainea was compared also with the West Indian genera referred to the family Chytodesmidæ, for in some of these the form of the body approaches that of *Chatelainea*, at least to the extent that the segments are nearly flat, the carinæ nearly horizontal, and the dorsum without any specially developed tubercles or ridges. Two such genera have been known for some years from the West Indies, *Docodesmus* from St. Vincent and *Tridesmus* from Porto Rico. Another genus from Porto Rico, hitherto undescribed, offers a still closer approximation to *Chatelainea*, in that the carinæ are deeply incised instead of having the margins entire or slightly scalloped, a feature that distinguishes it at once from the other West Indian genera of the group.

The carinæ of *Iomus*, as the new Porto Rican genus is now called, are fully as wide or wider than those of *Chatelainea*, and more deeply lobed. The lateral edge, in particular, is cut near the middle by a very deep notch, often completely closed at the margin by the projecting connivent corners of the lobes. The other notches are also partly closed along the edge, somewhat as in *Chatelainea*, but more so. The anterior margin, entire in *Chatelainea*, is notched in *Iomus* like the posterior margin, though not quite so deeply.

The carinæ of *Iomus* are strongly depressed, leaving the middle of the body very convex instead of nearly flat as in *Chatelainea*. Four longitudinal rows of distinctly enlarged tubercles ornament the segments of *Iomus*, but are not developed in *Chatelainea*. Each row is represented by three tubercles on each segment, the two inner rows having somewhat larger tubercles than the outer, and arranged with more regularity. The posterior tubercles of the middle row, on segments 17, 18, and 19 are distinctly enlarged into

¹ The family name Pyrgodesmidæ Silvestri (1896) is used by Pocock in the *Biologia* instead of Stylodesmidæ Cook (1895), on the ground of a conjecture by Attems that the generic name *Stylodesmus* is a synonym of *Urodesmus* Porath, and therefore not available as the basis of a family designation. In reality, *Urodesmus* is quite distinct from *Stylodesmus* and more likely to belong to the Hercodesmidæ than to the Stylodesmidæ. At most it may serve to connect the two groups. This would not interfere with the utility of Stylodesmidæ as a family name, but would only extend its application.

prominent papilliform processes, a tendency only faintly suggested on the posterior segments of *Chatelainea*.

The repugnatorial pores are extremely minute, much more so than in *Chatelainea*, but they occur on the same segments, near the base of the posterior lobe of the carina, near the base of the lateral notch. A further peculiarity of *Iomus* is that the segments without pores, 4, 6, 8, 11, and 14, have a distinct tubercle near the middle of the carina, while such tubercles are usually quite absent on poriferous segments. (Fig. 2.)

The basal joints of the antennæ are rather more slender in *Iomus* than in *Chatelainea*, and the second joint is much shorter than the third, whereas in *Chatelainea* it is distinctly longer than the third.

The first segment of *Iomus* has the anterior margin only slightly upturned and the marginal areas are indicated below by very faint impressed lines. The last segment does not project as in *Chatelainea*, but is covered and concealed under segment 19, somewhat as in *Stylodesmus*.

In the absence of any definite indication of affinity with members of other families of Stylodesmoidæ, it seems to be necessary to consider *Chatelainea* as representing a distinct group.

CHATELAINEIDÆ, new family.

African millipeds of the superfamily Stylodesmoidæ, but with external similarity to the Pterodesmoidæ.

Body small, oblong, depressed, with horizontal or slightly ascending carinæ, deeply lobed on the lateral and posterior margins.

First segment moderately large, rounded in front, covering the rather small, depressed head.

Dorsal surface of segments nearly flat, covered with slightly convex rounded or radiating areas and hispid with short hairs, but without prominent spines, crests or tubercles. Poriferous carinæ deeply lobed on the lateral margins; posterior corners produced into long recurved teeth on posterior segments.

Repugnatorial pores opening on the dorsal surface, near the base of the posterior lobe of the carinæ, not borne on a prominent cylindrical or conical tubercle.

Supplementary margin dissected into minute oblong lobes.

Last segment with a projecting conical apex, not covered by the penultimate segment, but exceeded by the greatly produced posterior corners of the penultimate.

Legs slender, joint 2 nearly as long as joints 3 and 6.

Gonopods with basal joint expanded and hollowed out to contain the small retracted second joint.

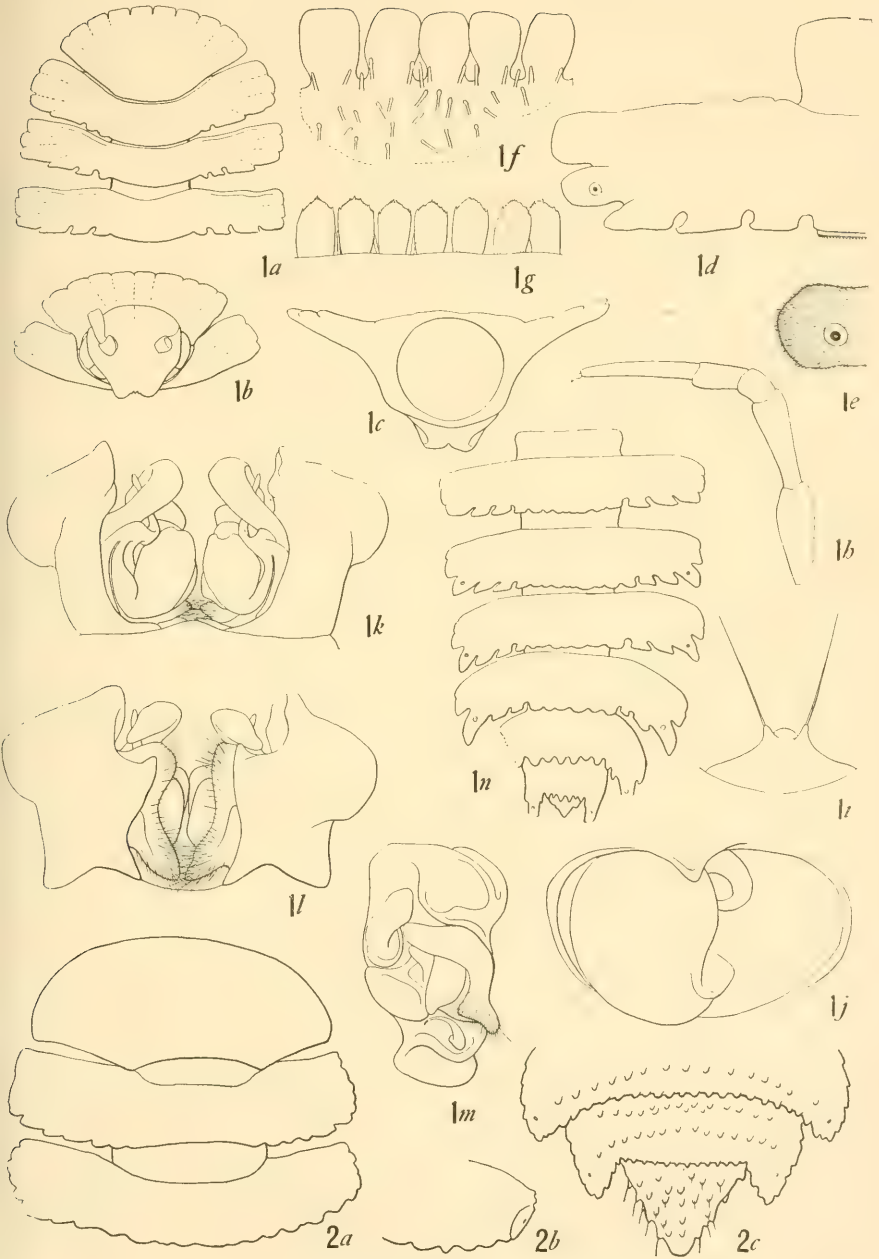
EXPLANATION OF PLATE 60.

Chatelainea pterodesmoides, new species.

- Fig. 1a. First four segments from above.
1b. Head and first two segments from below.
1c. A segment, posterior view, showing the position of the carinæ.
1d. Lateral carina, showing position of repugnatorial pore.
1e. Poriferous lobe of carina more magnified.
1f. Supplementary margin from ventral part of segment, seen from the outside.
1g. Supplementary margin from dorsal part of segment, seen from the inside.
1h. Five distal joints of leg.
1i. Preanal scale with long setæ.
1j. Copulatory leg *in situ*, ventral view, showing rim of aperture.
1k. Copulatory legs, anterior view.
1l. Same, posterior view.
1m. Same, mesial view.
1n. Last seven segments, dorsal view.

Cryptodesmus olfersii (Brandt).

- Fig. 2a. First three segments, dorsal view, drawn from type-specimen in the Berlin Museum.
2b. Carina of segment 5, with repugnatorial pore.
2c. Last three segments, dorsal view.



NEW TROPICAL MILLIPEDES.

FOR EXPLANATION OF PLATE SEE PAGE 473.

DESCRIPTIONS OF ONE NEW GENUS AND EIGHT NEW SPECIES OF ICHNEUMON-FLIES.

By H. L. VIERECK,
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In the present paper a number of names are proposed that are about to be used in a Bulletin by Dr. L. O. Howard and Mr. F. W. Fiske on the importation into the United States of the parasites of the gipsy and brown-tail moths. This Bulletin is to be published shortly by the U. S. Department of Agriculture, Bureau of Entomology.

Family BRACONIDÆ.

APANTELES (APANTELES) LACTEICOLOR, new species.

Female.—Length, 2.5 mm.; in structure and sculpture this agrees best with *A. contaminatus* Haliday as defined by T. A. Marshall; it differs materially, however, in having the propodeum provided with a clearly defined areola flanked by two distinct areas on each side, the boundaries being distinct septa and the interstices smooth and polished; the petiolarea is virtually wanting, the basal area not clearly circumscribed but rugose within; stigma not transparent but paler than the boundary.

Male.—Sufficiently similar to the female to be easily associated therewith; stigma agreeing well with *A. lacteus* as described by T. A. Marshall.

Type.—Male and female, Cat. No. 13072, U.S.N.M.

Type-locality.—Europe, Gipsy Moth Laboratory Cage, No. 515, June 24, 1907.

Paratypes.—Gipsy Moth Laboratory Cage, No. 515 and Nos. 1446, 682, 501, 238, 205, 1042, 1248, and 1295, U. S. Department of Agriculture, Bureau of Entomology.

In some of the female paratypes the stigma is transparent, but not clearly as in the male nor whitish as in the male. Specimens Nos. 1042 and 1248 are labeled "Bred from *E. chrysoorrhoea*."

Out of 78 females studied, four were noted to have a reduction of the postmedian expansion of the first tergite, making the sides nearly parallel and the segment nearly twice as long as wide at apex or at base; this departure from the apparent normal is even more marked in a small minority of the 54 males studied, the parallel sides of the first tergite in these becoming at least twice as long as wide at base or at apex.

PARAPANTELES Ashmead.

In structure and sculpture *Apanteles lacteicolor* Viereck is very similar to the type of *Parapanteles* Ashmead. Typical *Apanteles* and typical *Parapanteles* can be separated only on characters of at most specific value, hence it becomes necessary to include *Parapanteles* as a synonym of *Apanteles* Foerster.

CHELONUS BIPUSTULATUS, new species.

Female.—Length 5 mm.; head black, dullish, sculptured, proportionally as in the genotype; clypeus not compressed apically, the apical edge subemarginate; malar space separated from the face by a bandlike area of fine sculpture; cheeks plicately striate; antennæ black, more than 24-jointed, of the same form as in the genotype; first joint of flagel about two-thirds the length of the scape; mandibles partly testaceous; palpi fuscous; thorax essentially as in the genotype; wings transparent, with a brownish tinge throughout; most of veins and the stigma dark brown; coxæ and trochanters black; basal half of femora entirely or mostly black or blackish, the apical half of the same more or less testaceous; tibiæ yellowish, the hind pair with a subbasal and apical blackish band; tarsi fuscous with the basal joint more or less pale; carapace hardly twice as long as wide, simple at apex, uniformly sculptured and black except for two subbasal yellow maculæ.

Type-locality.—Chile.

Type.—Cat. No. 13796, U.S.N.M.

The type was presumably collected by E. C. Reed.

CYANOPTERIDEA, new genus.

This is the same as *Cyanopterus* Szepligeti not of Haliday.

Type of the genus.—(*Iphiaulax*) *Cyanopterus clypeolus* Szepligeti.

Mr. Roman has pointed out that the genotype of *Cyanopterus* Haliday and *Bracon orbitalis* Cresson are congeneric. With this conclusion (which seems to be justified by Marshall's interpretation of the *Bracon flavator* (Fabricius) Nees as a basis) it would appear that *Cyanopterus* Haliday is the same as *Campyloneurus* Szepligeti, at least in part.

CAMPYLONEURUS Szepligeti.

Campyloneurus SZEPLIGETI, Term. Fuz., vol. 23, 1900, p. 51.

Type.—*Campyloneurus bicolor* Szepligeti by present designation.

Cresson's species *Bracon faustus* and *Bracon mavoritus* are very likely congeneric with *Campyloneurus bicolor* Szepligeti as far as can be gleaned from description of the latter. This being the case the name *Campyloneurus* Szepligeti may be provisionally retained for the species of *Campyloneurus* that have at least the second segment of the abdomen coarsely sculptured. The *Bracon mavoritus* Cresson is synonymous with (*Bracon*) *Campyloneurus rugator* (Say) and *Bracon novitus* Cresson is its male.

CAMPYLONEURUS BICOLORINUS, new name.

This name is proposed to replace *C. bicolor* Szepliget, Term. Fuz., vol. 23, 1900, p. 51, not of Brulle, Hist. Nat. Ins. Hym., vol 4, 1846, p. 412, which has been removed from *Bracon* to *Campyloneurus* by Cameron, Rec. Albany Mus. Grahamstown, Africa, vol. 1, 1904, p. 155.

ORGILUS ASHMEADI, new species.

Female.—Length 3.5 mm; tegument mostly smooth, finely granular, subopaque, with inconspicuous whitish pubescence, and stramineous; malar line hardly greater than the greatest diameter of the scape; face mostly shining, with indistinct punctures which are on an average three to four puncture widths apart; second joint of m. p. six to eight times as long as thick; flagel more than 29-jointed, somewhat testaceous beneath, brownish above, the first joint at least five times as long as thick; inner side of scape nearly twice as long as the outer side; scape and pedicel brownish above; mesonotum mostly blackish, notauli uniting to form an arcuate impression near the hind third of the dorsulum; furrow between the scutel and dorsulum polished and traversed longitudinally by four nearly equidistant raised lines; scutel brownish; propodeum brownish behind, with only the median longitudinal and basal transverse carinæ present, the former incomplete, extending, but for an interruption near the middle, from the basal transverse carina to the posterior edge of the propodeum; radius attaining a point as near or nearer to the tip of the wing as the transverse cubitus is distant from the stigma on the radius; cubitus not prolonged beyond the transverse cubitus; first discoidal cell forming a trapezium; first abscissa of cubitus a little shorter than the recurrent vein, the latter a little shorter than the first abscissa of the basal vein which latter in turn is a little shorter than the basal vein; second discoidal cell trapezoidal with its longest sides parallel and at least three times as long as the nervulus; middle and hind femora more or less brownish at tip; hind tibiæ blackish; all tarsi brownish to blackish; first segment nearly twice as long as broad at apex, the outer edge of the first plate virtually straight throughout, first segment nearly or quite as long as the two following segments combined; tergum granular, medially more or less tending toward striation; all but the less conspicuous tergal segments at tip of abdomen, dark brown to blackish with a yellowish margin all around the segment; the inconspicuous segments stramineous and with the first tergal segment not margined with yellowish laterally beyond the base; sheaths of the ovipositor approximately as long as the tergum.

Male.—Length 3.5 mm. Sufficiently similar to the female to be readily associated therewith.

Type.—Cat. No. 13800, U.S.N.M.

Type-locality.—Manila, Philippine Islands.

Thirteen specimens collected by Father Brown.

Named for Dr. W. H. Ashmead.

ZELE ROSENBERGI, new species.

Female.—Length 11 mm.; compared with *Zele testaceator* Curtis this species may be described as follows: clypeus with the apical margin rather reflexed; scape and pedicel combined apparently not as long as the first joint of the flagel but obviously longer than the second joint of the flagel; vertex with a blackish band extending from eye to eye; thorax rather reddish; radius in hind wings practically straight and gradually diverging from the anterior margin of the wing; second discoidal cell completely closed; wings tinged with fuscous, veins dark brownish; stigma stramineous, infuscated; fore- and mid-coxæ rather stramineous; femora rather reddish; at least mid- and hind-tibiæ reddish, infuscated, their tarsi and spurs rather blackish; apical third of propodeum separated from basal two-thirds by an irregular transverse carina; upper half of abdomen rather infuscated; sheaths of the ovipositor approximately as long as the fourth dorsal segment.

Type.—Cat. No. 13797, U.S.N.M.

Type-locality.—Chanchamayo, East Peru.

Collection Rosenberg.

FAMILY ICHNEUMONIDÆ.

ANILASTUS TRICOLORIPES, new species.

Male.—Length 4.5 mm.; briefly characterized by the mostly black or blackish coxæ, the rest of the fore- and mid-legs being mostly yellowish to testaceous, the rest of the hind legs mostly black, the basal sixth of the hind tibiæ yellowish white, the spurs of the same whitish; costulæ not fully developed or merely indicated; basal area parallel sided, narrowly oblong, so that the bounding carinæ are almost in apposition; carina from the basal area to the insertion of hind coxæ distinct throughout.

Type.—Cat. No. 13799, U.S.N.M.

Type-locality.—Europe, Gipsy Moth Laboratory Nos. 1079 and 1065, U. S. Department of Agriculture, Bureau of Entomology.

In a paratype there is a more or less developed lateral longitudinal carina and an arcuate carina between the areola and petiolarea, also the basal area is triangular, indicating considerable range in the variation of the carinæ of the propodeum.

HYPOSOTER DISPARIS, new species.

Female.—Length 6 mm.; black; covered with an appressed silvery pubescence that is nowhere so dense as to obscure the tegument except when viewed in certain lights; cheeks in the middle nearly two-thirds as wide as the eye as seen from the side; malar line about two-thirds as long as the mandibles are wide at base; clypeus depressed along the anterior margin, which latter is nearly straight, lateral suture represented by a smooth line that is not appreciably

longer than one-third the malar line; scape and pedicel yellow in front, brown behind excepting the apical edge which is testaceous; mandibles yellow except apically, where they are castaneous; palpi yellowish; inner edge of eyes slightly shallowly impressed above the middle; greatest diameter of lateral ocellus not as long as the ocellular line, being only about two-thirds as long; lateral ocellar line as long as the greatest diameter of the lateral ocellus, the postocellar line nearly twice as long as the lateral ocellar line, costula developed, extending to the lateral longitudinal carinæ, second abscissa of radius straight as compared with the first abscissa and about twice as long as the same, stigma at least three times as long as wide or high, areolet oval, punctiform, almost obliterated, the petiole of the same several times longer than the areolet; outer edge of recurrent vein, where it joins the cubitus, on a line with the outer edge of the areolet, the recurrent vein oblique below and extending downward and outward; nervellus extending upward and slightly inward from the submedian vein, which latter is slightly prolonged beyond the former, the nervellus not broken but straight or nearly so; claws pectinate basally; tubercles, tegulæ, distal trochanters, mid- and hind-tibiæ mostly yellow; fore- and mid-coxæ pale, almost castaneous; proximal trochanters, femora, and tarsi of fore- and mid-legs, yellowish to testaceous; the tarsal joints of the mid-legs inclining to dark brown toward the end joint, which latter is blackish; fore tibiæ yellowish in front, darker behind; hind coxæ and femora reddish, infuscated apically; hind tibiæ brownish at base and with the apical third mostly infuscated; hind tarsi similarly colored to the mid-tarsi, but more darkly brownish; tibiæ of mid- and hind-legs sparsely spinose; spurs yellowish; areopetiolarea transversely wrinkled; narrowest part of petiole furrowed laterally; petiole behind the spiracles or postpetiole a little narrower anteriorly than posteriorly, nearly quadrate, half as long as the rest of the petiole and nearly four times as wide at apex as the narrowest part of the petiole; second dorsal segment about as long as wide at apex and about half as wide at base as at apex, its thyridia irregularly rounded and twice as far or a little farther than twice as far from the base as from the lateral edge and about one-sixth as wide as the second dorsal segment is wide at base, spiracle in or a little beyond the middle and about twice as far from the lateral edge as are the thyridia; third dorsal segment nearly parallel-sided, rather compressed apically and about three-fourths or four-fifths as long as the preceding segment; postpetiole finely reticulated, rest of dorsal segment finely sculptured; thyridia and greater part of apical two-fifths of second dorsal segment testaceous; ovipositor when in the resting position hardly exerted, straight and sharp, translucent brownish; sheaths clavate and toward the apex directed slightly upward; plica mostly yellow.

Male.—Differs little from the female; it is noteworthy, however, that in the male the transverse wrinkles are virtually wanting in the areopetiolarea of the type, that the spiracle of the second dorsal segment is a little before the middle and almost adjoining the lateral edge, and that the pale border of the second dorsal segment is invaded medially by black pigment.

Type.—Cat. No. 13074, U.S.N.M.

Type-locality.—Europe, Gipsy Moth Laboratory, No. 529, Aug. 20 and Nov. 2, 1908; U. S. Department of Agriculture, Bureau of Entomology.

This species bears a close resemblance to *Phobocampe crassiuscula* (Gravenhorst).

PIMPLA (PIMPLA) PORTHETRIÆ, new species.

Male.—Length 7 mm.; compared with *P. instigator*, this species differs chiefly as follows: Antennæ entirely black; face dullish, more pubescent; fore and mid legs beyond the trochanters rather yellowish, excepting the mid femora which are infuscated basally and the claws and pulvilli which are blackish; hind legs black throughout except the extreme base of their femora which is yellow, the spurs which are brownish and the claws which are castaneous apically; metapleuræ not striate throughout; dorsal segments apically more or less edged with yellow or yellowish.

Type.—Cat. No. 13077, U.S.N.M.

Type-locality.—Japan, ex *Porthetria dispar*, Gipsy Moth Laboratory No. 1825, U. S. Department of Agriculture, Bureau of Entomology.

PIMPLA (PIMPLA) DISPARIS, new species.

Female.—Length 15 mm.; in size, structure, and sculpture, as well as in color, very like *P. examiner* Fabricius, from which it differs chiefly as follows:—sides of propodeum separated from the rest by a rather distinct angulation, the propodeum not rounded off domelike; fore legs with their proximal trochanters yellow beneath, their femora yellowish above, apically; mid-tibiæ mostly reddish, infuscated basally, without a pale band; hind legs with more or less of the apical third of their femora black, their tibiæ and tarsi entirely black or blackish.

Male.—Antennæ entirely black or blackish in the basal third as in the female, the apical two-thirds becoming brown, legs colored as in the female.

Type.—Cat. No. 13078, U.S.N.M.

Type-locality.—Japan, ex *Porthetria dispar*, Gipsy Moth Laboratory Nos. 1650, 1825, 1647, U. S. Department of Agriculture, Bureau of Entomology.

ON THE SUPPOSED ORIGIN OF THE MOLDAVITES AND LIKE SPORADIC GLASSES FROM VARIOUS SOURCES.

By GEORGE P. MERRILL,

Head Curator of Geology, U. S. National Museum.

Peculiar pebbles of a greenish, chrysolite-like glass found in the gravels in regions remote from volcanoes or manufactories attracted the attention of observers in Bohemia and Moravia as long ago as 1787. The literature since that date contains numerous references to these and somewhat similar occurrences in India, Australia, and other widely separated localities, the descriptive matter as a rule being accompanied by speculations regarding the ultimate source of the materials. It is the purpose of the present paper to discuss these various finds with particular reference to their origin, and incidentally to describe several allied forms concerning the nature of which there is apparently no question.¹ Inasmuch, however, as no object of this nature has yet been described in America, and as, consequently, its literature is almost entirely silent on the subject, a brief review is perhaps admissible here.

In Moravia and Bohemia the objects are found with quartz pebbles in the late Diluvian and Tertiary conglomerates, but are never referable directly to the same. In Java they are found in Quaternary tuffs and in the platinum mines southeast of Borneo. On the island of Billiton they are found in the Quaternary and perhaps Pliocene tin-bearing gravels. In Australia they have been found mainly on the surface of the ground, and no positive proof of their existence in Tertiary beds has as yet appeared. According to information received from Mr. George W. Card, of the Mining and Geological Museum, Sydney, the examples from Bimbowrie in southern Australia were found on a plain thickly covered with weathered quartz which resulted from the denudation of the adjacent quartz reefs. Most of them were broken and shattered as though by a fall; all lay loosely on the surface.

¹ For a full bibliography of the subject up to and including 1898, see Franz E. Suess, *Die Herkunft der Moldavite und verwandter Gläser*, *Jahrb. d. k. k. geol. Reichsanstalt*, Heft. 2, vol. 50, 1900, pp. 193-381. This includes 55 titles referring to the occurrences in Europe, the Sunda Archipelago, and Australia. A bibliography of the Australian and Tasmanian occurrences is given by R. H. Walcott in his paper on *The Occurrence of So-called Obsidian Bombs*, in the *Proc. Roy. Soc. Victoria*, 1898, pp. 23-52.

In appearance and general physical properties these various bodies from the widely separated sources possess certain points in common, but are yet so different in appearance that examples from any one locality are readily recognized. The Moravian and Bohemian forms, as will be noted by reference to pl. 61, figs. 4-6, are more or less rounded pebbles or flattened slag-like masses, the surfaces of which are pitted in a way which has been compared by some writers to the thumb-like pittings on meteorites. In addition to this, they are dulled and rendered opaque through abrasion from other stony particles very much like ordinary pebbles from the bed of a stream. In some instances they are deeply cut or notched as in fig. 5. The colors are chrysolite green, and the refractive index so high that they have in some instances been cut and utilized as gems.

The examples from Billiton, shown in pl. 61, figs. 1-3, are much more remarkable both on account of their shape and the extraordinary groovings which traverse the surface in all directions. They are of a deep, lustrous black color and translucent only on the thinnest edges.

The Australian and Tasmanian occurrences have more the appearance of water-worn pebbles which have been abraded by wind-blown sand (pl. 61, figs. 7-9). These are also black and opaque excepting on the thinnest edges. In all, the glass is wholly amorphous without trace of the trichites so characteristic of obsidian and other volcanic glasses. A few characteristic forms only are shown on pl. 61 of this paper; for a complete series the reader is referred to the work of Franz Suess already noted.

Chemically, as will be noted in the selected analyses referred to later, these forms are all acid glasses approximating in composition the glassy forms of terrestrial rhyolites but unusually rich in lime and magnesia. They are also remarkable for their small water content as indicated by loss on ignition, and their high fusing point.

In none of the occurrences are the objects found in regions of volcanic rocks and under conditions which seem to render it at all likely that they are of local derivation. It is seemingly impossible to conceive of their having been ejected as volcanic bombs and drifted by winds, and equally impossible, apparently, that they should belong to either stream or glacial drift. An artificial origin is likewise considered impossible by the majority of those who have given the subject consideration, and of late those who should be best qualified to judge have been disposed to consider them as of a meteoric nature. It is with especial reference to this view that the accompanying paper has been prepared.

Aside from the conditions under which these objects (which have come to be known under the names of "Moldavites," "Billitonites," "Australites," "Obsidianites," and "Obsidian bombs," and which

Suess has suggested should all be included under the name of "tektites"), are found, their most striking characteristic is the peculiar markings, which, in the case of those of the island of Billiton, it would seem well-nigh impossible to explain in the present condition of our knowledge. Suess, to whose monograph I am indebted for the most detailed and comprehensive of recorded observations, regards the markings, or sculpturings, and those of "tektites" in general, as undoubtedly a consequence of their mode of origin, and as furnishing conclusive evidence of their ultra-terrestrial source. To this conclusion the present writer, as will be observed, takes decided exception, and has sought rather to explain them by comparing them with markings on pebbles of various kinds, concerning the origin of which there is no question.

(1) *Obsidian pebbles from near Cali, Department of Cauca, Colombia, South America.*—These were received at the Museum from a Mr. B. S. Hobbs through Dr. George F. Kunz, with the simple labeling "Obsidian"¹ from the locality above given. Nothing is known regarding their occurrence, nor have I been able to get in communication with Mr. Hobbs with a view of acquiring further data.

As shown in the illustrations (pl. 62, figs. 1–2) of two of the larger forms, the specimens are roughly spherical, each showing on one side a flattened area as though it had at some time been attached to a larger mass or had remained in one position during the etching process, since the larger grooves are entirely absent from these portions. The surface markings are of three kinds: First, those which appear like original conchoidal fractures, the sharp angles of which have been reduced by corrosion; second, a series of shallow pits and grooves which are distributed fairly uniformly over the entire surface except the flattened portion mentioned; and, third, a very fine stipple-like pitting which gives the surface a shagreen-like appearance. This shagreen effect with numerous small, nearly circular, shallow pits occurs also on the flat areas where the larger groovings are lacking as already stated. The colors are dull black, but by transmitted light smoky brown. These two larger forms are roughly 20 and 30 mm. in diameter, and weigh 12 and 30 grams, respectively. Thin sections under the microscope show a faint smoky glass almost completely isotropic, but with an occasional minute, colorless, doubly refracting point too small for satisfactory determination. A peculiar series of anastomizing cracks much resembling the crackle structure on certain porcelain glazes, traverses the section in all directions.

The composition of this glass, as shown by an analysis of a portion cut from the larger of the specimens, is given in column I below. In

¹ Since the above was written, but before this paper was sent to press, I received from Dr. J. Woldrich, of Prag, a copy of his *Beitrag zur Lösung der Tektitfrage*, in which this and the Arizona samples are referred to. It will be observed that I still hold the opinion expressed in my letter to Doctor Woldrich and by him quoted.

columns II to IV are given analyses of examples of tektites from Tasmania, Australia, and Bohemia for purposes of comparison. It may be well to note, incidentally, that H. S. Summers has discussed the various published analyses of the Australian "obsidianites" from the standpoint of the modern classification, and relegates them to the classes almerose, riesenose, urallaose, and piemenose.

Analyses of Tektites.

| Constituent. | I. | II. | III. | IV. |
|--------------------------------------|--------|--------|-------|--------|
| SiO ₂ | 75.87 | 69.80 | 76.25 | 77.96 |
| Al ₂ O ₃ | 14.35 | 15.02 | 11.30 | 12.20 |
| Fe ₂ O ₃ | 0.22 | 0.40 | 0.35 | 0.14 |
| FeO..... | | 4.65 | 3.88 | 3.36 |
| MgO..... | 0.29 | 2.47 | 1.48 | 1.48 |
| CaO..... | 0.00 | 3.20 | 2.60 | 1.94 |
| Na ₂ O..... | 3.96 | 1.29 | 1.23 | 0.61 |
| K ₂ O..... | 4.65 | 2.65 | 1.82 | 2.70 |
| H ₂ O+100°..... | 0.33 | | 0.32 | |
| H ₂ O-100°..... | | | 0.02 | |
| TiO ₂ | Trace. | 0.80 | 0.65 | |
| MnO..... | | 0.18 | 0.06 | 0.10 |
| SO ₃ | 0.23 | | | |
| Total..... | 99.90 | 100.37 | 99.96 | 100.49 |

I. Obsidian pebble. Colombia. Analyst, J. E. Whitfield.

II. Obsidianite. Upper Weld, Tasmania. Analyst, W. F. Hillebrand.

III. Obsidianite. Near Hamilton, Victoria. Analyst, G. Ampl.

IV. Moldavite. Tribitsch, Bohemia.

Although data are lacking regarding the mode of occurrence of this Colombian material, it is at once evident that we are dealing with a not unusual type of terrestrial obsidian.

(2) *Obsidian pebbles, Clifton, Arizona* (Cat. No. 53676).—These pebbles were received at the Museum in 1889 from Mr. Frank Keppler. There is apparently no question but what they are water-worn and corroded pebbles of ordinary obsidian. They are dark, smoky black in color, and show under the microscope the characteristic black hair-like trichites. The surfaces are roughened by pits and grooves, as shown somewhat enlarged in pl. 62, fig. 3. In addition the entire surface is shagreened.

(3) *Obsidian pebbles, near Marsh, Idaho* (Cat. No. 77784).—These pebbles, again, are of ordinary black obsidian, and were collected by Dr. W. Lindgren, of the U. S. Geological Survey, in gravel beds some $4\frac{3}{4}$ miles north and 20 degrees west of Marsh. The surfaces, as shown in pl. 62, fig. 4, are everywhere pitted and grooved, but the elongated, curvilinear, and lunar crater forms so characteristic of the billitonites are quite lacking. The surfaces are coated with a thin, mammilated crust, which is in part a secondary deposit of iron.

(4) *Obsidian pebble, High Rock Canyon, Nevada* (Cat. No. 35270).—This pebble (pl. 62, fig. 5) is of a coal black obsidian, only faintly translucent on the thin edges. The surface, it will be noted, is etched in a manner strikingly suggestive of the billitonites, even to the nearly

circular *lunar crater* forms, as they may be termed. The surface is also considerably abraded as though the pebble had been rolled about on a beach, and the bottoms of the grooves, or flutings, are coated with a dull brown-red material, which seems to be an original constituent rather than an extraneous substance deposited from the water as was at first supposed. It is probably a devitrification product similar to that found in the lithophysæ of obsidians. The specimen, which is about 12 cm. by 9 cm. by 4 cm. in thickness, was brought in many years ago by Prof. I. C. Russell and is labeled simply "Obsidian pebble," and from the locality above given.

These same markings I find roughly simulated on some large weathered obsidian pebbles sent me by Dr. J. Aguilera from between Guajolote hill and Cuyamaloya, Hidalgo, Mexico.

(5) *Obsidian, near Myvatu, Iceland* (Cat. No. 77616).—Perhaps the most strikingly billiton-like markings found on any of the terrestrial rocks which have come under the author's observation are those on some obsidians brought by Dr. F. E. Wright from a flow at Hrafninnuhyggur, near Myvatu as above noted. The specimens were collected by Doctor Wright in 1909, and briefly described by him at the December, 1910, meeting of the Geological Society of America, an abstract of three lines only appearing in the bulletin for that year. The material is a highly lustrous jet black glass, the outer surfaces of which are grooved and etched to a maximum depth of 2 or 3 mm., as shown in pl. 62, fig. 6. Not only are the lunar crater forms here in evidence, but there are also elongated, nearly straight grooves which, but for the position they occupy on the surface, might at first be thought to have been produced by the scoring of one mass against another while in a plastic condition. On one surface of this specimen, which unquestionably represents a more recent fracture than that of the surface shown in the figure, are found only the minute circular pittings such as were described as occurring on the flattened areas of the specimens from Colombia.

To still further test the possibilities of a terrestrial origin, fragments of dark obsidian from near Reno, Nevada, and Yucca, in Mohave County, Arizona, were submitted for a few days to the action of dilute fluorhydric acid. The resultant forms are shown in figs. 7-9 on pl. 62, fig. 9, it will be noted, compares very closely with the slag-like pieces in fig. 6 of pl. 61.

In referring to the above described materials attention needs first to be called to the fact that the markings on these pebbles and obsidians of known terrestrial origin more closely agree with those on the tektites than do the tektites from various localities agree among themselves; and, further, that the etchings produced by action of fluorhydric acid are practically indistinguishable from the markings on some of the moldavites. Further than this, the markings on the

tektites from various sources are so wholly unlike that it is impossible to conceive of their having a common origin, or been formed through the same agencies, and above all it is to be noted that in no case do they resemble the flutings which are characteristic of known meteorites. This, it seems to me, can not be accounted for on the ground of their superior refractibility, but as rather indicating an entirely different origin. Further than this again, the smaller meteoric stones, those corresponding in size with the tektites, rarely if ever show pittings and flutings. It is only the larger forms apparently which hold their orientation for a sufficient length of time for flutings to develop. The smaller forms are mere rounded blebs as is abundantly illustrated by the hundreds of individuals constituting the Pultusk and other noted falls. I can not, therefore, at all agree with Suess in his conclusions on this branch of the subject. Whatever may have been their original source, the Bohemian and Moravian specimens are now simply water-worn pebbles of weathered glass, originally etched by corroding vapors or solutions, the results being indistinguishable from those produced by artificial etchings on obsidian with fluorhydric acid. The Australian forms are likewise, to me, simply pebbles of glass which have been water worn or abraded by wind-blown sands. In their contours there is nothing even suggestive of meteoric markings, nor do I find any semblance of such an origin so far as the surface markings alone are concerned in the examples from Billiton. I do not, however, agree with Dr. G. F. Kunz¹ in regarding the pittings as due to "large bubble cavities that have been broken into by attrition."

In the above, it will be noted, I do not attempt or wish to controvert the theory of a cosmic origin for these very remarkable and interesting bodies. Until, however, such shall be seen to fall, it would seem that the explanation of their source or origin is to be found only in the conditions under which they occur and their somewhat anomalous composition.

EXPLANATION OF PLATES.

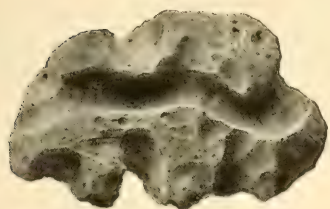
PLATE 61.

- Figs. 1 to 3.—Billitonites from the island of Billiton.
 4 to 6. Moldavites from Moldavia and Bohemia.
 7 to 9. Australites and an Obsidian button from Australia.

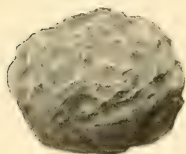
PLATE 62.

- Figs. 1 and 2. Moldavite-like Obsidian pebbles from Cali, in Colombia, South America.
 Fig. 3. Obsidian pebble from Clifton, Arizona.
 4. Obsidian pebble from near Marsh, Idaho.
 5. Obsidian pebble from High Rock Canyon, Nevada.
 6. Obsidian from Obsidian flow near Myvatu, Iceland.
 7-9. Obsidian pebbles etched by fluorhydric acid.

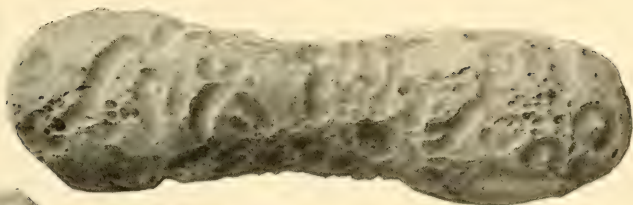
¹ Twentieth Ann. Rep. U. S. Geol. Surv., part 6, p. 594.



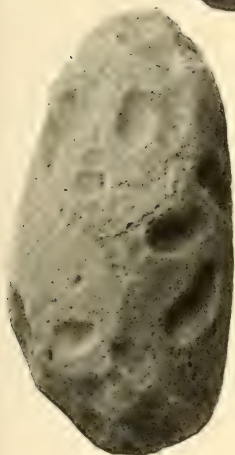
1



2



3



4



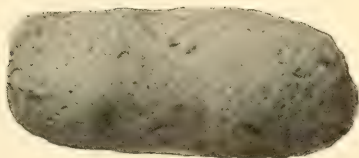
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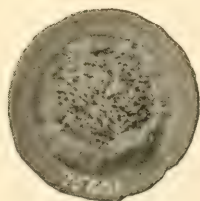
6



7



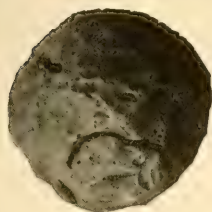
8



9

MOLDAVITES AND LIKE SPORADIC GLASSES FROM BILLITON AND AUSTRALIA.

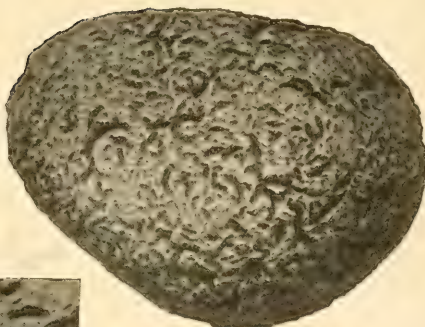
FOR EXPLANATION OF PLATE SEE PAGE 486.



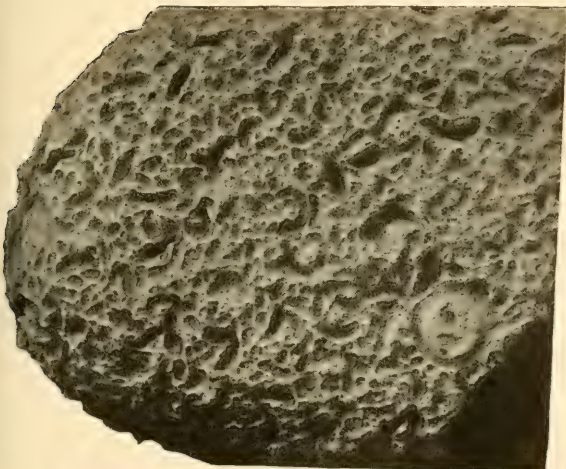
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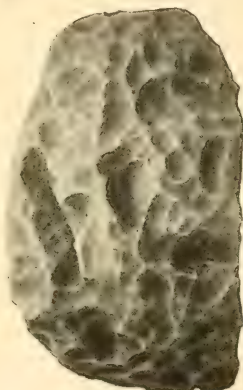
2



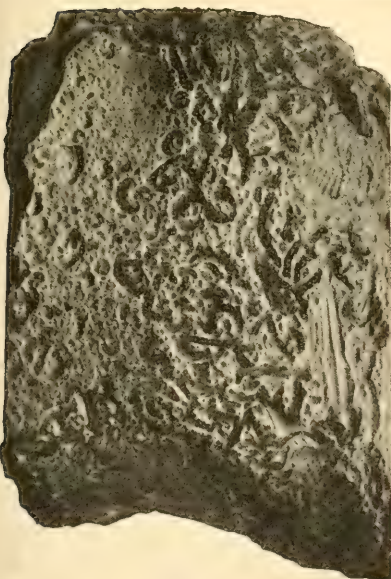
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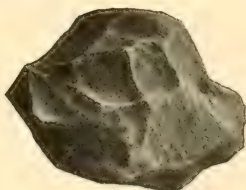
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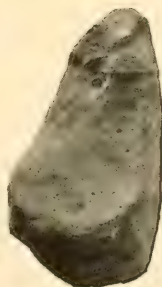
4



6



7



8



9

OBSIDIAN WITH MOLDAVITE-LIKE MARKINGS, NATURAL AND ARTIFICIAL.

FOR EXPLANATION OF PLATE SEE PAGE 486.

NOTES ON INSECTS OF THE ORDER STREPSIPTERA, WITH DESCRIPTIONS OF NEW SPECIES.

By W. DWIGHT PIERCE,

Of the Bureau of Entomology, U. S. Department of Agriculture.

INTRODUCTION.

The appearance of a considerable number of publications on the order Strepsiptera since the publication of the Monographic Revision in Bulletin 66 of the U. S. National Museum, calls forth this summary of the recent additions to our knowledge of the group. A number of corrections to the preceding paper must be noted and a considerable number of new or unpublished records are here to be added. In view of the approaching publication of the Genera Insectorum on this group a number of new species are here added. No attempt will be made at this time to indicate generic changes or arrangement, as these matters will all receive due attention in the forthcoming paper.

Special assistance in making the corrections to Bulletin 66 has been received from Mr. Karl Hofeneder of Innsbruck, Austria, and Prof. T. D. A. Cockerell of Boulder, Colorado. Material has been received from the former and also from H. L. Adams (Pennsylvania), W. L. McAtee (District of Columbia), J. D. Mitchell (Texas), V. I. Sastro (Louisiana), Prof. L. Bruner (Nebraska), Charles Robertson (Illinois), Prof. Henry Comstock (New York), Dr. E. D. Ball (Utah), William Cockle (British Columbia), Dr. E. Zavattari (Italy), E. E. Green (Ceylon), and Lt. Col. C. G. Nurse (England). Considerable material has also been found in the collections of the U. S. National Museum. Determinations of the host insects have very kindly been made by Messrs. Cockerell, Crawford, Heidemann, Robertson, Rohwer, and Viereck.

BIOLOGY.

ACTUAL RELATIONSHIP OF PARASITE TO HOST.

POLISTES METRICUS Say.

Wheeler (1910*b*) records studies of 1,000 wasps collected at Colebrook, Connecticut, in August. On these wasps the following data were obtained, as tabulated:

137 male wasps; 112 unparasitized, 25 parasitized.
863 female wasps; 637 unparasitized, 226 parasitized.

1,000 wasps; 749 unparasitized, 251 parasitized.

13.7 per cent of the wasps were males, 86.3 per cent females.

9.9 per cent of the parasitized wasps were males, 90.1 per cent females.

81.7 per cent of the male wasps were unparasitized, 18.3 per cent parasitized.

73.8 per cent of the female wasps were unparasitized, 26.2 per cent parasitized.

74.9 per cent of all the wasps were unparasitized, 25.1 per cent parasitized.

The 251 parasitized wasps contained 443 male, 119 female = 562 parasites.

78.8 per cent of the parasites were males.

21.2 per cent of the parasites were females.

POLISTES VARIATUS Cresson.

Between November 20 and 30, 1909, W. L. McAtee collected all the wasps which came into his room on Church's Island, North Carolina. These wasps were 61 in number, and the data obtained from them can be tabulated as follows:

61 female wasps; 29 unparasitized, 32 parasitized.

0.0 per cent of the wasps were males, 100 per cent females.

0.0 per cent of the parasitized wasps were males, 100 per cent females.

47.5 per cent of the female wasps were unparasitized, 52.5 per cent parasitized.

The following data give more specifically the extent of parasitism found in these wasps, bringing out the percentage of the sexes of the parasites and their relations to each other:

1 wasp with 2 male parasites = 2 parasites.

5 wasps with 1 male parasite = 5 parasites.

6 wasps with 7 male parasites.

4 wasps with 3 female parasites = 12 parasites.

4 wasps with 2 female parasites = 8 parasites.

6 wasps with 1 female parasite = 6 parasites.

14 wasps with 26 female parasites.

1 wasp with 3 male, 1 female (4) parasites = 3 male, 1 female = 4 parasites.

1 wasp with 2 male, 2 female (4) parasites = 2 male, 2 female = 4 parasites.

1 wasp with 1 male, 3 female (4) parasites = 1 male, 3 female = 4 parasites.

3 wasps with 1 male, 2 female (3) parasites = 3 male, 6 female = 9 parasites.

6 wasps with 1 male, 1 female (2) parasites = 6 male, 6 female = 12 parasites.

12 wasps with 15 male, 18 female = 33 parasites.

Summarizing this I find: 32 wasps with 22 male, 44 female = 66 parasites.

33.3 per cent of the parasites are males.

66.7 per cent of the parasites are females.

The location of the parasites may be summarized as follows:

15 males protruding from the third segment, dorsal }
1 male protruding from the third segment, ventral } total, 16.

4 males protruding from the fourth segment, dorsal }
3 males protruding from the fourth segment, ventral } total, 7.

2 females protruding from the third segment, dorsal, total, 2.

17 females protruding from the fourth segment, dorsal, total, 17.

23 females protruding from the fifth segment, dorsal }
1 female protruding from the fifth segment ventral } total, 24.

The wasps were collected between November 20 and 30 and shipped to Dallas, Texas. Twenty-three wasps arrived dead, of which

- 9 were unparasitized.
- 7 contained one parasite.
- 1 contained two parasites.
- 4 contained three parasites.
- 2 contained four parasites.

Nine of the dead wasps contained empty male puparia, but none of them contained living male puparia.

The living wasps were fed sugared water. Of the 20 living unparasitized wasps only 6 lived until April 6, 1910, and the average length of life in captivity was 99 days. The parasitized wasps lived as follows:

- 1 wasp with 3 females, 1 male exuvium, lived 9 days.
- 3 wasps with 1 female, 1 male exuvium each, averaged 9 days.
- 1 wasp with 1 female, 1 male exuvium, lived 11 days.
- 3 wasps with 1 female, 1 male pupa each, averaged 17 days.
- 4 wasps with 2 females each, averaged 26 days.
- 3 wasps with 3 females each, averaged 39 days.
- 2 wasps with 1 female each, averaged 62 days.
- 1 wasp with 1 male pupa, lived 84 days.

The maximum record was one wasp with 1 female, 125 days.

EFFECTS OF PARASITISM ON HOST.

In connection with the deformity of *Leionotus annulatus* (Bull. 66, p. 31) caused by parasitism it is interesting to note the occurrence of similar phenomena in *Polistes metricus* without the apparent intervention of parasitism (Wheeler, 1910, p. 389).

Wheeler (1910) finds very few external alterations in parasitized *Polistes metricus*.

On page 34 of Bulletin 66 several records of copulation of parasitized hosts are presented. To these Robertson (1910) has added the observation of copulation of two stylopized *Andrena salictaria* Robertson, of a parasitized female *Parandrena andreoides* Cresson, and of a parasitized male *Pseudopanurgus rudbeckiae* Robertson.

The list of Andrenidæ occasionally lacking the second transverse cubital vein (Bull. 66, p. 35) should have been credited to Robertson, with but one exception. Robertson (1910) lists 18 species of *Andrena*, and 17 other species of Hymenoptera in which this abnormality is known to occur and states that he does not think the absence of this vein indicates parasitism or is a result of it. The list was presented in the Bulletin because it suggested some connection, and, in fact, the matter is still an open question.

BIOLOGY OF THE PARASITE.

TRIOZOCERA TEXANA Pierce.

The occurrence of this species at light at Victoria, Texas, July 4, 1908, is of interest.

MYRMECOLAX NIETNERI Westwood.

The male referred to by Green (1902) as *Elenchus tenuicornis* (see Bull. 66, p. 57) has been kindly loaned to the writer and identified as above. The slide bears the following data: "Caught at light, March, 1902, Yatujantota, Ceylon."

XENOS, species.

The proportion of sexes and location of the parasites found in the *Polistes variatus*, collected by W. L. McAtee at Church's Island, North Carolina, are discussed on another page. One observation, however, is of considerable importance. Three wasps were found hibernating with male pupæ, which probably only died because the hosts died. It is not known to the writer that hibernating male pupæ have ever before been found in *Polistes*.

INTERNAL STRUCTURE.

The admirable translation into German of Nassonov's works by Sipiagin, together with the recent notes on the same by Hofeneder (1910c), have placed this valuable series of papers on the internal structure of the Strepsiptera in a far more available form, especially for American students.

Correction: On page 60, Bulletin 66, next to last line, *Accilius* was incorrectly spelled *Acilius*.

We find in Hofeneder's (1910b) description of the female *Stichotrema dallatorreanum*, a very peculiar arrangement of genital canals, which are described as being in three rows of 12 to 14 canals each.

Mr. Karl Strohm (1910) has pointed out that eyes of *Xenos (rossii) vesparum* are "ocelläre Komplexaugen," meaning that the lenses are continuous, but are interrupted on the surface by partitions.

DESCRIPTIONS OF STREPSIPTERA.

Correction: On page 84, Bulletin 66, the sentence on the second line reading "Alimentation probably osmotic," should be omitted.

Superfamily MENGEOIDEA Pierce.

Family MENGEIDÆ Pierce.

Genus TRIOZOCERA, emendation.

Triozocera PIERCE, 1910 (typographical error).

By an inadvertent following of an error in a preceding paper (Pierce, 1908) the generic name *Triozocera* was spelled *Trioxocera*. Application has been made to the International Rules Committee for permission to amend the spelling to its proper form.

The genus contains two species.

KEY TO SPECIES—MALES.

Oedeagus very slender, sinuate; medius with two superior branches. 1. *mexicana* Pierce.
Oedeagus stouter, almost straight in basal two-thirds; medius with one superior branch..... 2. *texana*, new species.

TRIOZOCERA TEXANA, new species.

Described from one specimen collected by Mr. J. D. Mitchell at light, July 4, 1908, at Victoria, Texas.

Male.—Length, 2.2 mm.; wing expanse, 5 mm.; brown; wings clouded, veins dark and distinct. Head transverse; eyes prominent, normal; antennæ (missing in type). Wings with seven primary veins from base; the first two (costa + subcosta) strong, united, bracing the margin to beyond its middle; parallel to this and very close to it is the third (radius), which is much lighter, wavy, and not as long as the first two; about opposite the tips of the subcosta a short wavy line appears, which is evidently an interrupted continuation of the radius; the fourth primary (medius) arises contiguous to the radius but diverges rapidly; between the bases of these two veins is a short darkened area; the medius extends three-fourths of the distance to the margin of the wing, at about the middle of the wing there arises a strong branch detached from the main vein, which extends to the margin of the wing; behind the medius and somewhat nearer its base arises another strong branch, also detached at its base and extending to the margin of the wing; the fifth primary (cubitus) diverges from medius at the same angle as medius diverges from radius, and extends as a strong vein to the outer margin; the sixth vein (first anal) is halfway between the cubitus and second anal and very strong, but reaching only a little way beyond the middle of the wing; the seventh primary (second anal) is also strong and reaches the outer margin; in the region of the third anal there is a very broad infuscation which might possibly stand for that vein. Anterior and median coxæ transverse; trochanters arising at the sides, stout, almost as long as the femora; posterior coxæ prominent, conical; trochanters stout, clavate, one-half as long as femora; tibiæ all slightly shorter than femora; tarsi five-jointed, first joint two-thirds as long as the tibia, second almost half as long as first; third slightly shorter; fourth one-half as long, broadened at apex and cupped for reception of fifth; fifth slender, two-thirds as long as third and armed with two claws. Oedeagus long and slender, barely sinuate, acute at tip.

Type.—Cat. No. 13713, U.S.N.M.

Family MINGENILLIDÆ Hofeneder (1910a).

Type genus.—*Mingenilla* Hofeneder (1910a).

Antennæ six-jointed, with the third, fourth, and fifth joints laterally produced, and the sixth elongate; tarsi five-jointed.

Genus MINGENILLA Hofeneder (1910a).

Type of genus.—*M. chobauti* Hofeneder (1910a).

Name based on the generic name *Mengea*.

The habits of the genus are not known, and it is at present restricted to North Africa.

MENGENILLA CHOBAUTII Hofeneder (1910a).

Described from a male collected in Ain Sefra, Algeria, in 1896, in the collection of Dr. A. Chobaut, in whose possession it remains as type.

Male.—Length 4.5 mm., breadth between tips of expanded wings 6.5–7 mm. Color light brown, head darker; abdomen and legs light golden, wings milky, with the strongest veins brownish. Head approximately twice as wide as long; dorsally emarginate at base. Mandibles moderately long, acute. Maxillæ two-jointed, slender. Antennæ sensitive, pubescent, six-jointed, the first two joints goblet-form; third, fourth, and fifth laterally produced, lamellate; sixth elongate, lamellate. Eyes ellipsoidal, prominent, with about fifty ommatidia. Prothorax short. Mesothorax longer but shorter on the median line, and wider at the sides. Metathorax elongate, with præscutum more or less quadrate, causing emargination of mesothorax; scuti about twice as long as wide; scutellum ogival, elongate; postlumbium almost as long on middle line as it is wide at base; postscutellum broad, hardly more than twice as long as wide, rounded at apex, deeply emarginate at base of postlumbium. Elytra normal, pubescent. Wings normal. Anterior and middle trochanters elongate, posterior shorter; femora stout, cylindrical; tibiæ more slender; tarsi five-jointed, with two large claws. Cedeagus at base very large, but rapidly diminishing to a point, gently sinuate, but not angulate.

Superfamily XENOIDEA Pierce.

Family MYRMECOLACIDÆ Pierce.

Genus MYRMECOLAX Westwood.

MYRMECOLAX NIETNERI Westwood.

Elnchus tenuicornis GREEN (1902).

There is practically no doubt in my mind but that Mr. Green's Peradeniya (Ceylon) specimen is identical with the original Ramboddo (Ceylon) species described by Westwood. As this rare insect belongs to the collection of Mr. Green a full description will be presented in the forthcoming generic revision, with a colored illustration.

Family STYLOPIDÆ Kirby.

Genus STYLOPS Kirby.

The genus *Stylops* still contains mainly species described from females. In addition to the species described herewith the writer has just received a number of other species which must be treated later. The host genus *Andrena* is an immense complex which has been divided into many subgenera or species groups. It seems to

be a matter of considerable difficulty to secure a satisfactory arrangement of the species. The females of *Stylops* show also many small groups, and it is probable that when we know the males we will be able to more definitely arrange them. It is, however, of interest to note the coordination of the parasite and host classifications. *Pterandrena asteris* and *P. solidaginis* are grouped together, and so may their parasites *Stylops asteridis* and *S. swenki* be grouped. The same is true of *Andrena solidula* and *A. vicina* and their parasites *S. solidulæ* and *S. vicinæ*; of *A. multiplicata* and *A. nivalis* and their parasites *S. multiplicatæ* and *S. grænicheri*; of *A. sparsipilosa* and *A. subcandida* and their parasites *S. sparsipilosæ* and *S. subcandidæ*.

In the following table the species known to the writer are arranged according to their relative forms as nearly as is possible.

The first column of figures represents the ratio of the breadth of the cephalothorax between the spiracles to the distance between the mandibles; the second represents the ratio of the breadth of the head to the distance between the mandibles; the third the ratio of the breadth between the spiracles to the breadth of the head; the fourth the ratio of the breadth between the spiracles to the distance from spiracles to apex.

| Stylops species. | Andrena species. | Cephalothorax to mandibles :—: 1. | Head to mandibles :—: 1. | Cephalothorax to head :—: 1. | Breadth to length :—: 1. |
|----------------------------|----------------------------|--------------------------------------|-----------------------------|---------------------------------|-----------------------------|
| <i>advarians</i> | <i>advarians</i> | 6.06 | 3.46 | 1.75 | 1.41 |
| <i>hartfordensis</i> | <i>hartfordensis</i> | 6.14 | 3.90 | 1.57 | 1.40 |
| <i>asteridis</i> | <i>asteris</i> | 6.23 | 4.84 | 1.28 | 1.35 |
| <i>swenki</i> | <i>solidaginis</i> | 6.27 | 3.93 | 1.59 | 1.65 |
| <i>hippotes</i> | <i>hippotes</i> | 6.28 | 4.00 | 1.77 | 1.77 |
| <i>bipunctatæ</i> | <i>bipunctata</i> | 6.45 | 3.90 | 1.65 | 1.37 |
| <i>solidulæ</i> | <i>solidula</i> | 6.61 | 3.66 | 1.80 | 1.32 |
| <i>vicinæ</i> | <i>vicina</i> | 6.68 | 3.81 | 1.75 | 1.40 |
| <i>bruneri</i> | <i>illinoiensis</i> | 6.63 | 4.84 | 1.36 | 1.79 |
| <i>vierecki</i> | <i>texana</i> | 6.75 | 4.16 | 1.62 | 1.50 |
| <i>salicifloris</i> | <i>salicifloris</i> | 7.00 | 4.35 | 1.60 | 1.42 |
| <i>polemonii</i> | <i>polemonii</i> | 7.00 | 3.91 | 1.66 | 1.32 |
| <i>multiplicatæ</i> | <i>multiplicata</i> | 7.12 | 4.08 | 1.74 | 1.52 |
| <i>grænicheri</i> | <i>nivalis</i> | 7.12 | 4.34 | 1.88 | 1.56 |
| <i>crawfordi</i> | <i>crawfordi</i> | 7.13 | 3.93 | 1.81 | 1.55 |
| <i>ressoni</i> | <i>ressoni</i> | 7.16 | 3.87 | 1.84 | 1.53 |
| <i>sparsipilosæ</i> | <i>sparsipilosa</i> | 7.30 | 4.40 | 1.65 | 1.53 |
| <i>subcandidæ</i> | <i>subcandida</i> | 7.30 | 4.50 | 1.62 | 1.58 |
| <i>nubeculæ</i> | <i>nubecula</i> | 7.41 | 4.00 | 1.85 | 1.57 |
| <i>cornii</i> | <i>commoda</i> | 7.50-7.66 | 4.07-4.60 | 1.66-1.84 | 1.34-1.35 |
| <i>californica</i> | <i>subtilis</i> | 7.58 | 4.83 | 1.56 | 1.51 |
| <i>nudæ</i> | <i>nuda</i> | 7.50 | 4.00 | 1.87 | 1.34 |
| <i>imitatrix</i> | <i>imitatrix</i> | 7.63 | 4.45 | 1.71 | 1.55 |
| <i>claytoniæ</i> | <i>claytoniæ</i> | 7.70 | 4.50 | 1.71 | 1.49 |
| <i>nasoni</i> | <i>nasoni</i> | 7.77 | 4.33 | 1.78 | 1.45 |
| <i>andrenoides</i> | <i>andrenoides</i> | 8.35 | 4.35 | 1.91 | 1.34 |
| <i>mandibularis</i> | <i>mandibularis</i> | 9.10 | 5.90 | 1.54 | 1.51 |
| <i>oklahomæ</i> | <i>flavoclypeata</i> | 9.57 | 5.52 | 1.73 | 1.43 |

STYLOPS ANDRENOIDES, new species.

Host.—*Andrena andrenoides* Cresson (det. Robertson), Carlinville, Illinois. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 0.69 mm., breadth at spiracles 0.69 mm., breadth at base of head 0.39 mm., distance between

mandibles 0.09 mm. Cephalothorax orange yellow, with disk lighter, and with a dark brown band behind the spiracles; cephalothorax as long as broad, rather narrowly truncate at apex, truncation less than one-third the breadth at the spiracles. Lateral margin almost straight from spiracles to apical truncation. Mandibles obtusely rounded, with a small blunt tooth at apex. Spiracles visible at margin but not prominent. Cephalothorax very slightly constricted behind spiracles.

Type.—Cat. No. 13689, U.S.N.M.

STYLOPS ASTERIDIS, new species.

Host.—*Andrena asteris* Robertson (det. Robertson), Carlinville, Illinois. Described from one female collected September 8 by Charles Robertson.

Female.—Length of cephalothorax, 0.76 mm., breadth at spiracles 0.79 mm., breadth at base of head 0.54 mm., distance between mandibles 0.14 mm. Cephalothorax orange yellow, lighter on disk, with brown band at base; cephalothorax almost as long as broad, truncate at apex, truncation less than one-fourth the width at the spiracles. Lateral margin slightly convex from spiracles to truncation. Mandibles obtuse, with a rather acute outwardly curved tooth on the inner apical angle. Spiracles lateral, but not prominent. Cephalothorax broader behind spiracles and then very strongly constricted.

Type.—Cat. No. 13690, U.S.N.M.

STYLOPS CLAYTONIÆ Pierce.

Stylops claytoniæ PIERCE.

Stylops imitatrix PIERCE.

Var. *S. claytoniæ vierecki* PIERCE.

Mr. Viereck considers that the host bees *Andrena claytoniæ* and *A. imitatrix* are synonymous and that he considers *A. texana* as a variety of *claytoniæ*. Following his lead the writer finds the parasites of the first sufficiently close to be considered identical, but the parasite of *texana* is quite different, as is shown by the preceding table. For this reason *vierecki* is now to be construed as a variety.

STYLOPS HARTFORDENSIS Pierce.

Mr. Viereck now considers *Andrena hartfordensis* a synonym of *A. nasoni*, but the writer has concluded that the parasites are sufficiently different to retain their specific rank.

STYLOPS MANDIBULARIS, new species.

Host.—*Andrena mandibularis* Robertson (det. Robertson), Carlinville, Illinois. Described from one female collected April 10, by Charles Robertson.

Female.—Length of cephalothorax 0.88 mm., breadth at spiracles 0.88 mm., breadth at base of head 0.52 mm., distance between mandibles 0.10 mm. Cephalothorax orange yellow, with disk lighter, and with a wide sharply marked dark brown band at base, half on the thorax and half on the abdomen, and not reaching the sides of the thorax in front of the constriction. Cephalothorax as long as broad, truncate at apex, the truncation slightly more than one-fourth the breadth at the spiracles. Lateral margin almost straight from spiracles to apex, having a slight sinuation at base of head and also just before apex. Mandibles obtusely rounded, not toothed. Cephalothorax with sides parallel for a short distance behind the spiracles and then strongly constricted. Spiracles slightly prominent on margin.

Type.—Cat. No. 13691, U.S.N.M.

STYLOPS NUDÆ, new species.

Host.—*Andrena nuda* Robertson (det. Robertson), Carlinville, Illinois. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 0.80 mm., breadth at spiracles 0.81 mm., breadth at base of head 0.42 mm., distance between mandibles 0.10 mm. Cephalothorax orange yellow, with disk lighter, and with a dark brown band at base, extending equally onto the abdomen, irregular in outline and fading out on the edges. Cephalothorax as long as broad, truncate at apex, the truncation about one-fourth the breadth at the spiracles. Lateral margin almost imperceptibly convex from spiracles to apical truncation. Mandibles small, apically toothed. Spiracles laterally prominent. Cephalothorax with sides convexly narrowed behind the spiracles to a strong constriction.

Type.—Cat. No. 13692, U.S.N.M.

STYLOPS PILIPEDIS, new species.

Host.—*Andrena pilipes* Fabricius (det. Cockerell), Pekin, China. Described from one specimen collected by M. L. Robb, April 21, 1901.

Female.—Length of cephalothorax 1.30 mm., breadth at spiracles 1.26 mm., breadth at base of head 0.83 mm., distance between mandibles 0.14 mm. Cephalothorax reddish orange, with disk lighter, and with a dark brown band at base, equally on thorax and abdomen. Cephalothorax slightly longer than broad, rounding truncate at apex, the truncation less than one-fourth the breadth at the spiracles. Lateral margin strongly convex with several very slight indentations. Mandibles obtuse, not toothed. Spiracles touching lateral margin but not prominent. Cephalothorax with sides almost parallel for a short distance behind the spiracles and then very strongly constricted.

Type.—Cat. No. 13693, U.S.N.M.

This is the largest female *Stylops* yet known to the writer.

Family XENIDÆ Semenov.

Genus HALICTOXENOS Pierce.

HALICTOXENOS GRÆNICHERI Pierce.

Correction: This specific name was wrongly spelled on page 150 of Bulletin 66, but correctly on pages 147 and 148, where it was also defined; hence the correct spelling holds and not *græincheri*.

HALICTOXENOS NYMPHÆARI, new species.

Host.—*Chloralictus nymphæarum* Robertson (det. Robertson), Carlinville, Illinois. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 0.55 mm., breadth at spiracles 0.52 mm., breadth at base of head 0.26 mm., distance between mandibles 0.07 mm. Cephalothorax yellow, with an orange brown band at base, which has its posterior margin on the abdomen semicircular. Cephalothorax longer than broad, convexly truncate at apex, constricted at base of head, and also behind spiracles. Apical truncation less than one-third the breadth at the spiracles. Lateral margin obliquely convex from spiracles to base of head, thence convex and almost parallel, rounding evenly into the convex apex. Spiracles lateral but not prominent. Mandibles small, obtuse, apically emarginate.

Type.—Cat. No. 13694, U.S.N.M.

HALICTOXENOS VIRIDULÆ, new species.

Host.—*Augochlora viridula* Smith (det. Robertson), Carlinville, Illinois. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 0.73 mm., breadth at spiracles 0.85 mm., breadth at base of head 0.33 mm., distance between mandibles 0.08 mm. Cephalothorax light yellow, with a small semielliptical brown spot at the center of the base which extends on the base of the abdomen as a broad band from one side to the other. Cephalothorax considerably wider than long, truncate at apex, constricted at base of head, strongly constricted behind spiracles. Lateral margin strongly sinuate, with the depressions at the base of the head and a little in front of the spiracles. Mandibles set obliquely, narrowed toward apex, which is squarely truncate but with a minute denticle on the inner apical angle. Spiracles marginal, but not prominent. Abdomen with five genital tubes.

Type.—Cat. No. 13695, U.S.N.M.

Genus CRAWFORDIA Pierce.

CRAWFORDIA COCKERELLI Pierce.

Host.—*Panurginus boylei* Cockerell (auth. Cockerell).

CRAWFORDIA LABROSI, new species.

Host.—*Pseudopanurgus labrosus* Robertson, Carlinville, Illinois. Described from one female collected July 3 by Charles Robertson.

Female.—Length of cephalothorax 0.47 mm., breadth at spiracles 0.48 mm., breadth at base of head 0.45 mm., distance between mandibles 0.11 mm. Cephalothorax light yellow, with anterior half of margin clouded with brown. Abdomen with a very broad dark brown band bordering the cephalothorax. Cephalothorax as long as broad, subquadrangular, very broadly truncate at apex, which is very little narrower than the width of the spiracles, strongly constricted behind spiracles. Lateral margins from spiracles almost parallel to a line through the bases of the mandibles, thence curving and regularly convex with apex. Head with sides produced almost to spiracles, mouth almost apical, mandibles broad, blunt, and armed on inner apical angle with a short curved tooth. Spiracles lateral, slightly prominent.

Type.—Cat. No. 13696, U.S.N.M.

CRAWFORDIA RUDBECKIÆ, new species.

Host.—*Pseudopanurgus rudbeckiæ* Robertson, Carlinville, Illinois. Described from one female collected August 29 by Charles Robertson.

Female.—Length of cephalothorax 0.49 mm., breadth at spiracles 0.51, breadth at base of head 0.49 mm., distance between mandibles 0.10. Cephalothorax light yellow, with margins tinged with orange. Abdomen with a dark band bordering thorax. Cephalothorax almost as long as broad, broadest behind spiracles, thence almost evenly convex on sides and apex, but not subquadrangular as in the preceding species, strongly constricted behind spiracles. Spiracles lateral, but not prominent. Head as in the preceding species, broad, blunt, and armed on inner apical angle.

Type.—Cat. No. 13697, U.S.N.M.

Genus XENOS Rossi.

Acroschismus PIERCE.

Schistosiphon PIERCE.

After receiving considerable new material the writer has come to the conclusion that the wing venation can not be used to separate *Xenos* and *Acroschismus*, and has therefore combined all three genera, which are parasites of *Polistes*.

XENOS AURIFERI, new species.

Host.—*Polistes aurifer* Saussure, Palo Alto, California. Described from one female collected in February, 1892, by W. G. Johnson, and received from Prof. Henry Comstock.

Female.—Length of cephalothorax 1.24 mm., breadth at spiracles 1.41 mm., breadth at base of head 1.08 mm., distance between mandibles 0.29 mm. Cephalothorax dark brown on basal half, light yellowish brown on apical portion, the lighter shades run back on the margins in a narrow line almost to the spiracles, and also cause a semicircular emargination of the dark area on the middle of the disk. Cephalothorax broader than long, constricted at base, margin almost perfectly convex, with only two long shallow emarginations in front of the mandibles; spiracles not reaching lateral margin; mandibles quadrate, emarginate at apex.

Type.—Cat. No. 13699, U.S.N.M.

Genus BELONOGASTECHTHRUS, new genus.

Name derived from *Belonogaster* (the host genus) + $\epsilon\chi\theta\rho\acute{o}\varsigma$ (enemy), meaning a parasite of the genus *Belonogaster*.

Type of genus—*B. zavattarii*, new species.

The genus is restricted to parasites of *Belonogaster* and is at present confined to Africa.

Male unknown.

Female.—Based on the figure by Zavattari (1909).

Triangulinid.—Length 0.32 mm. Head large, dark, eye spot dark. Head not half as long as thorax. Coxæ large, femora and tibiæ slender, tarsus a broad one-jointed transverse pulvillus, three times as broad as the tibiæ. First eight abdominal segments normal, ninth elongate and emarginate for tenth which bears two long stylets, and the lateral lobes of the ninth bear each a more slender stylet.

BELONOGASTECHTHRUS ZAVATTARII, new species.

Host.—*Belonogaster elegans* Gerstaecker; Butiti, Congo Free State, collected by the expedition of Duc d'Abruzzi, and figured by E. Zavattari (1909). Triangulinids were kindly presented the writer by Doctor Zavattari.

Female.—Cephalothorax about as long as broad; sides convex, margin of head sinuate, apex lobately rounded.

Genus PSEUDOXENOS Saunders.

Leionotoxenos PIERCE.

On account of a decision by Mr. S. A. Rohwer, of the U. S. National Museum, to consider *Leionotus*, *Ancistrocerus*, etc., as merely species groups of *Odynerus*, as was done by Saussure, it is expedient for the present to combine the genus *Leionotoxenos* with *Pseudoxenos*, espe-

cially as females are now at hand from several of the so-called genera recognized by Ashmead. These parasites are too closely allied to warrant even subgeneric separation.

PSEUDOXENOS ARVENSIDIS, new species.

Host.—*Odynerus (Leionotus) arvensis* Saussure, Carlinville, Illinois. Described from one female collected August 2 by Charles Robertson.

Female.—Length of cephalothorax 1.16 mm., breadth 1.25 mm., breadth of head 1.05 mm., distance between mandibles 0.23 mm. Cephalothorax orange brown, the margins very dark, and the anterior half, except in front of opening of brood canal, dark; posterior half of disk lighter. Cephalothorax broader than long, constricted at base, broadest behind spiracles, thence more or less evenly convex on sides and apex, apex almost imperceptibly truncate; spiracles lateral and barely prominent; mandibles oblique, emarginate at apex with curved tooth on inner angle.

Type.—Cat. No. 13700, U.S.N.M.

PSEUDOXENOS ERYNNIDIS, new species.

Host.—*Odynerus erynnys* Lepeletier, Inverness, Florida. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 1.32 mm., breadth 1.39 mm., breadth of head 1.08 mm., distance between mandibles 0.26 mm. Cephalothorax orange brown, with apex yellow, behind which is a quadrate dark spot as wide as the opening of the brood canal, marginal area from here back darker than disk, and margin from base of head very dark to base of cephalothorax. Cephalothorax broader than long, constricted at base, broadest immediately behind the spiracles, lateral margins between base of head and spiracles not very oblique, but at base of head strongly angled and thence oblique, slightly sinuate; apex strongly convex; spiracles lateral, barely prominent; mandibles distant, very oblique, deeply emarginate at apex, forming an acute tooth on inner angle, and a rounded lobe on outer angle.

Type.—Cat. No. 13701, U.S.N.M.

This species differs considerably in form from the others so far described.

PSEUDOXENOS FORAMINATI, new species.

Host.—*Odynerus foraminatus* Saussure, Trenton, New Jersey. Described from one female collected July 5, 1907.

Female.—Length of cephalothorax 1.02 mm., breadth 1.04 mm., breadth of head 0.85 mm., distance between mandibles 0.17 mm. Cephalothorax dark brown, with part of head between mandibles yellow, and a small area at base of disk lighter brown, margins very dark, but a lighter round area indicates location of spiracles. Cephalothorax almost as long as broad, convexly narrowed to base from

widest point, which is just behind the spiracles; spiracles barely reaching lateral margin; sides convex, slightly wavy, apex narrowly truncate; mandibles oblique with a strong tooth on the inner apical angle.

Type.—Cat. No. 13702, U.S.N.M.

PSEUDOXENOS FUNDATI, new species.

Host.—*Odynerus (Leionotus) fundatus* Cresson, Carlinville, Illinois. Described from one female collected June 25, by Charles Robertson.

Female.—Length of cephalothorax 0.99 mm., breadth 1.18 mm., breadth of head 0.91 mm., distance between mandibles 0.19 mm. Cephalothorax light brown, with area in front of opening of brood canal yellowish, and posterior fourth of disk lighter, margins especially near middle very dark, but with a lighter round area indicating the location of the spiracles. Cephalothorax convex from base, evenly rounded at widest point behind spiracles; spiracles not attaining lateral margin; sides sinuately oblique to the narrowly rounded apex; mandibles oblique, with a sharp tooth on inner apical angle.

Type.—Cat. No. 13703, U.S.N.M.

PSEUDOXENOS HISTRIONIS, new species.

Host.—*Odynerus (Ancistrocerus) histrio* Lepeletier, Inverness, Florida. Described from one female collected March 20, by Charles Robertson.

Female.—Length of cephalothorax 0.86 mm., breadth 0.89 mm., breadth of head 0.76 mm., distance between mandibles 0.17 mm. Cephalothorax light orange brown, with area in front of mouth yellow, a brown transverse band behind the opening of the brood canal, margins very dark, and remainder of disk lighter in color. Cephalothorax rather strongly constricted at base; broadest at spiracles which are laterally prominent; thence angulately convex, apex evenly convex; mandibles very oblique, apically emarginate and toothed on inner angle.

Type.—Cat. No. 13704, U.S.N.M.

PSEUDOXENOS PEDESTRIDIS, new species.

Host.—*Odynerus (Leionotus) pedestris* Saussure, Carlinville, Illinois. Described from one female collected July 6, by Charles Robertson.

Female.—Length of cephalothorax 0.80 mm., breadth 0.80 mm., breadth of head 0.67 mm., distance between mandibles 0.15 mm. Cephalothorax light orange brown, darkest on margins and across disk behind mouth in basal third, apex yellow, remainder of disk orange colored. Cephalothorax not strongly constricted behind, more or less evenly convex from base to apex, apex narrowly truncate; spiracles just reaching lateral margin; mandibles oblique, toothed.

Type.—Cat. No. 13705, U.S.N.M.

PSEUDOXENOS ROBERTSONI, new species.

Host.—*Odynerus (Ancistrocerus) histrionalis* Robertson, Carlinville, Illinois. Described from one female collected August 27, by Charles Robertson.

Female.—Length of cephalothorax 1.04 mm., breadth 1.05 mm., breadth of head 0.85 mm., distance between mandibles 0.20 mm. Cephalothorax light orange brown, with a very dark narrow marginal line and a dark line behind the opening of the brood canal, the color shading off from these dark lines to a very light disk, apex light, area of spiracles light on the dark rim. Cephalothorax constricted at base convex at widest point behind spiracles, convex with slight sinuations to apex which is evenly rounded; spiracles barely attaining the margin; mandibles with a very acute tooth on the inner apical angle.

Type.—Cat. No. 13706, U.S.N.M.

PSEUDOXENOS TIGRIDIS, new species.

Host.—*Odynerus (Ancistrocerus) tigris* Saussure, Carlinville, Illinois. Described from one female collected by Charles Robertson on September 23.

Female.—Length of cephalothorax 0.76 mm., breadth 0.70 mm., breadth of head 0.58 mm., distance between mandibles 0.16 mm. Cephalothorax light brown, darkest on margins, apex light, disk light orange brown. Cephalothorax oval, constricted at apex, broadest behind spiracles, sides convex from base to apex, very even, apex evenly convex; spiracles barely reaching margins, indicated by clear round area; mandibles small, oblique with a small outward curved tooth on inner apical angle.

Type.—Cat. No. 13707, U.S.N.M.

Genus TACHYTIXENOS, new genus.

Type of genus.—*T. indicus*, new species.

The only species of this genus is a parasite of *Tachytes* and the genus is at present confined to Asia.

Male.—Head transverse, broadly produced over antennæ. Mandibles curved, stout, ensiform, apically acute, maxillæ two-jointed, the first joint stout subclavate, the second longer, tapering but not acute at apex. Eyes large, many-faceted. Antennæ normally xeniform, rami flattened. Prothorax transverse, slightly arched forward. Mesothorax shorter, emarginate by præscutum; elytra slender, clavate. Metathoracic præscutum keystone-shape; scuti broad, angularly produced over base of wings, narrowly separated by peduncle of scutellum; scutellum reaching præscutum in a pedunculate process which widens to the main body in a sinuate curve, posterior angles laterally produced, posterior edge bisinuate; postlumbium of different consistency from other parts, with both anterior and pos-

terior edges bisinuate; postscutellum broad, strongly convex. Wing venation light. Legs moderate, posterior femora inflated behind. Oedeagus with almost no curve beneath at base and with the first outer bend very near base, reflexed at the apical fourth at about a right angle, apex very acute.

TACHYTIXENOS INDICUS, new species.

Host.—*Tachytes xenoferus* Rohwer, Deesa, India. Described from one male and one female collected by Lt. Col. C. G. Nurse in June, 1898. Four wasps contained four empty puparia, one male puparium, one female. The male puparium contained a fully developed male.

Male.—Length 2.5 mm. Dark brown, antennæ and palpi a little lighter, mandibles and oedeagus transparent yellow, postlumbium light brown, abdomen brown strongly tinged with yellow, elytra and legs yellowish brown, wings pale with venation yellow.

Female.—Length of cephalothorax 0.83 mm., breadth 0.97 mm., breadth of head 0.82 mm., distance between mandibles 0.18 mm. Cephalothorax reddish brown, darkest on edges, orange colored on disk; slightly constricted at base, widest behind spiracles which barely reach the edge, thence convex to apex; apex broadly rounded, sinuate in front of mandibles; mandibles diagonal, quadrate truncate, with a small tooth on the inner apical angle.

Type.—Cat. No. 13729, U.S.N.M.

Genus EUPATHOCERA Pierce.

EUPATHOCERA LUCTUOSAE, new species.

Host.—*Sphex (Psammophila) luctuosa* Smith; Colorado Springs, Colorado. Described from one female from the collection of University of Nebraska.

Female.—Length of cephalothorax 0.98 mm., breadth at spiracles 1.22 mm., breadth of head 0.95 mm., distance between mandibles 0.20 mm. Cephalothorax brown, becoming lighter orange brown on posterior half of disk; widest behind spiracles, evenly convex throughout; mandibles oblique, subquadrate, concavely emarginate at apex, with a small acute tooth near inner angle; spiracles not reaching margin.

Type.—Cat. No. 13708, U.S.N.M.

EUPATHOCERA PICTIPENNIDIS, new species.

Host.—*Sphex (Ammophila) pictipennis* Walsh, Carlinville, Illinois. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 0.92 mm., breadth at spiracles 1.11 mm., breadth of head 0.88 mm., distance between mandibles 0.19 mm. Cephalothorax dark reddish-brown, with a small lighter basal area; widest behind the spiracles, constricted at base, evenly

convex throughout; spiracles laterally prominent; mandibles oblique, quadrate with a large sharp tooth on the inner apical angle.

Type.—Cat. No. 13709, U.S.N.M.

EUPATHOCERA VULGARIDIS, new species.

Host.—*Sphex* (*Ammophila*) *vulgaris* Cresson, Carlinville, Illinois. Described from one female collected by Charles Robertson.

Female.—Length of cephalothorax 0.91 mm., breadth at spiracles 0.99 mm., breadth of head 0.54 mm. Cephalothorax brown, with basal area of disk lighter; widest just behind spiracles, which are located one-third of the distance from the base, sides behind spiracles almost parallel, but suddenly constricted at base, sides in front of spiracles convex, apex truncate; spiracles laterally prominent; mandibles oblique, emarginate, with an acute tooth on the inner apical angle.

Type.—Cat. No. 13710, U.S.N.M.

Genus OPHTHALMOCHLUS Pierce.

OPHTHALMOCHLUS AURIPEDIS, new species.

Host.—*Chlorion* (*Isodontia*) *auripes* Fernald, Plummers Island, Maryland. Described from one female collected July 10, 1910, by J. C. Crawford.

Female.—Length 1.55 mm., breadth 1.80 mm., breadth of head 1.44 mm., distance between mandibles 0.26 mm. Cephalothorax dark brown, with posterior third of disk lighter; widest at spiracles; obliquely widening from base to spiracles, thence convexly obliquely narrowing to apex, outline of head sinuate; spiracles not reaching margins; mandibles oblique, quadrate, truncate, but with a long acute tooth projecting from the inner apical angle.

Type.—Cat. No. 13711, U.S.N.M.

Superfamily STICHOTREMATOIDEA Hofeneder, 1910*b*.

This superfamily has been erected by Hofeneder because of the extremely peculiar arrangement of the female genital pores, which are arranged in three transverse series of twelve to fourteen each.

Family STICHOTREMATIDÆ Hofeneder, 1910*b*.

Type genus.—*Stichotrema* Hofeneder (1910*b*).

Parasites of Locustidæ.

The male is unknown. The triungulinid is similar to those of the preceding and following families.

Genus STICHOTREMA Hofeneder (1910*b*).

Type of genus.—*Stichotrema dallatorreanum* Hofeneder.

Name derived from $\sigma\tau\acute{\iota}\chi\omicron\varsigma$ (row) + $\tau\omicron\tilde{\rho}\tilde{\eta}\mu\alpha$ (aperture), referring to the arrangement of the genital pores in rows.

STICHOTREMA DALLATORREANUM Hofeneder (1910 b).

Host.—*Sexava nubila* Stål; Pack Island, Admiralty Islands, September 10, 1909, Dr. E. Wolf, collector.

Female.—Dorsal side outward, and not as in other Strepsiptera. Genital canals arranged in three parallel rows on the first or second abdominal segment, with twelve to fourteen in each row. Cephalothorax with lateral projections behind the spiracles. Head with two small projections, probably rudimentary maxillæ.

Triungulinid.—Length 0.22 mm. Elongate, head obtusely rounded, with a deep narrow emargination at the center of the apex. Head and thorax together shorter than abdomen. Head over half as long as thorax. Eyes large crystalline. Legs with coxæ, large, toothed; femora slender and apically mucronate, tibia longer and more slender, tarsus minute, hairlike. First eight abdominal segments transverse, short, ninth elongate, deeply emarginate, bearing the tenth segment in the emargination, and on the apices of the lateral lobes armed with two pair of short hairs; tenth segment bearing two very long stylets, which are approximate at base.

Above description is original from specimens of the triungulinids given the writer by Mr. Hofeneder.

Superfamily HALICTOPHAGOIDEA Pierce.

Family DIOZOCERIDÆ, new name.

Dioxoceridæ, PIERCE (1908).

Genus DIOZOCERA, emendation.

Dioxocera, PIERCE (1908), (typographical error).

The original spelling was due to an error in copying and is absolutely meaningless. Application has been made to the International Rules Committee for privilege to emend the spelling to its proper form.

Family HALICTOPHAGIDÆ Pierce.

Genus PENTOZOCERA, emendation.

Pentozocera PIERCE (1908), (typographical error).

The same remarks as above hold for this generic name.

PENTOZOE,¹ new genus.

Type of genus.—*P. peradeniya*, new species.

Male.—Head excavated behind, produced over antennæ. Eyes many faceted. Antennæ with flabelli short, flat and broad. Mandibles short and acute, slightly passing each other; maxillæ long,

second joint long. Prothorax and mesothorax arched far forward into head, the former appearing only as a disk. Elytra moderately long. Praescutum elongate triangular, narrowly truncate by scutellum; scuti quadrate, diagonal, approximate at apex of praescutum, not reaching to lateral processes of scutellum; scutellum with median anterior lobe separating scuti, behind which it is more or less quadrate with posterolateral prolongations; postlumbium of different consistency from the other parts, and almost as long as the scutellum; post-scutellum convex, broad and about as long as praescutum and scutellum together. Wings with seven primary veins, the costa and subcosta strong, the area between these and medius darkened; a very wide detached vein arising just beyond the darkened area; medius extending to margin with long detached branch in front of it; the two anal veins straight. Legs normal; tarsi three-jointed. Ninth abdominal segment elongate; œdeagus slender, inflated at basal third and strongly arched, thence very slender and at apical fourth bent back in an acute angle.

Female.—Cephalothorax quadrate, bi-emarginate at apex, with the lobe thus formed very prominent; mandibles oblique and with a long tooth; spiracles not laterally prominent; surface radiately wrinkled from base; opening of brood canal transverse; abdomen with a long, darkened area of the same shape as the cephalothorax.

PENTOZOE PERADENIYA, new species.

Host.—*Thompsoniella arcuata* Motschulsky, Peradeniya, Ceylon. Described from one male and one female collected by E. E. Green.

Male.—Length 1.25 mm. Dark brown, eyes black, antennæ and legs lighter.

Female.—Color light brown. Length of cephalothorax 0.26 mm., breadth 0.22 mm.

Type.—Cat. No. 13712, U.S.N.M.

HOST LIST.

The following additions to the host list of the Strepsiptera may be made:

ORTHOPTERA.

Superfamily LOCUSTOIDEA.

Family LOCUSTIDÆ.

Sexava Stål.

nubila Stål, Pack Island, Admiralty Islands, September 10 (E. Wolf), (female) *Stichotrema dallatorreanum* Hofeneder (Hofeneder 1910b).

species, Wogeo, Schouten Island, Admiralty Islands, September 13 (E. Wolf) (Hofeneder 1910b).

¹ Name derived from πέντε (five) + ἄκας, (branches).

HOMOPTERA.

Superfamily CICADOIDEA.

Family TETIGONIIDÆ.

Tribe PHRYNOMORPHINI.

Thompsoniella Signoret.

arcuata Motschulsky, Peradeniya, Ceylon, July (E. E. Green) (males, females), (*Pentozoe peradeniya* Pierce).

Deltocephalus Burmeister.

labiatus Gillette, Colorado (male pupa), (received from E. D. Ball).

HYMENOPTERA.

Superfamily VESPOIDEA.

Family EUMENIDÆ.

Odynerus Latreille (including *Leionotus* and *Ancistrocerus*).

anormis Say (*Leionotus*), Carlinville, Illinois, May 31, October 29 (Robertson 1910).

arvensis Saussure (*Leionotus*), Carlinville, Illinois, August 2 (Robertson 1910), (female) (*Pseudoxenos arvensidis* Pierce).

bifurcus Robertson (*Leionotus*), Inverness, Florida, March 3 (Robertson 1910).

capra Saussure (*Ancistrocerus*), Washington State (male exuvium) (U. S. National Museum collection).

clypeatus Robertson (*Ancistrocerus*), Carlinville, Illinois, May 24, 31 (Robertson 1910).

erynnys Lepeletier, Inverness, Florida, February 10, March 10, 25 (Robertson 1910), (female) (*Pseudoxenos erynnidis* Pierce).

foraminatus Saussure (*Leionotus*).

2. Carlinville, Illinois, August 13 (Robertson 1910).

3. Trenton, New Jersey, July 5, 1907 (female), (*Pseudoxenos foraminati* Pierce), (U. S. National Museum collection).

fundatiformis Robertson (*Leionotus*), Orlando, Florida, February 17 (Robertson 1910).

fundatus Cresson (*Leionotus*), Carlinville, Illinois, June, July (Robertson 1910), (female) (*Pseudoxenos fundati* Pierce).

histrionis Lepeletier (*Ancistrocerus*), Inverness, Florida, March 20, 24 (Robertson 1910), (female) (*Pseudoxenos histrionis* Pierce).

histrionalis Robertson (*Ancistrocerus*), Carlinville, Illinois, August 5, 27 (Robertson 1910), (female) (*Pseudoxenos robertsoni* Pierce).

- pedestris* Saussure (*Leionotus*), Carlinville, Illinois, July 6 (Robertson 1910), (female) (*Pseudoxenos pedestridis* Pierce).
sexcingulati Ashmead (*Ancistrocerus*), Florissant, Colorado, June 26, 1907, S. A. Rohwer, on *Salix brachycarpa* (U. S. National Museum collection).
tigris Saussure (*Ancistrocerus*), Carlinville, Illinois, September 23 (Robertson 1910), (female) (*Pseudoxenos tigridis* Pierce).
turpis Saussure (*Leionotus*), Inverness, Florida, March 19 (Robertson 1910).

Family VESPIDÆ.

Polistes Latreille.

- aurifer* Saussure, Palo Alto, California, February, 1892 (W. G. Johnston), (female, male exuvium) (*Xenos auriferi* Pierce) (from Cornell University collection).
hebræus Fabricius, India (Maxwell-Lefroy and Howlett 1909).
metricus Say.
 7. Cornell University (female), (Cornell University collection).
rubiginosus Lepeletier.
 10. Arlington, Texas, September 30 (exuvium).
 11. Tallulah, Louisiana, January 29 (exuvium) (V. I. Safro); February 16 (female), (V. I. Safro).
variatus Cresson.
 3. Carlinville, Illinois, September 30 (Robertson 1910).
 4. Church's Island, Maryland, November 3 (W. L. McAtee), (males, females).

Belonogaster Saussure.

- elegans* Gerstaecker, Butiti, Congo Free State (female), (Zavattari 1909) (*Belonogastechthrus zavattarii* Pierce).

Superfamily SPHECOIDEA.

Family SPHECIDÆ.

Chlorion Latreille.

- auripes* Fernald (*Isodontia*) 1. Plummer's Island, Maryland, July 10, 1910, (J. C. Crawford) (female) (*Ophthalmochlus auripedis* Pierce).
 2. Harrisburg, Pennsylvania (H. L. Adams) (female).
ichneumonæus Linnæus.
 5. Carlinville, Illinois (Robertson, 1910).
pollens Kohl, Ain Sefra, Algeria (Hofeneder 1910a).

Sceliphron.

- lætum* F. Smith, Sandgate, Queensland, February 19, 1905. (Dr. J. Turner), (in U. S. National Museum collection).

Sphex Linnæus.

campestris Latreille, Germany (Scholz, 1909).

luctuosa Smith. 1. Idaho, (female) (University of Nebraska collection); 2. Colorado Springs, Colorado (male pupa, female) (*Eupathocera luctuosæ* Pierce) (University of Nebraska collection).

Family LARRIDÆ.

Tachytes Panzer.

xenoserus Rohwer. Deesa, India (males, females) (C. G. Nurse) (*Tachytixenos indicus* Pierce).

Superfamily APOIDEA.

Family ANDRENIDÆ.

Subfamily HALICTINÆ.

Augochlora F. Smith.

viridula F. Smith, Carlinville, Illinois, September 17 (Robertson 1910), (female) (*Halictoxenos viridulæ* Pierce).

Halictus Latreille.

nymphæarum Robertson, Carlinville, Illinois (Robertson 1910) (female), (*Halictoxenos nymphæari* Pierce).

sparsus Robertson 2. Carlinville, Illinois, April, May, July, September, October (Robertson, 1910).

versatus Robertson 2. Carlinville, Illinois, April 11, November 3 (Robertson, 1910).

zephyrus Smith 2. Carlinville, Illinois, April, July (Robertson, 1910).

Subfamily ANDRENINÆ.

Andrena Fabricius.

andrenoides Cresson, Carlinville, Illinois, April 1-29 (Robertson, 1910), (female), (*Stylops andrenoides* Pierce).

asteris Robertson, Carlinville, Illinois, September 8 (Robertson, 1910) (female), (*Stylops asteridis* Pierce).

crawfordi Viereck, Dallas, Texas (Viereck, 1909).

cressoni Robertson, Falls Church, Virginia, June 14 on *Ceanothus* (female), (in U. S. National Museum collection).

desponsa Smith (*victima* Smith), Nova Scotia (male, female) (*Stylops childreni* Gray) (Latreille, 1845, Smith, 1853, Cockerell, 1906b).

didelta Viereck, Florissant, Colorado, July 17, 1907 (S. A. Rohwer) (female), (in U. S. National Museum collection).

erigeniæ Robertson, 1. Carlinville, Illinois, April 11 (Robertson, 1891, 1910), (female). 2. Castle Rock, Pennsylvania, April 17, 1908 (females), (in U. S. National Museum collection).

hemileuca Viereck, Florissant, Colorado, June 19, 1907 (S. A. Rohwer), (females), (in U. S. National Museum collection).

hilaris Smith, Georgia (female), (in U. S. National Museum collection).

hippotes Robertson, 2. Carlinville, Illinois, April 10 (Robertson, 1910).

illinoensis Robertson, 2. Carlinville, Illinois, April 17 (Robertson, 1891, 1910).

imitatrix Cresson race *claytoniæ* Robertson, *Stylops claytoniæ* Pierce.

var. *texana* Cresson *Stylops claytoniæ vierecki* Pierce.

var. *profunda* Viereck.

The above synonymy will change the location of the references in Bulletin 66.

lewisii Cockerell, Florissant, Colorado, July 8, 1907 (S. A. Rohwer), (females) (in U. S. National Museum collection).

mandibularis Robertson, Carlinville, Illinois, March 21, 29, April 10 (Robertson, 1910), (female) (*Stylops mandibularidis* Pierce).

nasoni Robertson (*hartfordensis* Cockerell).

Stylops hartfordensis is, however, not a synonym of *Stylops nasoni*.

nuda Robertson, Carlinville, Illinois, March 17 (Robertson, 1910), (female), (*Stylops nudæ* Pierce).

pilipes Fabricius, Pekin, China, April 21, 1901 (M. J. Robb) (female), (*Stylops pilipedis* Pierce) (in U. S. National Museum collection).

polygoni Viereck (paratype), Florissant, Colorado, July, 1907 (T. D. A. Cockerell) (females), (in U. S. National Museum collection).

ribesina Cockerell, Florissant, Colorado (Cockerell, 1906a).

salictaria Robertson, Carlinville, Illinois, April 2-17 (Robertson, 1910).

sitiliæ Viereck, Dallas, Texas (Viereck, 1909).

verecunda Cresson types (Robertson, 1910).

Biareolina Dufour.

neglecta Dufour (Perez, 1886; Pierce, 1909).

Family PANURGIDÆ.

Panurginus Nylander.

boylei Cockerell, Las Vegas, New Mexico, August 3 (W. Porter) (female), (*Crawfordia cockerelli* Pierce), (Pierce, 1909).

Pseudopanurgus Cockerell.

labrosiformis Robertson, Carlinville, Illinois, August 3 (Robertson, 1910), (female).

labrosus Robertson, Carlinville, Illinois, July 3 (Robertson, 1910), (female) (*Crawfordia labrosi* Pierce).

rudbeckiæ Robertson, Carlinville, Illinois, August 1, 29 (Robertson, 1910), (female) (*Crawfordia rudbeckiæ* Pierce).

solidaginis Robertson, Carlinville, Illinois, August 11, 12 (Robertson, 1910), (female).

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THE RELATION OF BORNITE AND CHALCOCITE IN THE COPPER ORES OF THE VIRGINIA DISTRICT OF NORTH CAROLINA AND VIRGINIA.

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Of the U. S. Geological Survey.

INTRODUCTION.

The copper ores of the Virginia district consist almost wholly of bornite and chalcocite. The level of ground water is from 50 to 75 feet below the surface, and the zone of secondary alterations does not appear to extend below 250 feet. The important mines of the district are from 350 to 500 feet deep, and the ore from the deepest levels contains almost as much chalcocite as bornite. If a specimen from the upper levels of almost any of these mines be examined in detail it will be found to consist of the two minerals in such relations that no hesitancy is felt in pronouncing much of the chalcocite secondary and more recent than the bornite. If, however, a specimen be taken from the deeper levels the two minerals are seen to be so intricately intergrown that no other conclusion than that they are genetically contemporaneous seems possible. These facts have led some observers, notably L. C. Graton,¹ to suppose that chalcocite occurs in these mines as a primary mineral. Chalcocite has been almost universally regarded as a mineral of secondary origin, i. e., derived from some leaner copper-bearing sulphide. Its manner of occurrence as heretofore observed left little doubt as to its secondary nature, and there grew up a belief that the mineral is always secondary. The chalcocite of the Virginia district therefore appeared to offer an exception to the generally accepted conclusion, and with the hope of throwing some light upon the genesis of this mineral, an extended microscopical examination of these ores was undertaken.

The field work upon which this investigation is based was done while the writer was employed by the Geological Surveys of North Carolina and Virginia, and a detailed report on the geology of the district is now being prepared. The U. S. National Museum fur-

¹ U. S. Geol. Survey, Min. Res. 1907, Pt. 1, p. 620.

nished a metallographic microscope and equipped it with an improved lighting device especially for this work, and the photomicrographs illustrating the paper were made in the photographic laboratory of the Museum by Thomas W. Smillie.

The specimens herein described are the property of the U. S. National Museum.

GEOGRAPHY AND GEOLOGY.

Before entering upon a description of the ores a brief sketch of the geology of the district will be given.

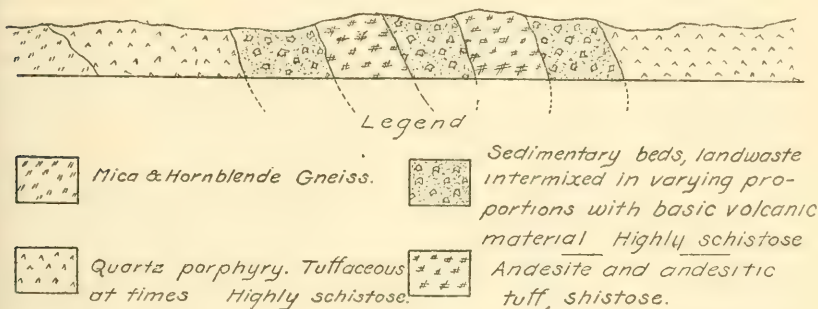
Location.—The Virgilina copper district is located near the eastern border of the Piedmont Plateau in Person and Granville counties, North Carolina, and Halifax and Charlotte counties, Virginia, each State including approximately one-half of the ore-bearing area. It takes its name from the village of Virgilina, a station on the Southern Railway situated on the State line near the center of the district, and about 160 miles west of Norfolk and 45 miles east of Danville. The most important ore deposits occur on two approximately parallel flat-topped, though somewhat conspicuous, ridges which trend from 15 to 20° east of north, and which have very gradual slopes. The maximum elevation is at Virgilina, 540 feet above sea level. The relief is not pronounced, varying from about 300 feet up to the maximum above stated, but the country is decidedly hilly. Rainfall is rather heavy, especially during the winter and spring, and streams are numerous.

Geology.—The rocks of the district are highly schistose, and are popularly known as slates. They are of two distinct types—greenstone schists, and quartzose sericitic schists or gneisses. Into these schistose rocks have been intruded large masses of granite, and less important bodies of more basic material, probably gabbro. Also here and there throughout the area occur small diabase dikes. The intrusive rocks are not schistose, but are closely jointed.

A close examination of these schists reveals their character—a great series of volcano-sedimentary rocks of two types—a basic rock, andesite, and one highly acid in character, a quartz porphyry. Of the andesite there are three types—porphyritic, amygdaloidal, and tuffaceous, and of the quartz porphyry only two—porphyritic and tuffaceous. Closely associated with the greenstone schists and grading directly into them, are heavy beds of highly schistose greenish rocks differing from the tuffaceous portions of the andesite only in that they contain varying amounts of land waste intermixed with the basic volcanic material. These range from fairly well-marked sandstone and fine conglomerate on the one hand to typical andesitic tuffs entirely free from terrigenous material on the other. The relative position of these two phases of the greenstone indicates that at the

beginning of the volcanic activity there was a period when the volcanic material was not equal to the land waste, and thus were deposited beds of sandstone and conglomerate with only a small amount of volcanic ash. As the activity increased, the amount of land material grew proportionately less and less, until at the time of maximum vulcanism it became nothing, and the normal volcanic beds were formed. As this activity began to diminish, the former conditions began to reassert themselves, and the beds deposited consisted to a greater or less extent of land waste. The following is a somewhat idealized cross-section through the middle of the district at right angles to the schistosity. This section is approximately that exposed along the Southern Railway from a point about ten miles west to about eight miles east of Virgilina.

The andesitic tuff passes by regular gradation into the sandy and conglomerate rock, so that in the field even where exposures are the best it is not possible to draw a sharp boundary line between the two.



CROSS-SECTION OF VIRGILINA DISTRICT AT RIGHT ANGLES TO THE STRIKE OF THE SCHISTOSITY, APPROXIMATELY ALONG THE SOUTHERN RAILWAY.

It is possible that the sandy beds may have been formed from the rapid erosion of unconsolidated volcanic ash beds as well as by the commingling of similar material with land waste at the time of eruption. Thus in either case it is clear that with an increase of the volcanic material the resulting rock would more nearly approach the true basic tuffs, while with a decrease of this it would approximate more nearly a normal sediment—a conglomerate, sandstone, or shale as the case might be.

The andesite and the andesitic tuff, especially the former, are the most massive of the older rocks of the region. The andesite is of two types, porphyritic and amygdaloidal, both of which are mashed and decidedly schistose. The amygdaloidal phase is not abundant, and is usually so highly metamorphosed that it is easily confused with the tuffaceous phase. All the ore deposits thus far developed, and in fact all the prospects as far as known at present, with a very few exceptions, are located in the andesite or the andesitic tuff.

The quartz porphyry is, for the most part, especially on the western side of the area, a typical rock of its kind, but much mashed and highly schistose. The phenocrysts are largely of feldspar, with a variable and usually an inferior amount of quartz. The basal and the upper, and at times other portions of this rock, are to a greater or less extent tuffaceous. This is especially true of the eastern area, where by far the greater portion is probably a very fine tuff. No workable ore deposits have been found in this rock.

The age of these rocks is not known; they have generally been regarded as pre-Cambrian. They appear to be somewhat similar to tuffaceous rocks intimately associated with the slate deposits lying northeast of the Virgilina district. These slates have recently been described by Watson¹ and Powell and shown to be early Paleozoic. It is believed that further study may determine the volcano-sedimentary rocks of this district to be of the same age.

Granite.—This is the youngest intrusive rock of the region except the diabase dikes, and is also the most important. Three prominent areas of it are included within the district, one in the southwest corner near Mill Creek post office, North Carolina, and another in the east-central portion at and surrounding Buffalo Lithia Springs, and the third and largest one, northwest of Redoak post office, Virginia. This area of granite extends almost across the region of volcano-sedimentary rocks and cuts out the ore-bearing horizon for a distance of 4 or 5 miles. It is apparently massive, and therefore shows nothing of the prominent schistosity of the other rocks. In all the occurrences it is a rather coarsely granular, highly quartzose rock, and in places, especially at Buffalo Lithia Springs, it is decidedly porphyritic. Like all the other granites of the southeastern United States, it contains a large amount of plagioclase in proportion to the orthoclase, and shows well its quartz-monzonitic character. This rock is of especial interest since all the field evidence obtainable points toward the conclusion that it is the source of the ores, and that they and the veins are closely connected genetically with its intrusion. In this relation it is further considered in the paragraphs relating to the origin of the ores.

Structure.—From the cross section above given, what the writer considers a probable structure of the district is readily seen, that of a closely compressed syncline, the axis of which has a strike of from 10 to 30° east of north, and which is inclined so that it has approximately the same dip as the schistosity—from 70 to 80° toward the southeast. It is believed that at the beginning of the formation of the series there was a great outpouring of acid lava—the quartz porphyry upon the mica and hornblende gneiss as a basement. This

¹Thos. L. Watson and S. L. Powell. Fossil evidence of the age of the Virginia Piedmont slates. Amer. Journ. Sci., ser. 4, vol. 31, 1911, pp. 33-44.

was followed by a period of quiescence, marking the beginning of the outpouring of the basic lava—the andesite. During this time the regular agencies of erosion were active, and the results were the beds of land-waste intermixed with basic volcanic ash. The vulcanism increased, and there followed the great beds of andesite and andesitic tuff. Finally the activity decreased and a period similar to that at the beginning of the basic activity followed, and during this time the upper beds of sandy tuff were formed. This marked the close of the volcanic activity as far as any record in the rocks goes. Following this the beds were complexly folded, much mashed, and the present schistosity largely developed. This was followed, probably after a long period, by the intrusion, first of the gabbro, later of the granite, and then, as phenomena concomitant with the coming in of the granites, the fracturing of the greenstone schists and the formation of the veins and the development of the ores.

VEINS AND ORES.

Veins.—The veins are composed dominantly of quartz with locally a considerable amount of epidote and calcite. (See pl. 63.) In width they vary from small stringers not more than a few inches up to 15 or 20 feet. They always have well-defined walls and are probably true fissure veins. As is always the case with such veins, these present many irregularities, most prominent of which are the numerous pinches and swells, both horizontally and vertically. In places they are reduced to little more than a mere stringer of quartz between two well-marked walls, while again they may locally swell out to several times their average thickness. In length they range from a few hundred yards to 4 or even 5 miles, and in many instances may be traced these distances by actual outcrop or by abundant quartz débris in the soil. Vertically they are also continuous, and aside from the irregularities in width they are as well defined in the bottom of the deepest shafts as at the surface. The size of the vein and the prominence of the outcrop form no criteria as to the richness of the mineralization. Often the richest ore bodies have been found under a very insignificant outcrop, and as often the strongest exposure at the surface is barren or very lean. The average strike of the veins is more northerly than the schistosity of rocks in which they occur, and while at times they follow the schistosity for short distances their average strike intersects it at acute angles. The fractures in which the veins have formed are therefore regarded as having been made subsequent to the development of the schistosity in the country rock. The ore is not evenly distributed throughout the veins, but is concentrated locally into definite ore shoots. These present the usual irregularities and as a rule appear to have a slight southerly pitch in the vein.

Ores.—Though apparently preferring the quartz, the ore is so intimately associated with all the gangue material as to make it almost certain that all were deposited contemporaneously. (See pl. 64.) The copper-bearing minerals are bornite and chalcocite, with the oxidized products derived from them. Chalcopyrite is present in such small and varying amounts that unless careful search is made it will not be found at all, and it is apparently no more abundant in one portion of a mine than in another. Certainly there is no increase with depth in the amount of this mineral. In fact the mine which shows it most abundantly is only about 150 feet deep, and here it was as abundant in the first sulphides encountered as in those in the bottom of the shaft. In two of the deepest mines—the Holloway, 450 feet in depth, and the Durgy, about 400 feet—it is so rare that one can hardly find it.

Chalcocite occurs in two very distinct relations with the bornite; secondary to and filling fractures in the bornite, and intergrown, sometimes clearly crystallographically, with it. Bornite is the most important mineral in all the mines in the district except the Holloway, in which it is subordinate to chalcocite. It appears, too, from even a casual observation of the ores that there has been considerable shattering since their original deposition. This is especially prominent in the ore from the Seaboard mine, which furnishes the purest bornite in the district. In the fractures in the bornite from this mine, be they ever so minute, are developed veinlets of chalcocite, which penetrate the bornite in all directions, and vary in size from the finest line, often not visible to the unaided eye, but perfectly clear under the microscope (pl. 67, fig. 1), up to areas a quarter of an inch in diameter (see pls. 65 and 66). In the center of many of these chalcocite-filled fractures are films of quartz which evidently mark the original fracture in which the chalcocite began to develop, thus showing that at the beginning of or prior to the development of the chalcocite, there were solutions carrying considerable quartz. In the interior of some of the largest quartz veinlets thus formed there occur particles of chalcocite so related to each other as to indicate a growth of the quartz since the beginning of the deposition of the secondary chalcocite (see pl. 66). Also in a few instances the vein of chalcocite when deeply etched presents a kind of spongy skeleton of quartz appearing as if quartz and chalcocite were deposited simultaneously. The boundary between these veinlets of chalcocite and the bornite is exceedingly irregular, usually presenting a somewhat feathery outline, though always perfectly distinct and clear-cut. There is absolutely no gradation of one into the other. There is certainly a growth of the chalcocite, but how it takes place is not made clear by the microscopic study of the veinlets. It appears, however, that it takes place at the periphery of the

material already deposited, but the chemistry of the process has not been worked out. Where fractures of two periods are present, both are often filled with chalcocite, that in the younger fractures cutting across the veinlets in the older ones. Fractures also occur in the intergrown chalcocite and bornite, and in such instances the secondary veinlets cut across both the primary chalcocite and the bornite. The relation of the two minerals to each other in the case in hand leaves no doubt as to the secondary nature of the chalcocite. This type of chalcocite, as far as observations have extended, is confined to the upper portions of the veins and was not found in sections of ore from the deeper mines. It was found, however, in the upper portions of all mines from which sections were examined, and in many instances a single section would show excellent examples of both types of chalcocite. (See pl. 68, fig. 1.)

The other type of ore is entirely different. Both minerals are present in every section examined, sometimes the bornite predominating, and at others the chalcocite. They are intimately associated with each other, but each has its own definite boundaries, cleavage, and other physical properties, with absolutely no indications that one is secondary to or derived from the other. In a number of sections the chalcocite predominated over the bornite, and in such instances the indications seemed to be that the bornite was the first to crystallize. It occurs in irregular areas, sometimes separated and again connected, lying in a larger area of chalcocite. In other instances the two are present in approximately equal amounts, and there is nothing to indicate that one is older than the other. In other occurrences, as in the ore from the Blue Wing mine, the two minerals are present as small areas or grains and in approximately equal proportions. In these sections the appearance is as if a sponge of bornite while growing had been merged with another similar sponge of chalcocite, the association being so intimate and so complex that there is no way of accounting for it except on the basis of contemporaneous deposition (see pl. 67, fig. 2). In the case of the sections in which the bornite appears to have been formed earlier than the chalcocite, it seems as though when the ores were being deposited, the solutions were first saturated, as it were, for bornite, and this mineral began to crystallize out, the iron possibly being the determining factor. This continued until by a reduction of the bornite molecules in the solution, the eutectic point for both bornite and chalcocite was reached, and these two minerals crystallized out simultaneously, and in many places solidified as crystallographic intergrowths. The chalcocite is rather coarsely crystalline, and the etch figures show that the larger areas are made up of numerous interlocking grains, which stand out distinctly and have no definite crystallographic rela-

tion to each other. The cleavage, as brought out by the etching, is apparently in two directions at right angles to each other, one more prominent than the other, one possibly prismatic and the other basal.

The crystallographic intergrowths are the most interesting and also the most conclusive as to the contemporaneous deposition of the two minerals. These are by no means rare, having been found more or less perfectly developed in ore from all the mines except the Seaboard. At a magnification of 40 diameters these areas resemble very closely the intergrowths of quartz and feldspar in a micropegmatite. At the highest magnification used, 220 diameters, this resemblance is even more pronounced. In these intergrowths the minerals present perfectly sharp and clear-cut boundaries, with absolutely no indication of gradation of one into the other—boundaries just as sharp as between any minerals in an igneous rock (see pl. 68). When an area of such intergrowth was etched deeply enough to bring out the two cleavages distinctly (pl. 69, fig. 1) the chalcocite proved to be a single grain or crystal, the cleavage lines of which could be seen extending from one side of the grain to the other, interrupted here and there by the filaments of bornite. This type of texture is regarded as proof that the minerals crystallized at the eutectic point of a solution, and it is, therefore, conclusive evidence that in the case in hand bornite and chalcocite were deposited contemporaneously.

It is realized that while these minerals are contemporaneous, they both may be secondary after some leaner copper mineral. There are certain reasons for suspecting such conditions, the most prominent of which is probably the long period of erosion which the region has undergone since the ore deposits were formed. This long erosional interval would afford time for conditions of oxidation and enrichment to penetrate to exceptional depths in the ore bodies. With this idea in mind careful observations were made as to the depth of the zone of alteration as far as the same could be determined, and the conclusion is that it rarely if ever extends below 175 or 200 feet, the impermeability of the veins limiting the downward circulation. They and their walls are all exceedingly dense and impervious to water, and the mines all furnish a surprisingly small amount of water, of which by far the greater part comes from the upper 100 feet of the vein. As an example of the tightness of the vein, it may be mentioned that when the Blue Wing mine was unwatered about two years ago, it was found that the air pressure had held the water out of an upraise which had been started from the 266 feet level. The vein rocks were so tight that the air could not escape even though it was under a pressure of about eight atmospheres. Under such conditions as these, circulation of meteoric waters must necessarily be at a minimum. This tightness of the vein is characteristic of

practically all the ore deposits of the Piedmont and Southern Appalachian regions.

The relations of ore to the gangue, and of the gangue minerals to each other are strong evidence against the assumption that the two sulphides are secondary minerals. It has been stated before that the ore is so complexly and intricately associated with the gangue minerals that no other conclusion than that of contemporaneous deposition seems tenable. If chalcocite and bornite of the intergrown type are secondary minerals, the whole vein, gangue and all, is secondary.

The minerals of the deposits, both gangue and ores, as a group, with the possible exception of the chalcocite, if they can be said to be characteristic of any one portion of a mineral vein, would probably be typical of the deeper vein zone.¹ These are, so far as has been determined, quartz, calcite, epidote, chlorite, specularite, bornite, chalcocite, a very little chalcopyrite, albite, and orthoclase. It must be stated that feldspar of any kind in direct association with the sulphides is rare, but good examples were found at the Seaboard mine, where the feldspar is a plagioclase, probably albite; at the Holloway mine, where both plagioclase and a pink feldspar, which is apparently orthoclase, occur; and at the Copper King mine, where the feldspar is albite. Feldspars, however, are very abundant in many of the veins, especially in lean or barren portions. In such occurrences the mineral is generally albite or an acid oligoclase. In certain portions of the veins at the gold mine near Redbank, Virginia, and Holloway mine in North Carolina, pink feldspar occurs in association with quartz so as to strikingly resemble a pegmatite. This is generally not closely associated with the ore, but at times, especially in the Holloway mine, it carries a small amount of the sulphides. It usually is found in barren portions of the vein or as stringers running off from the vein into the country rock.

Origin of the ores.—The origin of these ores is a more difficult question than one might at first suspect, and is as important as difficult. The country rock is by far too basic to have afforded the vast amount of quartz in the veins. Neither can the underlying quartz porphyry be looked to as the source, since this rock is also older than the veins and is itself cut by numerous quartz veins similar in all respects to those in the andesite and the andesitic tuff, except that they contain but little or no calcite and epidote and probably no copper ores. Some source, therefore, outside of and much younger than the country rocks must be looked for. The only rock in the region which apparently meets the conditions is the granite. This granite is highly quartzose, younger than the rocks in which the ore deposits occur, was not in-

¹ Waldemar Lindgren, Relation of ore deposition to physical conditions, *Economic Geology*, vol. 2, 1907, pp. 105-127.

W. H. Emmons, A genetic classification of minerals, *Economic Geology*, vol. 3, 1908, pp. 611-627.

truded until after a strong schistosity had been imposed upon the andesitic rocks, and is a type of magma the intrusion of which is frequently attended by more or less mineralization in the intruded or adjacent rocks. It is also well able to furnish the acidic material of the veins, and in its effects upon the intruded rocks, through hydrothermal metamorphism, could very well have been responsible for the development of the calcite, epidote, and probably the chlorite. In fact, it appears to be the only rock in the region that could have furnished the feldspars of the veins or have been responsible for the pegmatite-like character of certain portions of some of the veins. It is, therefore, believed that the deformation attendant upon the intrusion of the granite produced the fractures in which the veins now are, and that the filling of these, both gangue and ores, was supplied by the granitic magma, and that it came in as a phenomenon attendant upon or immediately following the intrusion.

As to the conditions of the deposition, there is little or no positive evidence. Since the ore deposits are confined to the more basic facies of the schists, it may be surmised that the basic character of the rock was a factor of prime importance in the deposition of the ores.

SUMMARY AND CONCLUSIONS.

The rocks of the Virgilina District are greenstone and sericitic schists, which in places have been intruded by granite and gabbro. The intrusive rocks show none of the schistosity of the other rocks. The schists have been derived from a series of volcano-sedimentary rocks of two types—andesite and quartz porphyry, with a preponderating amount of tuffs corresponding to these rock types. Their age is probably early Paleozoic.

The veins are true fissure veins which have a more northerly trend than the schistosity of the country rock, and the filling of which is quartz—about 70 per cent silica—with local and varying amounts of epidote and calcite. The ore-bearing veins are confined to the more basic portions of the greenstone schists, and the values lie in well-defined ore shoots.

The ore minerals are bornite and chalcocite. They apparently prefer the quartz, but are not confined to any one of the gangue minerals. Bornite is present in slight excess over chalcocite and is apparently of only one period of deposition. Chalcocite is clearly of two periods: One confined to the upper portions of the vein, younger than, and filling a network of minute fractures in, the bornite; the other contemporaneous and intergrown often crystallographically with it. There is no evidence that any of the bornite is of secondary origin. It is, therefore, clear that in the Virgilina District the greater part of the chalcocite is a primary mineral contemporaneous with the bornite and in no way derived from it, or from any other copper mineral, by processes of secondary alteration.

EXPLANATION OF PLATES.

PLATE 63.

- Fig. 1. Typical vein. Exposed in railroad cut near Christie, Virginia. The irregularities here shown are exhibited by nearly every vein that has been opened in the district.
2. Outcropping of a large but barren quartz vein near High Hill Mine. Few of the vein outcrops are as pronounced as this one.

PLATE 64.

- Fig. 1. Photograph of a specimen from the Wall mine showing relation of ore and quartz. The vein was "split" at the point where this specimen was taken and the piece here figured represents the entire width of one portion of the vein.

Dark areas=ore.

White areas=quartz.

2. Tracing made from a polished surface of a specimen from the Wall mine showing the relation of the ore to the quartz. Natural size.

Black=ore, chalcocite, and bornite.

White=quartz.

The relationship here shown is typical of all the mines in the district. The ore and gangue appear to be contemporaneous.

PLATE 65.

- Secondary chalcocite in bornite. $\times 10$. Seaboard mine. This photograph shows a mass of bornite penetrated in all directions by a mesh or network of chalcocite which has formed in minute fractures in the bornite. This is typical of all the secondary chalcocite studied, the only difference being the stage of development. This one is farther advanced than any of the others shown. The white line in the center of many of the chalcocite veinlets is quartz. Running diagonally across the specimen is a recent fracture which cuts bornite and the older veins of chalcocite. In this chalcocite is also seen to be developing.

PLATE 66.

- Fig. 1. Secondary chalcocite in bornite. $\times 40$. Seaboard mine. Similar in all respects to section shown in Plate 67, fig. 1, only the development of chalcocite is farther advanced. The same feathery line of contact between the two minerals is evident. In the center of the chalcocite areas are seen films of quartz which apparently mark the original fracture in which the chalcocite developed.
2. Secondary chalcocite in bornite. $\times 40$. Seaboard mine. Similar to fig. 1, but shows more clearly the relation of the chalcocite to the bornite. In one of the fractures in the bornite there is seen a stringer of quartz, the dark area running vertically through the section. On each side of the quartz, between it and the bornite, there is a considerable development of chalcocite.

PLATE 67.

- Fig. 1. Secondary chalcocite in bornite. $\times 40$. Seaboard mine.

Irregular lines=chalcocite.

Other portion of section=bornite.

This figure shows an incipient stage of the development of secondary chalcocite in minute fractures in bornite. The little lines of chalcocite are well defined, but present an irregular or "feathery" line of contact with the bornite.

Fig. 2. Intergrowth of bornite and chalcocite. $\times 40$. 266 feet level, Blue Wing mine.

Dark areas=bornite.

Lighter areas=chalcocite.

There does not appear to be any marked crystallographic relationship between the two minerals in this section as in those shown in Plate 68. The appearance is that of a spongy mass of bornite merged and intergrown with another similar mass of chalcocite.

PLATE 68.

Fig. 1. Intergrowth of bornite and chalcocite. $\times 40$. Wall mine.

Dark areas=bornite.

Lighter areas=chalcocite.

A typical example of crystallographic intergrowth of bornite and chalcocite. Such intergrowths are believed to form only at the eutectic point of a solution and are strong evidence that the two minerals were deposited contemporaneously.

2. Crystallographic intergrowth of bornite and chalcocite. $\times 220$. Wall mine.

Dark areas=bornite.

Lighter areas=chalcocite.

This is an area of the finely intergrown portion of the section shown in fig. 1, highly magnified, and shows that the relationship of the two minerals is a typical crystallographic intergrowth.

PLATE 69.

Fig. 1. Intergrowth of bornite and chalcocite. $\times 220$. Wall mine.

Stippled areas=bornite.

White areas=chalcocite.

This is a deeply etched section of the two minerals and shows clearly by the etch figure, the lines at right angles to each other in the chalcocite, that the portion of this mineral here seen is a part of a single individual crystal, and also brings out the crystallographic relations of these two minerals.

2. Intergrowth of bornite and chalcocite. $\times 40$. High Hill mine.

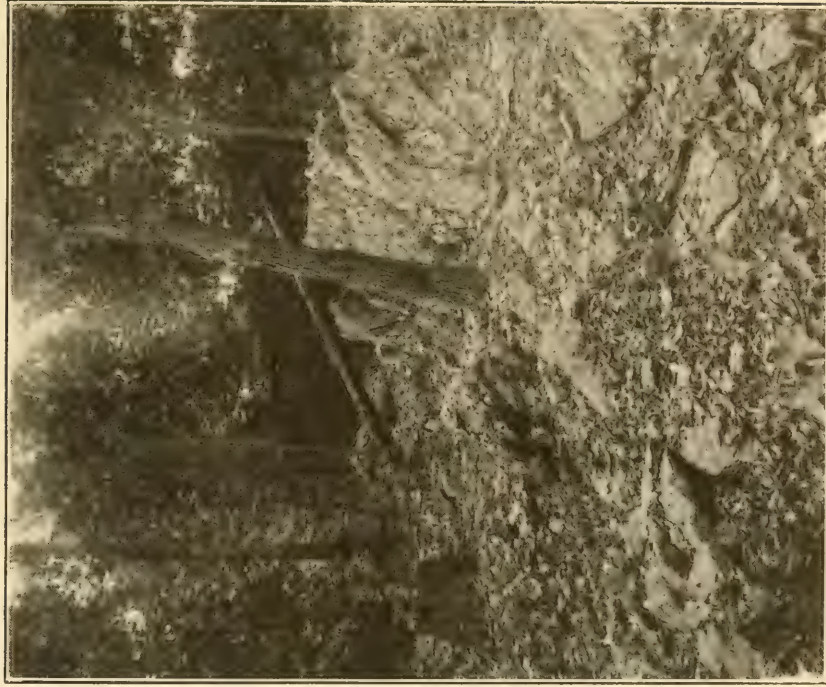
Stippled areas=bornite.

White areas=chalcocite.

The peculiar lines in the chalcocite areas are the etch figures and show the coarsely granular condition of this mineral.



1



2

TYPICAL VEINS OF THE VIRGILINA DISTRICT.

FOR EXPLANATION OF PLATE SEE PAGE 523.



1



2

ORE IN QUARTZ, WALL MINE.

FOR EXPLANATION OF PLATE SEE PAGE 523.

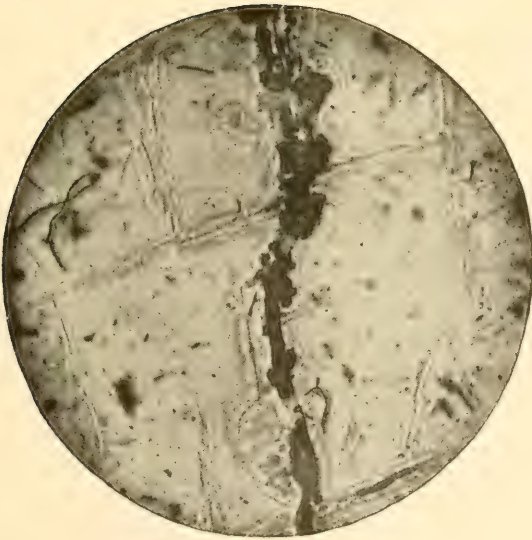


SECONDARY CHALCOCITE IN BORNITE SEABOARD MINE.

FOR EXPLANATION OF PLATE SEE PAGE 523.



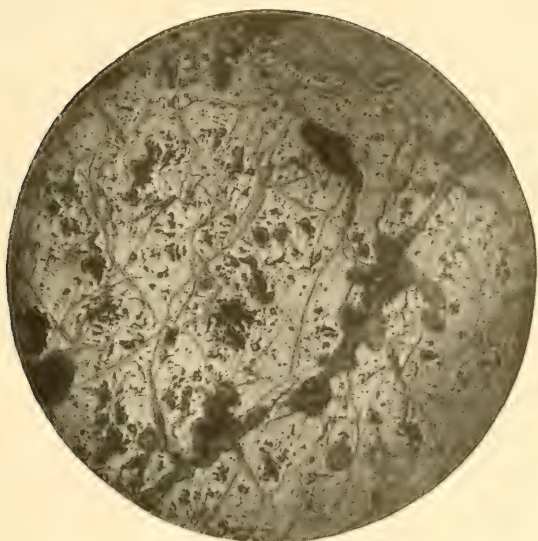
1



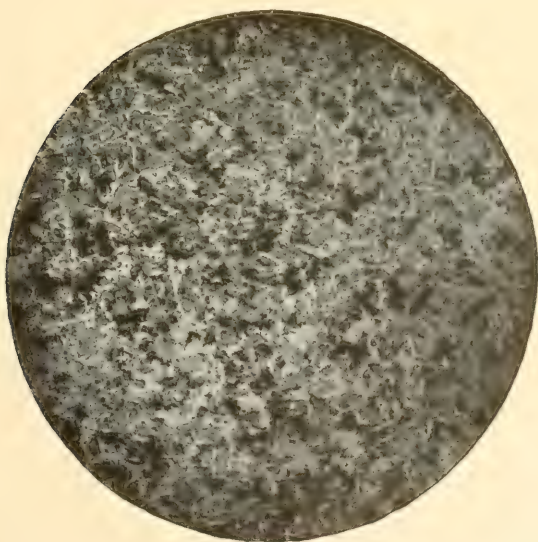
2

SECONDARY CHALCOCITE IN BORNITE, SEABOARD MINE

FOR EXPLANATION OF PLATE SEE PAGE 523.



SECONDARY CHALCOCITE AND BORNITE, SEABOARD MINE.



INTERGROWTH OF BORNITE AND CHALCOCITE, BLUE WING MINE.

FOR EXPLANATION OF PLATE SEE PAGES 523 AND 524.



1



2

CRYSTALLOGRAPHIC INTERGROWTH OF BORNITE AND
CHALCOCITE, WALL MINE.

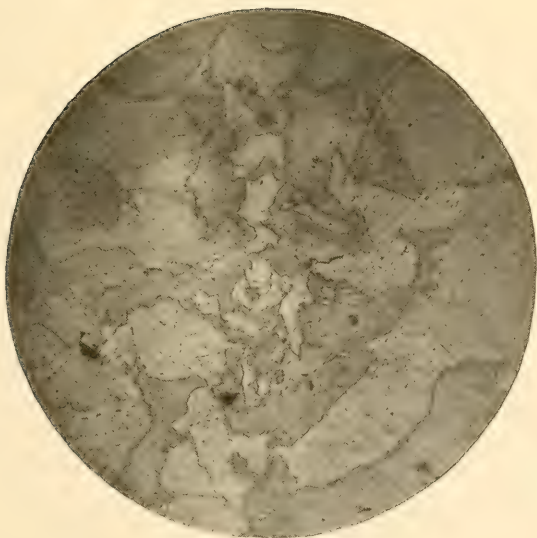
FOR EXPLANATION OF PLATE SEE PAGE 524.



INTERCOMPLEX



1



2

INTERGROWTH OF BORNITE AND CHALCOCITE.

FOR EXPLANATION OF PLATE SEE PAGE 524.

DESCRIPTIONS OF NEW GENERA AND SPECIES OF FISHES FROM JAPAN AND THE RIU KIU ISLANDS.

JOHN OTTERBEIN SNYDER,
Of Stanford University, California.

This paper contains descriptions of 3 new genera and 23 new species of fishes from Japan and the Riu Kiu Islands. They were collected during the explorations of the United States Bureau of Fisheries steamer *Albatross* in the north Pacific Ocean and along the shores of Japan, in 1906.

Family SYNGNATHIDÆ.

MICROPHIS EXTENSUS, new species.

This species is closely related to *M. pleurotænia* of Hawaii. Two examples of the latter agree with Günther's description of the species and differ from *Microphis extensus* in both color and form. The Hawaiian species has the light bands very broad, thus confining the light area on the side of the body to the dorsolateral row of plates, and almost eliminating it from the breast and abdomen. The caudal fin is without spots, having a dusky center and an indefinite, broad, light edge. The ridges of the snout are smoother and the body is considerably broader and heavier. The caudal fin is much less acute. There are 24 to 25 dorsal rays in *M. pleurotænia*, while *M. extensus* has 21 or 22.

Head 4.5 in length measured to base of caudal fin; depth 3.5 in head; depth caudal peduncle 7.5; snout 2; eye 4; interorbital space 9; D. 22; A. 4; rings 19+15.

Two strongly denticulated ridges extend from snout to interorbital space; a dorsolateral denticulated ridge from tip of snout to orbital rim, which is also serrated; upper edge of opercle with a strong ridge from which many striæ radiate. Osseous rings of body with strong keels at the angles which have spines posteriorly, the spines growing larger on the tail; plates with only a trace of a median keel. Dorsal located on seven rings beginning with the sixteenth. Caudal fin pointed, the length contained about 1.4 times in the head. Pectoral broadly rounded, about 2 in snout; rays, 18.

Color in alcohol deep brown; a white stripe extending along back from tip of snout to base of caudal; chin with a white spot; throat, breast, and abdomen with a broad, white stripe, which is divided by a dark median area of the body color; caudal fin with two large, oval, white spots on its basal third and with two narrow stripes beyond these.

In life the color is deep purple, the light stripes being brilliant, orange red. The caudal is dark reddish brown, with bright orange spots; the edge of the fin white.

This description is of the type, Cat. No. 68226, U.S.N.M., a female specimen 47 mm. long from Naha, Okinawa. Cotype, No. 21418, Stanford University collection.

The brood pouch of the male extends over fourteen osseous rings. It is connected with the anal opening by a furrow, the edges of which rise and merge into those of the brood pouch two rings in advance. There is a median keel on the breast anterior to the pouch.

Five specimens were secured measuring 28 to 48 mm. in length. In swimming the movements are slow, the caudal is broadly expanded, and the brilliant colors stand out in bold contrast against the gray coral rocks of the pools.

CORYTHROICHTHYS QUINQUARIUS, new species.

Head 7.7 in length to base of caudal; depth 2.7 in head; snout 2; eye 9; interorbital width 12; D. 28; A. 4; rings 16 + 38.

The head is long and slender, the slope from tip of snout to occiput interrupted by only a slight curve over the eyes; body deepest about midway between head and origin of dorsal fin. Head without spines or serrations; a median crest on upper part of snout, a dorsolateral one extending to nostril, a prominent supraorbital crest and a low occipital ridge; gill cover with a ridge which passes from orbit to its posterior third; plates of body without spines or keels; back flat; abdomen angular. Egg pouch extending over eighteen rings and including a little over half the tail. Dorsal fin located on six rings. Pectoral rays 17, their length about 5 in head. Anal very small, with apparently four rays. Caudal slightly shorter than pectoral.

Color in spirits brownish; upper part of snout, chin, and throat whitish; a broad, dark band from snout to eye, several rows of small spots along side of snout, and a median dark line running backward from chin; opercle with a light stripe extending along and beyond the keel, and also a shorter, parallel one below it; sides of body with very small, pearly ocelli in quinquax order, each with a brown dot in the center; back and tail variegated with brown and whitish; edge of pouch with white, dark-bordered bars; caudal narrowly tipped with white.

Described from the single specimen, type Cat. No. 68227, U.S.N.M., from Tanegashima, Japan; length 123 mm.

Family RUVETTIDÆ.

JORDANIDIA, new genus.

This genus is distinguished by the branched lateral line and the wholly degenerate ventral fins.

Body rather elongate and flat; a patch of small scales on posterior part of body; lateral line extending from upper edge of gill opening to near end of base of soft dorsal, with a branch originating below base of fifth dorsal spine, curving downward and backward and then passing in a straight line along median part of body to base of caudal fin; palatines with teeth; finlets 3, the anterior of which is closely apposed to the preceding fin.

Type of genus.—*Jordanidia raptoria*, new species..

The genus is named for Dr. David Starr Jordan.

JORDANIDIA RAPTORIA, new species.

Head 3.3 in length to base of caudal; depth 5; depth caudal peduncle 6.5 in head; diameter eye 4; width interorbital space 6.5; length snout 2.6; D. XVIII, 14; A. 12.

The body is moderately elongate, deepest in the middle, the caudal peduncle compressed; head pointed, interorbital area concave, lower jaw projecting beyond the upper; maxillary extending slightly beyond anterior edge of pupil; eye large and round, midway between tip of snout and border of opercle. A single row of teeth on jaws and palatines; teeth of jaws large, knife-like, widely spaced; a group of three to five greatly enlarged fangs in anterior part of upper jaw; two small teeth at symphysis which project upward and backward beyond tip of snout. Pseudobranchiæ large. Gill-rakers numerous, minute, unequally developed.

Lateral line originating at upper edge of gill opening, bifurcating beneath base of fifth dorsal spine, the upper branch passing directly backward a short distance below base of dorsal and ending below base of soft dorsal; lower branch abruptly curving downward and extending along middle of body to base of caudal. Posterior part of body with small, thin scales which occupy an area of rather indefinite extent projecting from base of caudal forward as a wedge, the tip of which lies on the lateral line; other parts of body and head apparently smooth.

Spinous dorsal inserted just a little behind upper edge of gill opening and extending to a point opposite the vent; the longest spines about equal in length to diameter of eye. First dorsal rays longest, about three in head, the others successively shorter. Three finlets

following the soft dorsal, the first more remote from the second than that is from the third and closely apposed to the soft dorsal. Anal inserted below soft dorsal, its rays somewhat shorter than those of the dorsal; followed by three finlets like those above. Caudal deeply forked, the upper lobe somewhat the longer, 1.5 in the head. Pectoral two in head. Ventrals absent, the ends of the small pelvic bones almost touching the surface on the median line beneath the bases of the pectorals. Vertebrae 31; caeca 7.

Color in the preservative pale silvery, darker above especially on the opercles, upper margin of eye, interorbital space, tip of snout, lips, area beneath the maxillary and gill cavity. Spinous dorsal with a black spot between first and third spines; edge of fin black; posterior part of caudal dusky.

Type.—Cat. No. 68228, U.S.N.M., a specimen from the market at Kagoshima, measuring 250 mm. in length. Cotype No. 21419, Stanford University collection.

Other specimens are similar to the type, not showing any marked amount of variation.

Family PEMPHERIDÆ.

CATALUFA, new genus.

This genus is distinguished from others of the family by the small, closely apposed, strongly ctenoid scales. It includes *C. umbra*, new species, which may stand as the type, and *C. compressus* of the Australian region.

CATALUFA UMBRA, new species.

Head 3.5 in length to base of caudal; depth 2.2; depth caudal peduncle 3.2 in head; eye 2.2; snout 6.5; maxillary 2; interorbital space 3.3; D. V, 12; A. III, 33; scales in lateral line 72.

Eye very large, circular; interorbital space convex; snout blunt and rounded; lower jaw rather sharp at its tip and projecting; maxillary extending to point below center of pupil. Edge of preopercle covered with scales except on lower portion where it is denticulate, the angle being armed with an especially strong spine which projects downward and backward; head elsewhere completely scaled except on tip of snout and lips. Minute, brush-like teeth on jaws, vomer, and palatines. Gillrakers somewhat slender and longer than the fringes behind them; 8-21 on the first arch. Pseudobranchiæ well developed. Scales of body small, close set, rather heavy and strongly ctenoid; extending for a considerable distance out on the base of the caudal and forming a high sheath along base of anal where they are extremely minute; seventy-two series in a lateral line counting to base of caudal from where the pores extend to near the end of tail;

eleven rows between origin of dorsal and lateral line; scales of head finer than those of body and less rough, a sharp line of demarkation between the two passing upward from the opercular opening and then curving far forward to a point midway between the eyes, thus allowing a sharply outlined, wedge-shaped area of the rougher body covering to extend forward over the nape and occiput to the inter-orbital area.

First branched ray of dorsal longest, 4 in the length; base of fin 5 in the length. Caudal forked, about 4 in the length. First anal spine short and easily overlooked; third spine strong; about half as long as the following ray; although damaged, the anal rays appear to be gradually shortened from the first to the last. Pectoral sharply rounded, 4 in the length. Ventral spine strong, the fin rounded, about 7 in the length.

Color in spirits rather pale bluish black, the head with a brownish tint; fins all dusky except the pectoral which is nearly immaculate; ventrals speckled; tips of dorsal, caudal, and anal blackish; base of caudal dark.

The species is represented by but one specimen which was collected by Mr. Aoki at Misaki. It measures 160 mm. in length.

Type.—Cat. No. 68229, U.S.N.M.

Family SERRANIDÆ.

PSEUDANTHIAS VENATOR, new species.

One specimen of a *Pseudanthias*, apparently new, was found in the Kagoshima market. It is distinguished by a pearly white bar which passes from snout beneath eye to lower edge of base of pectoral, a bow-shaped bar of same color extending from base of spinous dorsal to posterior end of base of anal, the filamentous fins, size of scales, and number of fin rays.

Head 4.3 in length to base of caudal; depth 2.8; depth caudal peduncle 2.2 in head; eye 4; snout 4.3; maxillary 2.1; D. X, 16; A. III, 7; scales in lateral series 40; pores in lateral line 44.

Maxillary without supplemental bone; completely scaled; extending to a vertical through posterior border of pupil; the width of posterior end equal to length of snout. Edge of preopercle denticulate, the teeth largest just above the angle. Opercle with two large, flat spines, the upper at the angle being the larger. Mouth oblique. Lower jaw with a large canine near the symphysis, followed by a smaller one halfway back; also a band of minute teeth which narrows to a single row posteriorly. Upper jaw with a large canine opposite and slightly behind the principal one of lower jaw; a second strong one entirely within the mouth on inner edge of maxillary, pointing

inward and backward; jaw covered with a band of fine teeth. Pseudobranchiæ large; gillrakers extremely long and slender, the ventral ones equal to diameter of eye; 11-24 on the first arch.

Curves of lateral line rather closely following the dorsal contour, and not abruptly bent at any point. Scales of body ctenoid; 6 rows above lateral line at its origin; 2.5 rows between lateral line and middle of spinous dorsal; 3.5 between lateral line and middle of soft dorsal; 14 between base of anal and lateral line.

The dorsal spines beyond the third are of about equal length, 3 times in head; rays about 1.9 in head, the last ones somewhat filamentous; base of soft dorsal with a low sheath of scales. Second and third anal spines contained 2.3 in head, the first not half as long; middle rays of fin slightly longer than head. Tips of both dorsal and anal extend beyond base of caudal. Caudal lunate, the upper and lower rays elongate and filamentous; extreme length of fin contained 2.5 in distance from tip of snout to base of caudal. Ventral acutely pointed; equal in length to caudal, reaching somewhat beyond base of third anal spine. Pectoral almost equal in length to head.

Color in the preservative pinkish with a bluish tinge; three yellowish, nearly parallel stripes extending from head backward and disappearing just before reaching caudal peduncle; a narrow, pearly white stripe extending from tip of snout beneath eye downward to lower edge of base of pectoral; a bow-shaped stripe of same color, though fainter, passing from middle of base of spinous dorsal downward and curving backward along base of anal; median line of abdomen with a dead white stripe; first gill arch with a very narrow, white stripe along base of filaments.

Type.—Cat. No. 68230, U.S.N.M., a specimen measuring 118 mm., from Kagoshima.

Family LUTIANIDÆ.

PLATYINIUS AMOENUS, new species.

This form resembles *P. macrophthalmus* of the Atlantic. It is somewhat more slender, has a more pointed snout, and differs in color.

Head 2.2 in the length to base of caudal; depth 2.9; depth caudal peduncle 3.2 in head; diameter of eye 3; length snout 3.2; width interorbital space 4.8; length maxillary 2.6; D. X, 11; A. III, 8; scales lateral line 62; between lateral line and origin of spinous dorsal 6; between lateral line and origin of anal 14.

Dorsal outline rather more strongly curved than the ventral. Eye very large, located before middle of head, high up, the interorbital area extending but little above it; maxillary not quite reaching a point below middle of eye; interorbital area convex; the skull almost flat, with four ridges, the inner of which are separated by a

rather wide, smooth space. Teeth of each jaw in a narrow, villiform band, outside of which is a row of small canines; villiform teeth on the palatines and vomer, the latter in a lunate patch; tongue naked. Pseudobranchiæ large; gill-rakers 5-9, the upper ones minute.

Head with a row of enlarged scales extending downward from posterior margin of eye to edge of maxillary; about six rows below this on the preopercle; border of preopercle naked, the edge finely serrated; opercle and subopercle scaled; occiput with two shields of coarse scales; head elsewhere naked; back with sixteen scales between occiput and insertion of dorsal; fins naked except the caudal, which has minute scales extending almost to the tips of the rays.

Third and fourth dorsal spines highest, about three in head; middle rays scarcely shorter, the posterior one somewhat elongate, the tip extending beyond edge of fin. First anal spine half the height of second, the latter about a fourth of its length shorter than the third, the length of which is contained 3.3 times in the head; anterior ray three in head, the others gradually shorter except the last which is similar to the last dorsal ray, neither dorsal nor anal reaching base of caudal when depressed. Caudal deeply forked, the lobes equal and pointed; 3.5 in the length. Pectoral very acutely pointed and slightly falcate, its tip extending to a vertical through origin of anal. Ventrals acute, 1.5 in head.

Color in spirits yellowish; a dark spot at upper edge of opercle, where it covers the lower part of a broken brown band which extends over the nape; a somewhat indefinite dark stripe having its origin about midway between nape and first dorsal spine extends along back below base of dorsal fin; a similar stripe, but less definite, extends along the side just above the lateral line to a point below end of dorsal, from where it passes upward and ends at base of caudal; scales above the pectoral with more or less dusky color.

The type, Cat. No. 68231, U.S.N.M., is a specimen 260 mm. long, from the market at Naha, Okinawa. Another example, somewhat smaller but differing in no other way from the type, is in the Stanford University collection, cotype No. 21420.

Family HÆMULIDÆ.

PENTAPUS FORMOSULUS, new species.

An apparently new species is here described from one specimen found in the market at Naha, Okinawa. It resembles *P. microdon*, but it has a deeper body and a much smaller eye.

Head 3.6 in length to base of caudal; depth 3; depth caudal peduncle 9.3; eye 4 in head; snout 3; interorbital space 3; D. X, 9; A. III, 7; scales in lateral series 45; between lateral line and spinous dorsal 2; between lateral line and base of anal 12.

Head pointed; mouth small, the maxillary extending to a point about midway between posterior nostril and border of eye. Teeth weak, in narrow bands on the jaws; the outer row enlarged; four small canines on upper jaw, two on the lower; lateral ones of upper jaw somewhat heavier than median pair. Edge of suborbital smooth, with a spine-like point below center of pupil; preopercle smooth; opercle with a small, flat spine. Gill-rakers 5-6 on first arch; reduced to mere knobs. Snout naked; scales of head and body weakly ctenoid.

Third dorsal spine highest, 2.3 in head; the following ones slightly shorter; longest rays equal in height to third spine. Third anal spine slender, its length about 3 in head. Anal when depressed not extending so far posteriorly as the dorsal, neither dorsal nor anal reaching beyond middle of caudal peduncle when depressed. Caudal deeply cleft; lobes falcate, the upper longer than the lower, about 2.5 in the length. Pectoral rather acute, 1.3 in head. Outer ray of ventral long, reaching anal opening when the fin is depressed.

Color in spirits brownish yellow, darker above than below. There are indications of a broad, light stripe along side of body above base of pectoral, and also of a dark spot on opercle.

Type.—Cat. No. 68247, U.S.N.M., a specimen 222 mm. long, from the market at Naha, Okinawa.

Family SPARIDÆ.

NEMIPTERUS BATHYBIUS, new species.

Three specimens of a *Nemipterus* that appears to be undescribed were bought in the market at Kagoshima. The width of the suborbital at the widest part is not over half the diameter of eye, the maxillary extends to a point below anterior edge of pupil, there are three or four canines on either side of upper jaw, the dorsal fin is filamentous, the last spine is highest, the upper lobe of the caudal falcate, the ventrals extend to the origin of anal, and there are 45 scales in the lateral line.

The species appears to be related to *Nemipterus japonicus* (Bloch). When compared with specimens of the latter from Cavite, *N. bathybius* may be easily distinguished by the narrower preorbital which is deeply concave on its ventral edge.

Head 3.2 in length to base of caudal; depth 3.4; depth caudal peduncle 3 in head; eye 3.6; snout 3.2; maxillary 2.6; width interorbital space 4; D. X, 9; A. III, 7; scales in lateral line 45; between lateral line and base of dorsal 3; between lateral line and origin of anal, obliquely downward and backward 9.

The interorbital space is convex; the snout rather pointed; sub-orbital area narrow, the width contained about 2.2 times in longitudinal diameter of eye, the ventral edge with a deep and rather abrupt concavity near end of maxillary; the concavity together with the convex posterior edge giving the suborbital a distinctive form. Edge of preopercle smooth except for some very minute denticulations at its upper edge. Maxillary extending to anterior edge of pupil. Teeth of upper jaw villiform; an enlarged outer row with three or four canines on either side anteriorly; lower jaw with two rows of comparatively strong teeth anteriorly, a single row of enlarged teeth along the sides. Gillrakers short and stubby, 4-9 on the first arch. Opercle with three rows of scales.

Dorsal spines high, rather slender and acute, the membrane not incised between their tips; last three spines longest, about 2.4 in head; anterior rays equal in height to the preceding spines, the posterior ones somewhat longer. Second anal spine intermediate in height between the first and third, 7.5 in head; last ray 2.3 in head. Lower lobe of caudal pointed, 1.3 in head; upper lobe falcate, a little over twice as long as lower; edge of caudal deeply emarginate. Ventrals reaching origin of anal. Pectorals acutely pointed, equal in length to ventrals.

In life the body was bright silvery with a pinkish tinge and pearly reflections; a narrow lemon-yellow stripe extends from upper edge of axil to middle of caudal peduncle, a faint brassy stripe along base of dorsal, a wide red stripe above lateral line, lateral line bordered by a light stripe with pearly reflections, below which is a brassy stripe narrowly bordered by dark pink; head pinkish, the snout purple; chin, throat, breast, belly, and lower surface of tail bright lemon yellow; dorsal translucent, the edge yellowish orange; vermiculations of lemon on membrane of fin; caudal bright pink, the filamentous rays yellow, becoming orange toward tip, upper edge of fin orange; anal and ventrals translucent; pectorals pink.

In spirits the body is rather reddish above, plain silvery below, all the bright tints having disappeared and no indication of the stripes remaining.

Type.—Cat. No. 68232, U.S.N.M., a specimen 280 mm. long including the caudal filament. Locality Kagoshima, Japan.

Two smaller examples, one of which has been placed in the Stanford University collection, cotype No. 214201, are like the type except that the ventrals are slightly shorter.

The stomach of each specimen is everted, indicating that it was taken in rather deep water.

Family POMACENTRIDÆ.

ABUDEFDUF RHOMALEUS, new species.

Head 3.5 in length measured to base of caudal fin; depth 1.8; depth caudal peduncle 6; eye 4.2 in head; interorbital space 2.5; snout 3; D. XII, 15; A. II, 13; scales in lateral series 24; between lateral line and base of dorsal 2; between lateral line and origin of anal 10.

The body is very deep, the ventral outline much more elevated than the dorsal; dorsal contour evenly curved on anterior half; ventral contour oblique and almost straight from chin to breast and nearly horizontal from the latter point to anal opening; head short and broad; eye very small, the diameter less than length of snout and equal to about half the width of interorbital space; mouth very small, oblique, the maxillary not reaching much over half way between tip of snout and border of eye. Teeth scarcely flattened, small, simple, fixed, closely apposed, in a single row. Gillrakers slender, the longest equal in length to about half the diameter of eye, 5-15 on first arch. Suborbital and preopercle with naked, smooth edges.

Scales weakly ctenoid; snout naked below and in front of nostrils; suborbital with one row of scales; preopercle with 3; opercle with 3; bases of dorsal, anal, and caudal with large scales above which minute ones extend outward on the membranes; lateral line with pores on 18 scales; each scale of the median row on caudal peduncle with a pit near the center.

Spines and rays of fins very strong; dorsal spines beyond the sixth of about equal height, 2 in head; soft dorsal rounded, the middle rays highest, reaching almost to middle of caudal when depressed, 1.2 in head. Cleft of caudal shallow, the lobes convex, the length equal to that of head. Second anal spine 2 in head; the fin rounded, 1.4 in head; Pectoral rounded, equal in length to head. Outer ray of ventral filamentous, the tip reaching anal opening when the fin is depressed.

Color in spirits, uniform deep brownish black.

Described from the type Cat. No. 68233, U.S.N.M., a specimen 165 mm. long, from Naha, Okinawa. Another example, cotype No. 21422, Stanford University collection, is of equal size and does not appear to differ from the type except that there are 13 spines and 16 rays in the dorsal fin.

ABUDEFDUF CLARKI, new species.

Head 3.3 in length to base of caudal; depth 1.7; depth caudal peduncle 5.5; eye 2.5 in head; interorbital width 2.5; snout 3; D. XIII; A. II, 13; scales in lateral series 26; between lateral line and origin of spinous dorsal 4; between lateral line and origin of anal 9.

Body markedly deep the dorsal and ventral contours evenly rounded, the dorsal more elevated than the ventral. Eye large, its longitudinal diameter greater than length of snout and about equal to distance between orbit and edge of opercle; interorbital area broad and convex. Suborbital and preopercle covered with scales, the edges smooth. Teeth simple, scarcely compressed, in a single row, closely apposed. Maxillary extending just beyond a vertical through anterior edge of pupil.

Lateral line discontinued beyond middle of soft dorsal; no pores on the caudal peduncle, but each scale in the median row with a minute pit. Scales of head and body denticulate; bases of dorsal and anal with a sheath of scales; membranes of dorsal, caudal, and anal with minute scales; snout naked.

Fourth, fifth, and sixth dorsal spines longest, 1.3 in head; soft dorsal and anal elevated, the dorsal rather pointed; height of fins about 1.2 in the head. Caudal deeply cleft, the lobes with acute tips. Pectoral pointed, its length a little less than that of head. Ventrals pointed, the tips filamentous, reaching base of second anal spine.

Color in spirits deep brown; a narrow, oblique, white band passing across body from base of ninth dorsal spine to origin of anal; upper edge of pectoral with a black spot which spreads downward and becomes diffuse over the base of fin.

This description is of the type, Cat. No. 68234, U.S.N.M., an example 70 mm. long from a pool at Tanegashima. Three smaller specimens were collected at the same time, one of which is numbered 21423 cotype, in the Stanford University collection.

In young individuals the white band is somewhat more distinct, an occasional example showing it very sharply outlined, and also followed by a second which is separated from the first by about four scales.

A few young specimens were found in the pools at Misaki. Other examples of the species were earlier identified by Jordan and Snyder as *Chrysiptera melas*. They differ from that form in having the light, oblique band, the sharply pointed caudal lobes, and the black spot at the base of pectoral. For like reasons this species can not be identified with *Glyphisodon violaceus* Brevoort.

The species is named for Mr. Austin Hobart Clark.

Family OSTRACIIDÆ.

LACTOPHRYS TRITROPIS, new species.

This species differs from others known to the Japanese fauna in having the carapace three angled. It differs from *O. concatenatus*¹ in the strong spines of the dorsal and lateral ridges. It does not

¹ Bloch, Ichth., pl. 131.

appear to be identical with any Atlantic form. It has been compared with the young of *O. gibbosus* Linnæus and found to differ in that the latter has a four or five angled carapace.

Carapace distinctly three angled, the greatly elevated dorsal ridge surmounted by two distinct, flat spines; two suborbital spines; four spines on the lateral ridge, one of which is beneath the eye, one below the dorsal, two closely apposed and located on anterior half of ridge; ventral surface convex in the middle, the lateral ridges projecting rather strongly downward; snout pointed, a slight knob near its tip, 1.6 times diameter of eye, four in length to base of caudal; carapace broadly closed both above and below the tail. D. 9; A. 9; P. 10; C. 10.

Color in the preservative, yellowish; each facet of the sides of carapace narrowly outlined in black and with a dark center; caudal peduncle with a few oblong, dark spots.

Three specimens from Misaki, measuring about 75 mm. long, show no important individual variation. A much smaller specimen from the Tokyo market, collected by Prof. K. Otaki, has the spines relatively longer and stronger than the others.

Type.—Cat. No. 68235, U.S.N.M., Misaki, Japan. Cotype, No. 21424, Stanford University collection.

Family SCORPAENIDÆ.

SEBASTODES TANAKÆ, new species.

A dark colored species of *Sebastodes* characterized by short gill-rakers, concave interorbital space, well-developed preopercular, postocular, and tympanic spines, prominent parietal spines and ridges, and a very long, naked maxillary is represented by a single specimen from Hakodate.

Head 2.6 in length to base of caudal; depth 2.7; depth caudal peduncle 3.4 in head; eye 4.8; snout 4; maxillary 2.2; width interorbital space 6.1; D. XIII, 13; A. III, 7; pores in lateral line 34.

Nasal, preocular, postocular, and tympanic spines present, each of which is heavy and high, but not very acute; postocular spine preceded by a strong ridge; parietal ridges high, each with a low posterior spine; preorbital with a broad, flat, triangular spine; preopercle with three well-developed spines which are close together and directed backward; below these are two low, rounded processes. Opercular spines, two, broad and flat, the lower one nearly covered with scales. Two humeral spines, the upper of which is short and acute, the lower broad and flat, its tip serrated. Eye of moderate size, its diameter somewhat greater than width of interorbital space. Interorbital area flat, the high spines and ridges above eye making it appear concave; a narrow trough in the middle formed by two low frontal ridges which diverge somewhat posteriorly, as do also the

rows of spines and the parietal ridges. Length of maxillary three times as great as width of interorbital space, reaching well beyond a vertical through posterior edge of orbit. Jaws even, the lower one without a prominent symphyseal knob. Teeth very fine; in broad patches on jaws, vomer, and palatines. Gillrakers 7 - 14; short and rather broad; all but two on the upper arch and four or five on the lower being little more than mere rounded knobs.

Fifth dorsal spine highest, its length contained a little less than two times in head; the spines from the third to the seventh but little shorter; longest rays about 2.2 in the head, reaching base of caudal when depressed. Second anal spine slightly higher than third and considerably stronger, its length contained three times in head; longest rays 1.8. Pectoral rays 18, half of which are simple; depressed fin reaching a vertical through anal opening. Ventral spines 3 in head; rays 13; fin pointed, not reaching anus. Caudal obtusely rounded, 1.6 in head.

Body with scales that are weakly ctenoid, a thick epidermal covering causing them to appear smooth; about 15 oblique series above lateral line and 45 below; many small supplemental scales, often 10 or more covering the base of a single large scale. Head crowded with small, weakly ctenoid scales which are also supplied with supplemental scales. Snout and region anterior to preopercular spines, preorbital, maxillaries, mandible, chin, throat, and branchiostegal region naked. Spinous dorsal naked. Other fins with minute scales that extend almost out to the tips of the rays.

Color in spirits deep, dark brown, obscurely mottled; traces of a light band extending along back beneath the dorsal fin. Peritoneum inside of mouth and gill chamber light.

One specimen, type, Cat. No. 68236, U.S.N.M., about 290 mm. long, from Hakodate, Japan.

Family COTTIDÆ.

COTTUS NOZAWÆ, new species.

Cottus nozawæ is distinguished from other Japanese species of the genus by the following combination of characters: Three preopercular spines, naked palatines, four ventral rays, and a very short maxillary which reaches to anterior border of eye and not beyond anterior border of pupil.

Head 3.2 in length to base of caudal; depth 4.5; depth caudal peduncle 3.2 in head; snout 3.2; eye 3.6; interorbital space 7; maxillary 2.7; D. VIII, 17; A. 13; P. 15; pores in lateral line about 30.

Body moderately robust, the head short, snout blunt; interorbital area and occiput convex; maxillary not quite reaching pupil; anterior nostril with a low tube, the posterior one with a scarcely evident rim;

preopercle with a long, slender, curved spine at its upper edge; two smaller spines below this pointing downward and forward; a sharp spine on lower edge of opercle; nasal spines not evident, palatines naked; vomer with a small patch of weak teeth. Lateral line complete. Minute prickles covering a small area beneath pectoral; other parts of body naked and smooth. Dorsals entirely separate, the membrane of spinous dorsal just reaching base of first ray; middle spines highest, 3 in head; longest rays about 2.3. Anal rays about 2.8; both dorsal and anal falling far short of caudal when depressed. Ventral rays I, 4, not reaching vent. Pectorals reaching a vertical through base of first anal ray.

Color light below, clouded with dusky above; four more or less definite saddle-like spots on back; two below spinous dorsal and two below soft dorsal; a narrow, dark band on base of caudal; rays and spines of fins with rows of dark spots.

Type.—Cat. No. 68237, U.S.N.M., a specimen 85 mm. long, from the Ishikari at Sapporo. Cotype, No. 21425, Stanford University collection.

Named for Prof. Sunziro Nozawa.

MYOXOCEPHALUS YESOENSIS, new species.

One specimen of a *Myoxocephalus* obtained at Hakodate does not appear to belong to a known species. It is characterized by a short, robust body without plates or scales except along the lateral line, short snout and small eyes, verrucose skin on upper parts of head where the ridges are very low, short postorbital and occipital tentacles, and two short preopercular spines. An almost colorless chin and throat and the short spines distinguishes it from *M. stelleri*, and the small eyes alone will prevent it from being confused with *M. nivosus*. It appears to most closely resemble *M. brandti*. It has, however, a smaller eye, the longitudinal diameter being considerably shorter than the snout and equal to the width of interorbital space. The upper preopercular spine is shorter and there are no small plates below the lateral line.

Head 2.4 in length to base of caudal; depth 3.5; depth of caudal peduncle 5 in head; eye 5.6; snout 3.5; interorbital space 5.6; maxillary 2.2; D. IX, 13; A. 10; P. 17; pores in lateral line 34.

Skin on upper parts warty; very short postocular and occipital filaments; postocular region with short, digitate ridges, some of which approach the median line while others extend backward and unite with an uneven, low ridge which extends from posterior border of eye, along occiput to nape where it breaks up into minute forks; a second ridge parallel with and a little below the occipital ridge passes backward and after one or two interruptions becomes continuous with the humeral spine; interorbital stay with a bony surface; upper

parts of opercle with a bony ridge continuous with the short, blunt spine; nasal spines short and very sharp; preopercle with three spines, the upper of which is somewhat shorter than longitudinal diameter of eye, the second not half so long, the third very short, blunt, and projecting downward. Interorbital space concave; occipital region flat between the ridges; lower jaw included; maxillary extending to posterior edge of orbit.

Skin naked except along lateral line where each pore opens beneath a small, concealed scale. Dorsal spines very slender, the longest (fourth and fifth) contained about 3.2 times in length of head; tip of each with a short villus; longest rays contained about 3.2 times in length of head. Anal scarcely higher than spinous dorsal, the rays of neither anal nor dorsal reaching base of caudal when depressed. Pectoral 1.5 in head; ventrals 2 in head.

Head clouded with dusky above; a poorly defined dark spot extending from eye along snout; a second less evident spot between eye and maxillary; lower lip with dusky spots, the chin and throat immaculate; back with two indefinite, dark bands which extend upward on the spinous dorsal; similar bands below the soft dorsal, the posterior part of the last one being definitely outlined, the fin with oblique, dusky clouds; anal with three broad, oblique, dark bands; posterior half of caudal peduncle and base of anal with a sharply outlined cross-band with irregular edges; posterior half of caudal with broad, blackish reticulations.

Type.—Cat. No. 68238, U.S.N.M., measures 175 mm. in length. Locality, Hakodate market.

OCYNECTES MODESTUS, new species.

This species differs from *Ocynectes maschalis* in the absence of occipital tentacles and in its plain color. Also the snout is more pointed, the maxillary shorter, the eye smaller, the body deeper, and there is one more ray in the dorsal fin.

Head 3.4 in the length to base of caudal; depth 3.9; depth of caudal peduncle 9; eye 5 in head; snout 3.5; maxillary 3.2; interorbital space 4.7; D. IX, 14; A. 11; P. 14; pores in lateral line 35.

Head and body as in *O. maschalis*, though slightly deeper, the dorsal contour being a little more elevated and the snout more pointed. Above each eye is a broad flap, the posterior edge of which bears a row of seven or more tentacles, the whole resembling a coarse-toothed comb. Nasal spines prominent, embedded in a thick, fleshy covering, each with a slender tentacle at its tip; anterior nostrils with low rims; posterior nostrils with large tubes located immediately behind the nasal spines; a low, fleshy ridge extending from between nostrils along interorbital area, growing lower and disappearing at a point between orbital flaps; head otherwise perfectly smooth

and without tentacles; body perfectly smooth; lateral line complete; pores large, the anterior nine with tentacles which are simple, bifid or trifid. Preopercular spine long, simple, and with a perceptible upward curve. Mouth small; maxillary extending to a vertical passing between anterior edge of orbit and pupil. Teeth in broad bands on jaws, vomer, and palatines.

Dorsals separate; outline of spinous dorsal slightly concave, the length of highest (anterior) spines contained about 2.3 times in the head; all but the last three anal rays large and fleshy, the membrane deeply incised between them; height of longest anal rays 2.5 in head; last dorsal ray connected by membrane with caudal peduncle, the last anal ray free posteriorly; both dorsal and anal falling far short of base of caudal when depressed. Tip of pectoral reaching a vertical through base of first anal ray when depressed; lower seven pectoral rays fleshy, the membrane deeply incised between them; all the rays simple. Ventrals 2 in head, not reaching anal opening. Caudal rounded; 1.4 in head.

In spirits the color is almost plain, a faint dusky band being suggested below the spinous dorsal, and two similar ones below the soft dorsal; tentacles of the lateral line black; orbital flap dusky. Spinous dorsal dusky, with two indistinctly outlined light spots; soft dorsal with about seven oblique, dusky bars; anal with similar bars which are broader and more numerous; upper and lower rays of caudal with four or five elongate, dark spots which are faintly continued as bars on the fin. Pectorals with narrow, irregular, dusky bars. Ventrals immaculate. Head with a narrow, dark line curving from tip of snout beneath nostril and passing backward below eye; another beginning at posterior margin of eye and extending across preopercle to base of spine.

Type.—Cat. No. 68240, U.S.N.M., from Same, Japan. A cotype, No. 21426, Stanford University collection, is like the type in all particulars except that there are 15 dorsal rays and no tentacles at tips of nasal spines. The cotype is also from Same.

BERO ZANCLUS, new species.

This species differs from *Bero elegans* in having a markedly slender body and no multifid tentacles on the head, there being a pair of slightly fringed flaps above the eyes and but one pair of small, simple tentacles on the occiput. The intromittent organ is much smaller and more slender in *B. zanclus*.

Head 2.8 in length to base of caudal; depth 5.8; depth of caudal peduncle 13.5; eye 4.5 in head; maxillary 2.1; snout 3.9; interorbital space 15; D. IX, 15; A. 15; P. 15; pores in lateral line 38.

Body elongate, tapering gradually from head to caudal peduncle; snout rather pointed; lower jaw included; eye large, the diameter about equal to length of snout; maxillary extending to a point below

posterior edge of orbit. Bands of minute teeth on jaws, vomer, and palatines. Preopercular spine equal in length to half the diameter of eye, broad, very flat, and strongly curved upward, the greater part of it concealed beneath the skin; nasal spines well developed. Anterior nostril with a long tube; posterior nostril with a high rim located behind nasal spine. A slender tentacle on maxillary near its posterior edge; a rather broad, pointed flap above upper, posterior margin of eye, and a pair of minute tentacles on occiput. Anterior part of lateral line with a row of thirteen small, scale-like plates, below which is a row of seven somewhat larger ones, the exposed edges of which are denticulate; head and body smooth elsewhere. Four very large mucous pores on each side of lower jaw; lateral line with a slight double curve anteriorly, bending downward from upper edge of gill opening, and then swinging upward somewhat above its general level. Anal papilla slender and pointed, its length equal to half the diameter of eye.

Dorsal fins separate, the spines slender and flexible, the highest contained 2.5 times in length of head; highest dorsal rays 2.3 in head. Origin of anal below second dorsal ray; highest ray 3 in head. Caudal slightly rounded posteriorly, 16 in head. Pectoral pointed, the tip reaching a vertical through base of third anal ray. Ventrals with two weak rays; 3.3 in head.

In the preserved specimen the head and body are spotted and mottled with dark brown, the pattern being very intricate; dorsals, anal, and caudal with broad, oblique, and rather indefinite dark bars; pectoral with a dark blotch near its base and three or four irregular bars beyond this.

The species is described from a single specimen measuring 88 mm. in length, found in the market at Otaru, Japan.

Type.—Cat. No. 68239, U.S.N.M.

Family AGONIDÆ.

PODOTHECUS XYSTES, new species.

A specimen of *Podothecus* collected at Nagaoka, Japan, by Mr. M. Nakamura, appears to belong to an unknown species, which is characterized principally by its long anal fin. It appears to be related to *P. sturioides* (Guichenot), but that form has a shorter anal, ten rays, and it also differs in color and other particulars. In many respects this species resembles the young of *Draciscus*, and possibly it should be placed in that genus. It differs from *D. sachi* Jordan and Snyder in having a shorter and broader snout, larger eye, fewer barbels, and in having fewer dorsal and anal rays.

Head 3.6 in the length to base of caudal; depth at nape 7.6; snout 2.2 in head; eye 4.2; interorbital space 4.6; length maxillary 3.5; D. IX, 9; A. 15; lateral line 41.

The depth at the nape is equal to the length of snout; the width of head measured between the crests of the subopercular ridges is slightly greater than length of snout. The tip of the snout is injured, but there appears to have been two terminal spines, each of which is followed by a short lateral spine, and these in turn followed by a series of very narrow, slightly diverging, rugose ridges, several of which converge and unite at the bases of a pair of closely apposed spines, which are a little nearer eye than tip of snout. Other ridges pass backward and end just above the tubular nostril, while others more ventrally located pass backward along the edges of lower jaw. Orbital crest arched somewhat above contour of head, with a strong spine on its upper posterior part; interorbital space broadly concave; the lateral ridges well separated. Occiput with two parallel crests, each ending in a high, flat spine which is similar to the succeeding ones on the nape and body; surface of the occipital region between the crests concave and smooth. On the orbital margin, below and posterior to the larger spine is a smaller spine marking the anterior end of a curved ridge which passes backward and ends at a point directly above gill opening. Lower rim of orbit with a row of fine denticulations. Side of snout with a prominent ridge ending in a spine below posterior margin of pupil; a small spine on snout above the ridge. Lower border of preopercle with a pronounced ridge; subopercle with two ridges, the upper much higher and sharper, both ending in flat, blunt spines. Mouth broad, the maxillary extending to a point beneath anterior margin of eye. A group of four or five barbels on each side beneath tip of snout; posterior edge of maxillary with a group of about ten barbels, the posterior pair of which are much longer than the others; lower lip with a pair of small barbels near the middle on each side; none at the symphysis. Each angle of the body armed with a row of strong spines as is usual in the genus. Plates with radial striæ.

Spinous dorsal inserted just behind the fourth row of dorsal plates, the base including the membrane extending over ten of them; one row between the spinous and soft dorsal; soft dorsal located on twelve rows. First dorsal spine highest, 2.5 in the head; the others graduated in length to the last which about equals the diameter of pupil; longest (first) dorsal ray 2 in head. Origin of anal just posterior to a vertical through base of last dorsal spine; the middle rays longest, 2 in head. Caudal 1.7 in head, the margin slightly concave. Upper pectoral rays longest, 1.25 in head; the succeeding rays shorter until the fourth from below which is elongate, the following 3 in turn growing shorter; the 5 lower rays somewhat thickened, the membrane deeply scalloped between their tips. Ventral rays 2, their length contained 3.3 in the head.

Snout with a black bar on each side extending from tip to eye; tip of snout black beneath; three indefinitely outlined dark blotches on opercular region; a dark, transverse bar on occiput including the spines and extending to the lateral ridge; a similar bar on nape crossing the second row of body rings; body with a number of elongate, blackish spots located mostly above the lateral line; basal region of pectoral with an oval, black spot; axil of fin dusky; dorsals and caudal bordered with blackish.

Type.—Cat. No. 20702, Stanford University collection, a specimen measuring 190 mm. long from Nagaoka, Japan. Mr. M. Nakamura, collector.

Family TRIGLIDÆ.

LEPIDOTRIGLA KISHINOYUI, new species.

This species is characterized by the possession of a rather long, emarginate, armed snout, unmarked dorsal with evenly graduated spines, moderately long, free pectoral rays, and a dark colored pectoral fin with elongate white spots.

Head measured to edge of opercle 2.9 in length to base of dorsal; depth 4.1; depth caudal peduncle 5.5 in head; snout (eye to base of spine) 2.2; eye 3.4; interorbital space 4.8; D. IX, 13; A. 15; scales in lateral series about 60.

From the median line outward the edge of the snout grows more serrate to the large spine at the angle, the length of which is contained three times in the width of the interorbital space. Upper outline of snout almost straight; somewhat concave in one example; interorbital area deeply concave; two supraorbital, one opercular, one occipital and one scapular spine present; plates of head rugose, a little rougher than in allied species; a furrow behind eye which does not extend across occiput; No teeth on vomer and palatines. Seven slender gillrakers present on lower limb of first arch.

Third dorsal spine slightly longer than second, 1.8 in head; its tip and those of succeeding ones reaching an equal distance (origin of soft dorsal) posteriorly when depressed; anterior edges of spines serrated, the median row of serrations strongest on first spine; longest dorsal rays 2.5 in head. Edge of caudal concave; length of fin 1.4 in head. Tips of anal and dorsal rays reaching an equal distance posteriorly when depressed. Pectorals reaching an eye's diameter beyond origin of anal; longest detached ray falling short of tip of ventral a distance equal to one-third the diameter of eye. Ventrals reaching base of third anal ray. Dorsal fins inserted in a groove each edge of which is bordered by a row of spinous scales, those along base of soft dorsal being stronger and sharply pointed. Other scales of body heavy and roughly ctenoid.

Alcoholic specimens have the throat, breast, and outer or anterior surface of pectorals, except the tips, dead white; inner surface of pectorals dusky, the color not extending over the lower attached rays, which are white; lower half of fin dense black with elongate, white spots; rays white near tip of fin. Caudal with two indistinct, vertical, dusky bands.

Type.—Cat. No. 68241, U.S.N.M., a specimen measuring 98 mm. in length, from Kagoshima. Two other specimens, one of which is deposited in the Stanford University collection, cotype, No. 21427, are from the same locality and do not differ from the type.

The species is named for Dr. K. Kishinouye.

Family GOBIIDÆ.

CLARIGER EXILIS, new species.

This species differs from *Clariger cosmurus* in having the body more extensively scaled, the scales extending forward over an angular region to or beyond the base of spinous dorsal. The body is more slender and the dark lateral stripe is broader, extending downward and almost covering the sides of the body.

Head 4 in length to base of caudal; depth 8; depth caudal peduncle 8.5; eye 6 in head; snout 3.6; interorbital space 5.5; D. III, 11; A. 11; P. 18.

The head is broad, much wider than the body and considerably depressed; snout short, the eyes located far forward and directed obliquely upward; interorbital space flat; mouth broad, the cleft extending backward to a point beneath pupil; lower jaw projecting somewhat; tongue broad and deeply notched anteriorly. Teeth in narrow bands on the jaws; a well defined outer and inner row of enlarged teeth on the upper jaw; an inner row of slightly enlarged teeth on the lower jaw, the teeth increasing in size posteriorly, the last on each side separated from the others and considerably enlarged. Vomer and palatines naked. Gill clefts restricted to the sides, the openings somewhat broader than the base of pectorals. The skin of the head is full and wrinkled about the snout and chin; a row of four or five fleshy barbels below eye; a pair of broad, short flaps at the symphysis.

Head and greater part of body naked; caudal peduncle completely scaled except on the upper and lower edges, the scaled area extending forward in an irregular patch, the point of which reaches to or beyond a vertical through the spinous dorsal. Spinous dorsal short and low, the first spine inserted about midway between occiput and origin of soft dorsal; the first two spines closely apposed; the entire fin very frail. Bases of soft dorsal and anal of about equal length, the membranes rather thin and the rays frail; no membrane

posterior to the last ray. Caudal broadly rounded. Pectoral somewhat acutely rounded. Ventrals united; free posteriorly.

Color much like that of *C. cosmurus*; the lateral stripe light brown and much broader, extending downward so that the entire sides are covered; sides with many scattered white spots of various sizes; a number of larger ones about equal to diameter of pupil, located in a row near upper edge of dark area; a large light spot on upper and also on lower edge of caudal peduncle; upper part of snout, head and back whitish; throat and abdomen light; base of pectoral and central portion of caudal dark.

Type.—Cat. No. 68242, U.S.N.M., measuring about 32 mm. in length. Locality, Tanegashima, Japan. Cotype No. 21428. Stanford University collection. Ten specimens from Tanegashima range in size from 20 to 32 mm. in length. They were found in the more outlying pools and appeared only after the water had been thoroughly poisoned.

Family CALLIONYMIIDÆ.

DRACULO, new genus.

In this genus the spinous dorsal is absent; the preopercular spine has three or four strong branches or prongs; the lateral line is single. The body is broad and flat, skin of head smooth, mouth small, teeth in narrow bands, lower lip fringed, gill rakers short and few.

Type of genus.—*Draculo mirabilis*, new species.

DRACULO MIRABILIS, new species.

Head (tip of snout to end of opercular flap) 2.9 in length to base of caudal; depth 6.6; width of body 4.5; length of snout 4.5 in head; diameter of eye 5; width interorbital space 10; D. 14; A. 13; P. 18.

The body is broad and flat, the head triangular when viewed from above, the tail rather abruptly compressed behind the body; caudal peduncle deep; dorsal contour but little curved between tip of snout and base of caudal. Skin of head thin and smooth. Anterior nostril with a tube or elevated rim. Mouth small, the maxillary not reaching eye; lower lip with a fringe of long papillæ. Teeth minute, in narrow bands on the jaws; none on palatines and vomer. Gill openings very narrow; pseudo-branchiæ present, the filaments long; gillrakers short and widely spaced, seven on first arch. Preopercle with a large, four-pronged spine. Opercular flap extending to base of pectoral. A small anal papilla present.

Lateral line extending from occiput to base of caudal fin; an abrupt downward curve occurring near middle of body; with large pores and short branches at intervals; a branch passing over caudal peduncle and connecting with line on opposite side; a transverse, connecting

branch extending across occiput; two accessory branches on head, one of which is beneath the eye, the other extending downward to edge of opercle.

No spinous dorsal present. Soft dorsal and anal inserted on a vertical passing just posterior to anal opening and decidedly nearer tip of snout than base of caudal; the middle rays of both fins nearly equal in height, about three in head; the posterior rays of anal growing longer posteriorly so that they reach slightly beyond base of caudal when depressed. Caudal pointed, the length contained about 1.5 times in length of head. Pectoral pointed, 1.25 in head, the tip reaching beyond origins of dorsal and anal. Posterior rays of ventral longest, two in head.

In alcohol, pale flesh color, finely marbled and speckled with brown; immaculate beneath; dorsal, caudal, and upper pectoral rays spotted with brown.

The species is represented by three specimens measuring 35 mm. in length. They were found entangled in a great seine drawn by fishermen on the sandy beach near Tomakomai in Hokkaido, at the request of Prof. S. Nozawa.

Type.—Cat. No. 68243, U.S.N.M. Cotype No. 21429, Stanford University collection.

Family PLEURONECTIDÆ.

HIPPOGLOSSOIDES KATAKURÆ, new species.

This species may be distinguished from *H. dubius*, *H. classodon*, and *H. hamiltoni* by the more abrupt and higher arch in the lateral line, there being six or seven rows of scales between its uppermost part and the horizontal; by the deeper body, the dorsal contour being accordingly more arched. There are more rays in the dorsal fin of *K. katakuræ*, it having 90, while the other closely related species have not more than 85. The ventral fins of the new species are pointed, and the dorsal originates slightly in front of the eye.

Head 3.8 in length to base of caudal; depth 2.5; depth of caudal peduncle 9; eye 4.7 in head; snout 5.5; maxillary 2.5; D. 90; A. 69; pores in lateral line 93; transverse series of scales 100.

Body dextral; dorsal contour rather strongly arched from a point above the eye, thus giving the anterior parts a more obtuse appearance than is common to other Japanese species of the genus. The upper eye is placed well in advance of the lower; the interorbital space rather broad, with four rows of minute scales at its narrowest part. Maxillary extending to a vertical passing midway between posterior edge of eye and pupil. Teeth small, slender, in a single row on the symphysis, where they are irregularly placed, enlarged and somewhat canine-like. Gillrakers long, flat, and rather slender, 3+12 on the first arch. Vertebrae 41.

Scales finely ctenoid except in the abdominal region, where they appear to be cycloid; those of blind side somewhat smoother than the others. No plates or rough surfaces on head or other parts. Eyes naked. Fin rays with minute scales, the membranes naked. Lateral line arched though not abruptly so, the curve being gentle and even, about 30 scales long and 7 above a horizontal at its highest part; straight from curve to tip of caudal.

Dorsal inserted on the blind side at a point directly opposite anterior edge of orbit, the fin reaching the median line at base of third ray; rays highest beyond median part of fin, about 2.3 in the head. Anal preceded by a strong spine which protrudes through the skin; base of fin extending anteriorly a slight distance beyond that of dorsal; highest rays of anal contained 2.3 in head. Caudal obtusely rounded, 1.2 in head. Pectoral with 11 rays, the third, fourth, and fifth from above, longest; two in head; that of blind side with 10 rays, the fifth and sixth longest, 2.3 in the head. Ventrals symmetrical, the fifth ray from before longest, 3 in head.

Color in spirits plain pale brown.

One specimen, the type, Cat. No. 68244, U.S.N.M., measuring 320 mm. in length. Locality, Otaru, Japan.

The type was presented along with specimens of other species by Mr. Kenkichi Katakura, for whom the form is named.

LEPIDOPSETTA MOCHIGAREI, new species.

Two specimens of a species closely related to *Lepidopsetta bilineata* were collected at Otaru in Hokkaido. They belong to a form which evidently represents *L. bilineata*, but differ in having a much narrower interorbital width, larger eyes, blunter snout, and smoother scales. In number of fin rays and size of scales the Otaru species also differs materially from specimens of *L. bilineata* from Nikolski and from Alaska. The former has 74 to 80 rays in the dorsal, 57 to 61 in the anal, and 92 to 98 scales in the lateral line, as shown by two specimens. Five specimens of *L. bilineata* from three localities have fin rays and scales as follows:

| | | | |
|------------------------------|-----------|-----------|--------------|
| Nikolski, Bering Island..... | D. 75-79; | A. 58-62; | L. L. 83-90. |
| Chignik Bay, Alaska..... | 72-76; | 57-58; | 78-83. |
| Seattle, Puget Sound..... | 68-75; | 50-58; | 79-89. |

Head 3.8 in length to base of caudal; depth 1.9; depth of caudal peduncle 9.2; eye 3 in head; snout 5.5; maxillary 4; D. 80; A. 61; pores in lateral line 98; in transverse series of scales 90.

Body apparently somewhat deeper than in *L. bilineata*, the dorsal contour rising somewhat abruptly, and the snout having a less pointed appearance. Orbits very large, the upper being considerably larger than the lower; anterior edge of the lower in advance of the upper. Interorbital area high and very narrow. Maxillary extending

to anterior border of pupil of lower eye. Teeth small, conical, closely apposed; strong on the blind side, very weak and few on the opposite side; located in a single row with occasionally an irregular one. Gillrakers on first arch 2 + 5; those on upper limb scarcely evident, the lower ones short, flat, blunt, and widely spaced. Nostrils tubular.

Lateral line with a very abrupt arch which at its highest point is about eight scales above the horizontal, with an accessory branch which does not extend backward as far as the gill opening. A conspicuous ventral branch extends downward and forward beneath the eye to the maxillary. Scales weakly ctenoid, this character appearing as distinctive when the species is compared with *L. bilineata*; those of opercles minute and closely crowded; occipital space with but a single row of minute scales; all the fin rays except the pectoral on the blind side with minute scales; edge of preopercle naked.

Dorsal originating above anterior edge of pupil; longest rays contained about two times in head. Highest anal rays equal in length to those of dorsal. Caudal rounded, 1.2 in the head. Pectoral 1.8 in head; that of blind side about 3 in head. Ventrals rather stout, the rays heavy, 3 in head. Base of anal preceded by a short, strong spine that protrudes through the skin.

Color in spirits pale brown.

Two specimens were procured in the market at Otaru, Hokkaido, one of which, measuring 208 mm. in length, is selected as the type, Cat. No. 68245, U.S.N.M. The other, measuring 145 mm., is recorded in the Stanford University collection as cotype No. 21430.

(*Mochigarei*, a Japanese name, meaning rice-cake flounder.)

GLYPTOCEPHALUS SASÆ, new species.

This species has a deeper and more robust body than *G. zachirus*, and it also differs from that species in having a shorter, rounded pectoral and a much weaker anal spine, which does not appear to protrude from the skin. It differs markedly from *G. zachirus* and also from *G. cynoglossus*, the Atlantic form, in having but 49 vertebræ.

Head 4.8 in length to base of caudal; depth 2.9; depth caudal peduncle 11.5; eye 3.5 in head; snout 4.1; maxillary 5.2; D. 90; A. 77; pores in lateral line about 109; transverse series of scales about 113.

Body dextral, the snout rather blunt; mouth small; the maxillary extending but little beyond anterior margin of eye, that of the blind side almost a third longer. Lower eye advanced in position, its posterior border touching a perpendicular through edge of pupil of upper eye; interorbital space broad, almost equal in width to half the vertical diameter of lower eye. Anterior nostril with a short tube. Teeth present on both sides of the jaws, in a single row, closely

apposed, short, rather stubby, though incisor-like, the cutting edges somewhat granular and brown in color. Gillrakers 48, very short, pointed, and widely spaced. Bones of blind side of head very cavernous, four large pits in the preopercle being very distinct.

Dorsal inserted on the median line, the first ray rising from a point directly above middle of pupil; highest rays contained about 1.9 times in the head. Anal spine minute, concealed beneath the skin; longest anal rays 2 in head. Caudal obtusely rounded, somewhat shorter than head. Pectoral rays 11, the fourth and fifth from above longest, 1.3 in head. Pectoral of blind side 2.5 in head. Ventrals 3 and 3.6 in head, respectively.

Lateral line almost straight, the anterior part with a slight elevation.

Scales small, cycloid, well imbricated, covering the preopercular margin and the interorbital area, but not intruding on the skin of the eyes; extending outward to near the tips of the rays of the unpaired fins; basal parts of rays of unpaired fins scaly; snout naked on the right side, almost entirely scaled on the blind side.

Color in spirits deep brown, the dorsal, anal, and caudal somewhat darker along their edges; pectoral of eyed side broadly bordered with blackish.

Described from the type, Cat. No. 68246, U.S.N.M., a specimen 350 mm. long from the market at Otaru, Hokkaido. This specimen was secured through the courtesy of Mr. Shigeo Sasa, for whom the species is named. Two other examples were secured from a mass of partly decayed fishes at Mororan. One is large, dark colored, and similar to the type. The other is much smaller and very light in color, except for the dark edges of the fins. In these the dorsal has 85-84 rays; anal 74-77 rays; pores in lateral line 112-106. One of the Mororan specimens is retained in the Stanford University collection as cotype No. 21431.

DESCRIPTIONS OF NEW SPECIES OF WASPS WITH NOTES
ON DESCRIBED SPECIES.

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The following notes and descriptions have accumulated during the past three years. Some of the descriptions were drawn up years ago, while the others have been made since November, 1909, when the writer came to Washington.

Superfamily VESPOIDEA.

Family ANTHOBOSCIDÆ.

Genus SIEROLOMORPHA Ashmead.

The genus *Sierolomorpha* Ashmead was founded¹ for a curious little wasp described² by Ashmead under the name *Sierola ambigua*. In Ashmead's tables to the genera of Vespoidea it is placed in the family Cosilidæ, but according to his own tables this is wrong, as the intermediate coxæ are distinctly separated,³ and following his characters it runs out at category 5 (p. 40) in his family Tiphidæ because there is only one complete, well-defined cubital cell, the second being only faintly indicated, as in the genus *Trypoxylon*. The cubitus of the hind wings is much beyond the transverse median vein. The habitus of *Sierolomorpha* would recall certain of the Bethylids, or is more like *Tiphia* than like *Anthobosca*. The ventral constriction of the abdomen is like *Anthobosca* and not like the Bethylids. The genus may for the present be placed in the family Anthoboscidæ, which may be recognized by the shape of the first abdominal segment, the unarmed pygidium, and other characters.

¹ Can. Ent., vol. 35, 1903, p. 42.

² Bull. 45, U. S. Nat. Mus., 1893, p. 56.

³ The use of the distance between the intermediate coxæ as a family character in this group is open to question. The above-mentioned distance varies to some extent in the sexes, and in the genus *Anthobosca* (which Mr. Turner has shown *Cosila* Guérin is a synonym, hence the change of the family name from that used by Ashmead) the type of the family, the distance between the intermediate coxæ is great enough to permit one to say that they are well separated.

Family SCOLIIDÆ.

Genus SCOLIA Fabricius.

Type.—*Scolia quadripunctata* Fabricius (Latreille, 1810).

Mr. C. Schrottky has¹ contended that the type of the genus *Scolia* Fabricius is *Scolia atrata* Fabricius. *Scolia atrata* was the first species included and according to the system used by Saussure and Sichel² belongs to *Elis*. In stating that the type of *Scolia* is *atrata* Fabricius, Schrottky adheres to the antiquated first-species rule. This adherence is unfortunate, as the idea has been entirely done away with by most systematists in all groups of animals, as well as being ruled against by the International Congress of Zoological Nomenclature.

The genus *Scolia* as originally defined by Fabricius³ included 10 species. The eighth species, *Scolia quadripunctata* Fabricius, was chosen as the type by Latreille in 1810.⁴ No older designation of type for this genus is known to the writer, therefore *Scolia quadripunctata* Fabricius is considered the type of the genus *Scolia* Fabricius.

Other designations of the type of *Scolia* are *Scolia flavifrons* Fabricius by Bingham (1897) and Ashmead (1903).

Family ELIIDÆ.

Genus ELIS Fabricius.

Type.—*Elis sexcincta* Fabricius (Bingham, 1897).

Mr. R. E. Turner⁵ places the genus *Plesia* Jurine as a synonym of *Elis* Fabricius; the types of the two genera involved show that this view is correct. Colonel Bingham in 1897⁶ fixed as the type of the genus *Elis* Fabricius *Elis sexcincta*, the first species originally included in the genus;⁷ W. H. Ashmead⁸ fixed as the type of *Plesia* Jurine *Tiphia namea* Fabricius, a species originally included. *Elis sexcincta* Fabricius and *Tiphia namea* Fabricius are congeneric, so the synonymy is:

ELIS FABRICIUS, Syst. Piez., 1804, p. 248, n. 46.

Plesia JURINE, Nouv. meth. class. Hym., 1807, p. 150.

¹ Deutsche Ent. Zeit., vol. 2, March, 1910, p. 196.

² Cat. des species gen. Scolia, 1864.

³ Syst. ent., 1775, p. 355, n. 111.

⁴ Considerations Generales sur L'Ordre Naturel des Crustaces Arachnides et Insects.

⁵ Ann. Mag. Nat. Hist. (8), vol. 4, Sept., 1909, p. 165.

⁶ Fauna Brit. India Hym., vol. 1, p. 89.

⁷ C. Schrottky, Deutsche Ent. Zeit., vol. 2, March, 1910, p. 197, also uses this type.

⁸ Can. Ent., 1903, p. 5.

Family EUMENIDÆ.

Genus PTEROCHILUS Klug.

PTEROCHILUS MORRISONI Cresson.

Pterochilus morrisoni CRESSON, Proc. Ent. Soc. Acad. Nat. Sci. Phila., April, 1879, p. XIX.

Pterochilus flavobalteatus CAMERON, Ponoma Journ. Ent. Col., vol. 1, No. 3, 1909, p. 34.

Specimens of *Pterochilus morrisoni* collected in Colorado (one from Rifle, which is in the Transition Life Zone, collected July 2, 1908, by S. A. Rohwer, and others without definite data) agree even better with Cameron's description of *P. flavobalteatus* than they do with Cresson's description of *P. morrisoni*. There seems to be no doubt about the identity of the two forms.

PTEROCHILUS SENECONIS, new species.

Related to *Pterochilus morrisoni* Cresson, but may be separated by the sharper angles to the truncate part of the clypeus, whitish markings, and small pale spot on the mesopleuræ.

Female.—Total length about 8 mm. Clypeus in outline pentagonal, wider than long, with shallow, sometimes confluent punctures, apex truncate, the lateral angles sharp; front somewhat produced between the antennæ, with close, rather large punctures, vertex and cheeks more sparsely so; impressed line from anterior ocellus short and feeble; occiput carinated, arcuate; antennæ very robust, the third joint subequal with the two following; thorax punctured similar to the front, notauli present only posteriorly; sides of pronotum irregularly punctured; metanotum rounded, perpendicular; abdomen finely reticulate, with small, well-separated punctures better defined on the apical margins, second segment wider than long. Black; spot on clypeus, mandibles except picuous apices, inner orbits to emargination of eye, spot on posterior orbits, scape beneath line on pronotum narrowed within, tegulæ, spot below, two spots on scutellum, line on metanotum, spot on lateral posterior face of propodeum, all the dorsal abdominal segments apically, second ventral apically, and lateral spots on three following whitish; legs black, tibiæ except spot within, and tarsi yellow; flagellum rufo-ferruginous beneath. Wings dusky hyaline, venation basally pale, apically dark brown.

Paratypes show the clypeus may be almost or entirely black, the second ventral segment with the band interrupted.

Male.—Total length about 8 mm. Differs from the female in the entirely pale clypeus, orange-colored flagellum, four anterior femora being pale beneath, and ventral segments two to six with a pale apical band. The clypeus and thoracic markings are yellowish.

Florissant, Colorado. Type, female collected on June 28, 1908, on flowers of *Senecio cyambalarioides* Nuttall; two other females collected June 15 and June 21; two males collected near Florissant on June 18, 1906, one at flowers of *Senecio*, sp.; one male collected east of Lake George (near Florissant), June 18, by W. P. Cockerell. Unless otherwise stated, the specimens were collected by S. A. Rohwer.

Type.—Cat. No. 13732, U.S.N.M.

PTEROCHILUS LEUCOTÆNIUS, new species.

Should be easily recognized by its size, whitish markings, and rufo-ferruginous legs.

Female.—Total length about 14 mm. Clypeus convex, depressed apically to the truncate anterior margin, the angles of the truncation sharp, in outline pentagonal, feebly punctured basally, apically with rather large, irregular, separate punctures; front with close, well-defined punctures, vertex and occiput with smaller and more widely separated punctures; front raised between the antennæ; no incomplete impressed line from the anterior ocellus; occiput carinated, broadly arcuately emarginate; antennæ robust, the third joint subequal with the two following; mesonotum and scutellum punctured similar to the front; notauli present only posteriorly; metanotum rounded perpendicular; abdomen dulled with fine reticulations, the apical margins of the three last segments with irregular punctures. Black; basal half of clypeus, except two spots, narrow inner orbits below emargination, pronotum dorsally in part, tegulæ except middle spot, spot beneath tegulæ, two small spots on scutellum, line on metanotum, spots on lateral posterior angles of prododeum, band on all the dorsal segments, slightly dentate laterally on the apical ones, band on second and spots on third ventral segment whitish; scape beneath and legs beyond bases of femora rufo-ferruginous; wings dusky hyaline, basal of basal vein slightly yellowish, apical margin distinctly dusky; basal venation and stigma yellowish, apical venation dark brown.

Paratypes show that the clypeus may be entirely pale.

Lethbridge, Alberta, Canada. Five females collected July 4 and 9, 1909, by Mr. J. B. Wallis.

Type.—Cat. No. 13731, U.S.N.M.

PTEROCHILUS DIVERSICOLOR, new species.

Perhaps related to *Pterochilus luteicollis* Cameron, but differs from his description of this species in many characters.

Female.—Total length 9 mm. Slender; clypeus in outline nearly hexagonal, much wider than long, apex gently rounded, the angles obtuse, surface finely punctate-striate; mandibles slender, with three blunt, inner teeth; front hardly produced between the antennæ; front with separate, rather large punctures, vertex and cheek more

finely and sparsely so, antennæ subclavate, third joint slightly longer than the two following; thorax with the punctures rather more separated than those of the front; suture between mesonotum and scutellum foveolate; metanotum rounded, the perpendicular face nearly impunctate; posterior face of the propodeum with a median furrow; abdomen longer than the head and thorax, first segment long, about one-third longer than the apical width, length and width of second segment subequal; dorsal surface with distinct separate punctures, becoming smaller apically. Head and thorax (except a broad band between eyes at vertex, a median black line on mesonotum expanding at the ends, and mesopectus, which are black) *testaceous*; abdomen *rufo-testaceous*, the first four dorsal segments narrowly banded with white; wings yellowish hyaline, venation basally *testaceous*, apically dark brown.

San Diego County, California. One female collected by Mr. D. W. Coquillett.

Type.—Cat. No. 13733, U.S.N.M.

Family MASARIDÆ.

Genus PSEUDOMASARIS Ashmead.

PSEUDOMASARIS COQUILLETTI, new species.

In color and habitus much like *P. edwardsii* Cresson. The female may be separated by the presence of a fine raised line on the scutellum, the orbits entirely yellow, and with an interrupted yellow band on the vertex. The male may at once be known from *edwardsii* by the club of the antennæ not being concave beneath.

Female.—Length 15 mm. Clypeus much wider than long, the apical margin broadly, arcuately emarginate, the surface finely sculptured; third antennal joint longer than the fourth and fifth; ocelli nearly in an equilateral triangle; the postocellar line shorter than the ocellorbital line; thorax finely, closely granular; notauli wanting; angles of propodeum sharp; transverse cubiti separated on the radius; abdomen finely, closely granular. Black with abundant yellow markings; the following parts yellow: Mandibles, clypeus except two black lines, labrum, large subtriangular spot above antennæ, orbits broadly, an interrupted band on vertex, basal five antennal joints, pronotum except a black line, tegulæ, two lines on mesonotum, large spots on mesopleuræ, apex of scutellum, metanotum, two spots on metapleuræ, propodeum except two large black spots, all the segments of the abdomen broadly (more or less emarginate in the dorsal middle). Legs yellow except coxæ, trochanters and base of femora beneath which are black. Wings yellowish-hyaline; venation yellowish.

Male.—Length 14 mm. Colored like the female except the black on the propodeum and metapleuræ is larger, and there is no black on

the clypeus. Structurally the male is like *zonalis* Cresson, except the apical segment of the abdomen, which resembles *edwardsii* differing in the apical dorsal protuberances being closer together.

Los Angeles County, California. A male and female collected in April by Mr. D. W. Coquillett, for whom the species is named.

Type.—Cat. No. 13734, U.S.N.M.

Family PSAMMOCHARIDÆ.

Genus PRIOCNEMIS Schiödt.

PRIOCNEMIS SUBCONICUS, new species.

Apparently most closely allied to *conicus* Say, but may be separated at once by the opaque abdomen. From *subopacus* Cresson it may be known by the narrowly arcuate pronotum and different shape of the third cubital cell. From *idoneus* Banks the flat vertex, paler wings, and longer calcarium of the hind tibiæ (it being one-half times as long as the basitarsis) will distinguish it.

Female.—Length 11 mm. Clypeus produced, the anterior margin nearly truncate, the anterior surface more closely sculptured than the basal; front so closely punctured as to appear granular, the impressed line faint; scape robust, about two-thirds the length of the first joint of the flagellum; antennæ slender, much longer than the head and thorax, the third joint a little longer than the fourth; postocellar line distinctly shorter than the ocellocular or ocelloccipital line, lateral-ocellar line shorter than the diameter of the anterior ocellus; posterior margin of the pronotum narrowly arcuate; propodeum with an indistinct impressed line; tarsal comb wanting; apical tarsal joint without spines, legs feebly spined; transverse median its own length beyond the basal; second cubital narrowed basally; third cubital cell one-third longer below; hind cubitus slightly basad of the transverse median vein; abdomen opaque. Black, opaque; well clothed with black hairs; wings not quite uniformly dark brown, venation nearly the same color.

Lawrence, Kansas. One female collected at "twilight" in July by Mr. E. S. Tucker.

Type.—Cat. No. 13735, U.S.N.M.

Superfamily SPHECOIDEA.

Family SPHECIDÆ.

Genus PODIUM Fabricius.

PODIUM CAROLINA, new species.

Differs from the meager description of *P. rufipes* Fabricius in having the clypeus quinque-dentate, not quadridentate. Nor does this agree with Saussure's interpretation of *P. rufipes*, which has the clypeus quinque-dentate.

Female.—Length 16 mm. Clypeus armed with five sharp teeth; space between the eyes at the vertex distinctly less than at the clypeus; ocelli in an acute triangle; front below the ocelli with irregular, confluent punctures; the rest of the head with widely separated punctures; third antennal joint not much shorter than the fourth and fifth; pronotum sculptured like the head, with a distinct median sulcus; mesonotum with larger and closer punctures than the scutellum or pronotum; mesopleuræ and pectus punctured as mesonotum; propodeum striato-punctate, rounded, not abruptly truncate; petiole a little more than twice the length of the posterior coxæ; second cubital cell narrowed above, receiving the second recurrent vein at about the apical fourth; first recurrent vein received by the first cubital cell free from the transverse cubitus. Black: most of mandibles, and legs below about the middle of the femora rufous; pubescence sparse, gray. Wings clear hyaline, a cloud at upper apex, and one in the second cubital cell fuscous; a narrow fuscous line on basal side of basal vein; venation dark brown.

Tryon, North Carolina. One female collected by Mr. W. F. Fiske, June 20.

Type.—Cat. No. 13736, U.S.N.M.

Genus CHLORION Latreille.

CHLORION (PALMODES) RUFIVENTRIS, var. OPUNTIÆ, new variety.

Differs from the typical form in the nonimpressed scutellum, and in the strong aciculation of the vertex, pronotum, and the anterior part of the mesonotum.

Victoria, Texas. One female collected "On *Opuntia*," April 17, 1908, by J. D. Mitchell.

Type.—Cat. No. 13737, U.S.N.M.

FAMILY PSENIDÆ.

Genus STIGMUS Panzer.

STIGMUS CONESTOGORUM, new species.

Closely related to *americanus* Packard, but the pygidium is about one and a half times as long as wide (in *americanus* it is hardly as long as wide); and the legs and venation are darker.

Female.—Clypeus polished, the anterior margin slightly emarginate medially; front very finely granular, rest of head polished, impunctate; impressed frontal line wanting; head nearly quadrate, as in *americanus* Packard; eyes not strongly converging to the clypeus; third antennal joint subequal with second, distinctly longer than fourth, apical joint robust neither pointed nor spatulate, not as long as two preceding; pronotum sharply carinate, dentate laterally; mesonotum shining impunctate except anteriorly where it is finely scratched; scutellum not impressed; sutures on mesopleuræ strongly foveolate;

dorsal aspect of propodeum with a transversely ridged enclosure, parted by a longitudinal carina, in outline the inclosure is somewhat like a truncate arrowhead; sides of propodeum reticulate; second cubital cell slightly narrowed above; sides of petiole with strong oblique carinæ apically, in length subequal with the posterior femora; pygidium well defined, narrow, about one and a half times as long as wide. Shining black; spot on mandibles and tubercles tegulæ and posterior tarsi ferruginous; anterior femora and posterior tibiæ brownish; venation brown, stigma black.

Highspire, Pennsylvania. One female collected by Mr. W. S. Fisher, June 13, 1908; two other females collected near Harrisburg, Pennsylvania, June 14, 1909, by A. B. Champlain, and July 18, 1909, by Mr. P. R. Myers; also a female from the Baker collection from Pennsylvania.

Type.—Cat. No. 13769, U.S.N.M.

STIGMUS APHIDIPERDA, new species.

Of the described nearctic species this is more closely allied to *S. fraternus* Say, from which it may be known by the dorsal lateral angle of the pronotum (not the sides) being dentate, the apical joint of the antennæ not spatulate and other minor characters.

Female.—Length 4 mm. Process of the clypeus slightly emarginate; frontal impressed line strong; pedicellum and third antennal joint subequal in length, third joint longer than the fourth; ocellocipital line about twice as long as the postocellar line; mesonotum finely punctured; dorsal aspect of propodeum with a trapazoidal-shaped enclosure bounded laterally by rectangular-shaped reticulations; posterior part of sides of propodeum granular; petiole shorter than the hind femora, obliquely striate; pygidium short, not twice as long as wide, narrow. Black; mandibles, scape in front, four anterior tibiæ and tarsi, posterior tarsi and tegulæ dark ferruginous; tubercles white; wings hyaline, iridescent; venation and stigma black.

The intermediate tibiæ may be mostly black.

Male.—Length 4 mm. Bears about the same relation to the female as does the male of *fraternus* to its female. Anterior margin of the clypeus somewhat produced; head dulled with fine granulation, frontal impressed line strong; antennæ rather slender, third and fourth joints subequal, the apical joint pointed; mesonotum finely granular; scutellum somewhat impressed; sutures of the mesopleuræ not as strongly foveolate as in female; sculpture of propodeum similar to the female, but the enclosure is not narrowed anteriorly. Differs from the female in coloration in the black flagellum, and nearly black intermediate tibiæ.

Highspire, Pennsylvania. Seven females and four males bred from young peach stems by Mr. W. S. Fisher in December, 1910, and recorded under the Bureau of Entomology number "Quaintance 5692." The nests were provisioned with wingless specimens of *Aphis persicæ-niger* Smith. Also two females from Colorado.

Type.—Cat. No. 13770, U.S.N.M.

STIGMUS INORDINATUS HUBBARDI, new subspecies.

Female.—Separated from typical *inordinatus* by the absence of the frontal impressed line and having all the femora pale.

Male.—Differs from typical *inordinatus* in the eyes converging more strongly to the clypeus, so the distance between them at the clypeus is subequal with half the distance between them at the vertex. The legs are also pale.

Palm Springs, California. Many males and females bred from pupæ in *Polyporus*, issuing March 1. Collected by Mr. H. G. Hubbard, for whom the subspecies is named.

Type.—Cat. No. 13771, U.S.N.M.

This may be raised to a species eventually, as the male presents good differences.

STIGMUS FRATERNUS COLORADENSIS, new subspecies.

Female.—Differs from *fraternus* Say in the apical joint of the antennæ not being spatulate, and the femora are all more or less black.

Colorado. Two females from the C. F. Baker collection.

Type.—Cat. No. 13772, U.S.N.M.

STIGMUS FULVIPES, var. **COQUILLETI**, new variety.

Male and *female*.—Differs from *fulvipes* Fox in the dark-brown antennæ and black femora.

Los Angeles County, California. Two females and one male collected by Mr. D. W. Coquillett, for whom the variety is named.

Type.—Cat. No. 13773, U.S.N.M.

Mr. Coquillett also collected typical *fulvipes* in Los Angeles County, California.

GONOSTIGMUS, new genus.

Habitus very like *Stigmus* Panzer, but differing at once in the shape of the head. Head seen from the front, excluding clypeus, distinctly longer than wide; seen from above, the head is quadrate, slightly narrowing posteriorly; facial quadrangle strongly narrowed below; eyes large and broadened below as in *Crabro*, but not as strongly so; clypeus strongly produced in the middle, truncate; labrum concealed; mandibles long, slender, single except the bidentate apex, the outer

tooth longer, maxillary palpi 6-jointed, labial palpi 4-jointed, palpi long, slender; antennæ inserted at the top of the clypeus and almost against the orbits, the distance between them almost as great as the width of eyes at clypeus; abdomen, thorax, legs, and wings much as in *Stigmus*.

The lower posterior margin of the head is strongly angled in the genotype, but this may only be a specific character.

Type.—*Gonostigmus typicus* Rohwer.

Gonostigmus may at once be separated from *Stigmus* by the head being longer than wide, the facial quadrangle being narrowed below, the larger and produced clypeus, the antennæ inserted very close to the orbits.

GONOSTIGMUS TYPICUS, new species.

Female.—Length 3 mm., slender. Lower inner orbital margins finely foveolate; head strongly angled on the lower posterior margin; the posterior margin finely carinate; front finely granular, the rest of the head shining and impunctate; ocellar line at least as long as the ocellocular line; flagellum simple, the first and second joints equal in length; pronotum strongly ridged and sharply angled laterally; dorsulum very finely longitudinally scratched; scuto-dorso suture strongly foveolate; propleuræ strongly longitudinally striate; a longitudinal suture on the mesopleuræ, the area above which is finely striate-granular, the area below finely striate; propodeum dorsally with large reticulations, laterally longitudinally striate; legs without spines; petiole slightly longer than the hind femora, with five fine carina on the dorsal and lateral surfaces; abdomen normal. Black, shining; mandibles, scape, two joints of flagel, tubercles, tegulæ; four anterior legs, posterior trochanters and tarsi pale yellow. The usual pubescence sparse; wings clear hyaline, iridescent; venation and stigma dark brown, nervures paler toward the base of the wings.

Motzorongo, Vera Cruz, Mexico. One female collected February 11, 1892, by H. Osborn.

Type.—Cat. No. 13738, U.S.N.M.

Genus DIODONTUS (Curtis) Shuckard.

DIODONTUS BIDENTATUS, new species.

This may be the undescribed male of *Diodontus adamsi* Titus, but the description of that species is very brief, and the following species differs in being 3 mm. smaller and having the tubercles pale. It is easily distinguished from the other described Nearctic species by the dentate clypeus.

Male.—Length 3.5 mm. Labrum concealed; clypeus produced in the middle, with two large, obtuse teeth, the emargination between

angulate; vertex and occiput finely granular, with large irregular, separated punctures which are smaller and closer in the postocellar area; postocellar line equal with the ocellocular line, but distinctly shorter than the ocelloccipital line; the apical antennal joints with short spines at the apex beneath; scutellum and mesonotum shining, with well separated, distinct punctures; the sutures separating the scutellum not foveolate; mesopleuræ irregularly, coarsely granular; propodeum with irregular, coarser reticulations; legs normal; second cubital cell narrowing above; abdomen with small indistinct punctures. Black; mandibles and legs below femora reddish-yellow; tegulæ and tubercles yellow. Wings distinctly dusky; venation black and pale brown.

Nerepis, New Brunswick. One male collected August 20 by Mr. A. G. Leavitt.

Type.—Cat. No. 13739, U.S.N.M.

Genus PASSALÆCUS Shuckard.

PASSALÆCUS MELANOCRUS, new species.

Related to *P. annulatus* (Say), but the scutellum is not impressed, the propodeum does not have an impressed median line, and the femora are black.

Male.—Length about 5 mm. Slender; clypeus and front closely granular, vertex and occiput shining with separate, small punctures; frontal line distinct; postocellar line much greater than the ocellocular line; antennæ not spinose or dentate, the third joint distinctly shorter than the fourth, apical one about one-fourth longer than the preceding; dorsulum with distinct, close punctures, with two impressed foveolate lines anteriorly; scutellum sparsely punctured and not impressed; propodeum rather finely reticulate, without an impressed line, upper surface of posterior face with a poorly defined fovea; abdomen shining with little or no hair. Black; mandibles, except margin, tubercles and base of posterior tibiæ yellow; apical margins of flagellar joints except apical one and scape beneath whitish; tegulæ brownish; four anterior tibiæ and tarsi reddish-yellow. Wings hyaline, iridescent; venation dark brown.

Davis Mountains, Texas. Three males bred July 5, 1907, from material collected April 12, 1907, from the galleries of *Dendroctonus barberi* Hopkins. Notes under Bureau of Entomology number "Hopk. U. S. 3904."

Type.—Cat. No. 13740, U.S.N.M.

Genus CERATOPHORUS Shuckard.

CERATOPHORUS GRINNELLI UTAHENSIS, new subspecies.

Very like *grinnelli* Rohwer, but differs in the female sex as follows:

C. grinnelli grinnelli.

1. Apical part of enclosure of propodeum shining impunctate.
2. Fovea on posterior face of the propodeum punctiform.
3. Second recurrent vein basad of the second transverse cubitus by one-fourth its length.

C. grinnelli utahensis.

1. Same dull finely longitudinally striate.
2. Fovea on posterior face of the propodeum narrow, elongate.
3. Second recurrent vein very nearly interstitial with the second transverse cubitus.

Beaver Valley, Utah.

Type.—In the Museum of the Brooklyn Institute, New York.

Family CRABRONIDÆ.

Genus LINDENIUS Lepeletier.

ENOPLOLINDENIUS, new subgenus.

General habitus as *Lindenius*; clypeus quadra-dentate; mandibles simple; basal joints of antennæ emarginate; facial fovea deep, sharply defined; supraorbital fovea elongate, well defined; ocelli in almost an equilateral triangle; posterior orbit and sides of occiput with strong carinæ; head and thorax with close fine punctures; pronotum crested, long for group, lower than dorsulum, no smooth enclosed area on metanotum; venation as *Lindenius*; four posterior legs normal; anterior femora enlarged and flattened; anterior tarsi strongly flattened and somewhat distorted; abdomen shining impunctate.

Type.—*Lindenius* (*Enoplolindenius*) *clypeatus* Rohwer.

This may prove to be a distinct genus when the female is discovered. It is very distinct from *Lindenius* by the characters given above.

LINDENIUS (ENOPLOLINDENIUS) CLYPEATUS, new species.

Male.—Length about 4 mm. The notch between the lateral and middle teeth of clypeus deeper than the notch between the middle teeth; a carina in the depression from anterior ocellus to facial fovea; the area between the eye and postocellar carina subfoveolate; pronotum before the carina foveolate; scutellum with indistinct striations with the punctures; suture between postscutellum and dorsal aspect of propodeum foveolate; propodeum laterally separated from posterior face by a distinct line-like carina; depression of posterior face heart-shaped; propodeum dorsally with a median fovea which meets the fovea on posterior face. Black; mandibles, tubercles, small spots

on pronotum, and four anterior legs below trochanters, except a line on femora, reddish-yellow (the reddish tint may be due to potassium cyanide, but probably not). Wings hyaline, beautifully iridescent; venation dark brown.

Brownsville, Texas.

Type.—In the Museum of the Brooklyn Institute, New York.

Orbital carina strong, the area between it and the eye margin foveolate.

Genus CRABRO Fabricius.

CRABRO (SOLENIUS) TOWNSENDI, new species.

Allied to the North American species *interruptus* and *cinctibellus*, but much different in the sculpture of the propodeum.

Female.—Length nearly 11 mm. Production of the clypeus broader at the apex, the emargination very shallow; facial fovea very narrow and deep, without a bounding carina above but nevertheless well defined; ocellar line subequal with the ocellocular line; supraorbital fovea as long as first two joints of the flagellum; head with close, large, distinct punctures, the punctures of the front a little larger than those of the cheeks; first joint of flagellum a very little longer than second; pronotum sharply carinated, the lateral tooth small; dorsulum striato-punctate, anteriorly a few distinct punctures; scutellum striato-punctate; mesopleuræ striato-punctate above; below mostly punctured though there is a tendency to striation; propodeum dorsally and posterior face strongly striato-reticulate; the broad median furrow foveolate; strongly longitudinally, propodeum laterally striate; legs and venation normal for *Solenius*; abdomen with strong, distinct, rather close punctures, larger on the first segment and becoming smaller apically; apical margins of the first two segments somewhat depressed; pygidial fringe thick. Black; tegulæ rufotestaceous; scape, two elongate spots on pronotum, tubercles, two oval spots on scutellum which meet, four anterior knees, all the tibiæ and tarsi, elongate spots on the first three dorsal segments (narrowly separated) and bands on the fourth and fifth dorsal segments yellow. Wings fusco-hyaline; venation pale brown, stigma and costa reddish; the usual facial pubescence slightly yellowish.

Meadow Valley, Mexico. Collected by Mr. C. H. T. Townsend, for whom the species is named.

Type.—Cat. No. 13741, U.S.N.M.

CRABRO (subgenus?) SCHWARZI, new species.

Very distinct and belonging to an undescribed subgenus, falling near *Metacrabro* and *Xylocrabro*. Easily known by the head narrowing behind eyes, the occiput margined, and coarse sculpture.

Male.—Length 8 mm. Clypeus strongly carinated; distance between the eyes at the clypeus slightly less than the length of the

clypeus; facial fovea not sharply defined above; supraorbital foveæ wanting; ocellar line slightly longer than ocellocular line; head strongly narrowing behind eyes, the occiput strongly margined; antennæ short, simple; pronotum strongly crested, dentate laterally; dorsulum with large, close punctures, scutellum more sparsely punctured, some of the punctures on the dorsulum are confluent; mesopleuræ above striato-punctate, below with large separate punctures; propodeum dorsally and posterior face strongly reticulate, the posterior face transversely so; propodeum laterally rather strongly longitudinally striate; legs slender and simple; anterior face of the abdominal segment depressed; first two dorsal segments with large, rather close, distinct punctures; the following segments finely and closely so. Black; scape line on the pronotum, tubercles, anterior, legs below middle of femora, tips of middle femora above, middle tibiæ exteriorly, spurs of hind tibiæ, base of first abdominal segment with a narrow line running to the elongate spots, and elongate lateral spots on second, third, and fourth segments yellow. Wings dusky hyaline; venation black. Pubescence almost wanting.

Cacao, Trece Aguas, Alta Vera Paz. Guatemala, March 23, 1906. One male collected by Schwarz (for whom the species is named) and Barber.

Type.—Cat. No. 13742, U.S.N.M.

CRABRO (HOPLOCRAURO) FERRUGINEIPES Rohwer.

This species was described from a single male collected at Pecos, New Mexico. From the C. H. T. Townsend collection of Meadow Valley, Mexico, there are five males and four females. The female is much like the male but is of course larger and has the antennæ simple.

CRABRO (HOPLOCRAURO) NOVANUS, new species.

Of the described Mexican species perhaps this is more like *sonorensis* Cameron, but is at once distinguished by the sculpture. Belongs in with *decemmaculatus* Say, but may be known at once by the sculpture of the propodeum.

Female.—Length 13.5 mm. Anterior margin of the clypeus slightly produced into a truncate process, middle carina strong; facial fovea as on *Hoplocrauro*, as is the rest of the head; post ocellar line a little shorter than ocellocular line; third joint of antennæ distinctly longer than fourth; head with small close punctures, much sparser on the cheeks; pronotum feebly carinated, not dentate, separated by a broad furrow from mesonotum; dorsulum with rather close, distinct punctures; scutellum more sparsely punctured; mesopleuræ striato-punctate; propodeum dorsally with rather large, well separated, distinct punctures; median furrow broad, well defined, striolate; posterior face with separate striato-punctations; propodeum laterally very finely longitudinally striate; legs robust; first dorsal segment with scattered,

distinct, small punctures, the following segments closely punctured. Black; tegulæ brownish; mandibles except apices, scape, interrupted line on pronotum, tubercles, postscutellum, spots on all the dorsal segments (meeting on the fifth and sixth) yellow; legs black, four anterior knees, all the tibiæ and tarsi yellow. The tibiæ are dark brown within. Wings fusco-hyaline; venation reddish brown. Pubescence fuscous.

Meadow Valley, Mexico. Six females. Collected by Mr. C. H. T. Townsend.

Type.—Cat. No. 13743, U.S.N.M.

Genus *THYREOPUS* Lepeletier (Ashmead).

THYREOPUS (THYREOPUS) VENATOR, new species.

Very distinct, easily recognized by the closely punctured dorsulum, punctured mesopleuræ and separate abdominal spots.

Female.—Length 10 mm. Median carina of the clypeus strong; distance between the eyes at the clypeus about equal with the length of the clypeus; facial fovea not sharply defined above; lateral ocelli above the supraorbital line; post-ocellar line subequal with the ocellular line; head closely punctured; first flagellar joint slightly shorter than two plus three; pronotum hardly carinate but with a sharp lateral tooth; dorsulum and scutellum sculptured like the head; mesopleuræ with the punctures more distinct; propodeum dorsally irregularly rather feebly striate, no median furrow; posterior face punctured with some faint striations also, laterally finely striato-granular; legs robust, rather strongly spined; abdomen elongate, shining, impunctate, pygidium with somewhat elongate punctures. Black; spot on mandibles, scape in front, line on pronotum, tubercles, large spots at the sides of all the dorsal segments and four anterior tibiæ in front pale yellow; wings smoky-hyaline, venation black. Pubescence gray or fuscous.

Male.—Very like the female. The tooth on the pronotum is sharper; the flagellum is simple but slightly flattened; the shield is wider than long, and wider at the apical third, with two or three longitudinal pale lines otherwise black; and the pronotum is black.

The suture on the mesopleuræ may be strongly or feebly foveolate, the scape almost entirely black, and the pronotum with small pale spots, the postscutellum black or with a yellow line.

Meadow Valley, Mexico. Collected by Mr. C. H. T. Townsend.

Type.—Cat. No. 13744, U.S.N.M.

THYREOPUS (BLEPHARIPUS) MELANIUS, new species.

Related to *ater* Cresson, but the ocelli are not in depressions and the sculpture is finer and the insect duller.

Female.—Length 7 mm. Clypeus with a median carina, the anterior margin rounded; space between the eyes at the clypeus slightly

greater than the length of the clypeus; postocellar line distinctly shorter than the ocellocular line; no depressions around the ocelli; a distinct furrow from anterior ocellus to the facial fovea; head with distinct small, well separated punctures but dull because of the very fine close punctures; first and second flagellar joints subequal; pronotum not crested or dentate; dorsulum, scutellum, and mesopleuræ sculptured like the head, the punctures of the dorsulum larger and those of the mesopleuræ smaller; enclosure separated by foveolate suture from the posterior face, the base foveolate, the middle furrow strong and above foveolate; propodeum laterally and posterior face granular, the latter more strongly so; legs and abdomen normal. Entirely black; wings dusky hyaline, venation black; gray pubescence abundant on the pleuræ.

Male.—The male agrees with the above characters, except the head and thorax are shining, the punctures smaller, and the strongly foveolated middle furrow of the metathorax. The gray pubescence is very sparse.

Meadow Valley, Mexico. Collected by Mr. C. H. T. Townsend in September.

Type.—Cat. No. 13745, U.S.N.M.

THYREOPUS (CROSSOCERUS) XANTHOGNATHUS, new species.

A very distinct little species. In some points it seems to be related to *angulicolle* Cameron (described as belonging to *Rhopalum*), but the shorter first abdominal segment will distinguish it at once.

Female.—Length 5 mm. Anterior margin of the clypeus rounded, without a median carina; space between the eyes at the antennæ less than the length of the clypeus; a depression near each lateral ocellus; ocellar line shorter than the ocellocular line; front with small, rather close, distinct punctures, cheeks and occiput almost impunctate; first flagellar joint longer than the second; dorsulum with small punctures on a very finely granular surface; scutellum and mesopleuræ with small punctures but the surface not granular; enclosure well defined, the base, median furrow, and bounding sutures faintly foveolate; enclosure with fine oblique striæ; posterior face and pleuræ finely striato-granular; second abdominal segment subequal with the first; pygidium with large, distinct, separate punctures. Black; mandibles (apices rufous) line on scape, tubercles, four anterior knees and tibiæ exteriorly, four anterior tarsi, base of posterior tibiæ and tarsi yellow; wings hyaline, slightly dusky, venation black. Pubescence sparse.

Meadow Valley, Mexico. Collected by Mr. C. H. T. Townsend.

Type.—Cat. No. 13746, U.S.N.M.

Family NYSSONIDÆ.

Genus GORYTES Latreille.

GORYTES (GORYTES) NEGLECTUS, new species.

Related to *Gorytes mystaceus* (Linnæus), but is smaller and the suture between the mesonotum and scutellum is foveolate. Superficially resembles *G. (Hoplisoides) costalis* (Cresson), but is otherwise quite different.

Female.—Length about 8 mm. Anterior margin of the clypeus broadly rounded out, the surface finely, closely punctured apically the punctures are much larger; facial quadrangle higher than broad; eyes distinctly but not strongly emarginate above the middle, disregarding the emargination subparallel; front with small, distinct, well separated punctures, no impressed line from the anterior ocellus; postocellar line almost twice as long as the ocellocular line; antennæ slightly thickened apically, the third and fourth joints subequal; mesonotum with rather large, well defined, separated punctures; the suture between the scutellum and mesonotum foveolate; mesopleuræ more finely punctures than the notum, the suture strongly foveolate; sides and posterior face of propodeum shining, with small well separated punctures, posterior face with a broad irregularly foveolate furrow, enclosure sharply defined by strongly foveolate sutures, a median foveolate furrow which is broader anteriorly, surface with well defined punctures; third cubital cell strongly narrowed to radius where it is shorter than the second; first and second recurrent veins separated by a distance about as great as the length of third cubital cell on the radius; first dorsal segment with small, setigeous punctures, the following dorsal segments finely reticulate; pygidium rather narrow, with rather large, close punctures covered with fuscous hair; second ventral segment prominently angular basally, with large punctures interspread among the fine close ones which cover the entire center. Black; two basal spots on clypeus, scape beneath, line on pronotum, tubercules, spot behind, spot above tegulæ, metanotum, small spot on propodeum, band on first three dorsal segments (broadest on the first) and lateral spots on second ventral segment yellow; basal three joints of flagellum beneath, tegulæ, legs except the dusky coxæ and trochanters and slightly yellowish anterior tibiæ and tarsi ferruginous; pile fuscous; wings dusky hyaline, radial cell strongly clouded; venation dark brown, stigma paler.

Texas. One female from the Belfrage collection.

Type.—Cat. No. 13747, U.S.N.M.

From the description *Gorytes sapellonis* Baker would seem to be a very different insect.

GORYTES (PSEUDOPLISUS) GYPONACINUS, new species.

Female.—Length 10 mm. Anterior margin of clypeus truncate; eyes strongly converging to clypeus; impressed middle line strong; front very closely finely punctured with large, widely separate punctures intermingled; antennæ normal for this group; mesonotum and scutellum with fine close punctures; suture between mesonotum and scutellum foveolate; metapleural suture foveolate at top; bounding sutures of enclosure subfoveolate; extreme lower portion of posterior face rugose; suture between metanotum and propodeum foveolate; abdominal segments shining, the apical ones dulled with fine tessellation; pygidium with large, separate punctures. Black; clypeus except apical margin, spot above, lower half of inner orbits, scape, line on pronotum, tubercles, spot behind, line on scutellum metanotum, large spots on propodeum, apical band on all dorsal abdominal segments, knees and legs below yellow or slightly brownish-yellow; wings clear except fuscous radial cell; venation including stigma dark brown.

Male.—What may be to be the male differs from the female besides the usual sexual differences, in the more strongly foveolated suture between the metanotum and propodeum; and the infuscate posterior tarsi.

Washington, District of Columbia. One female seen storing her nest with a green bug (*Gypona VIII-lineata flavilineata* det. Heidemann) July 5, 1909, by A. K. Fisher. The male from Waldoboro, Maine, collected July 24, 1909, by J. H. Lovell and recorded under his number 4514.

Type.—Cat. No. 13748, U.S.N.M.

This seems to be nearest to *rufomaculatus* Fox, but is not that species; in some ways it is like *venustiformis* Rohwer, but the clearer wings will readily separate it from that form.

Since the above was written three metatypes have been studied; two males, Trenton, New Jersey, August 10, 1906, and a female, Germantown, Pennsylvania, August, 28, 1906. Collected by H. S. Harbeck.

GORYTES (PSEUDOPLISUS) VENUSTIFORMIS, new species.

Male.—Length about 10 mm. Allied to *venustus* Cresson, but differs from that species in the following manner: The large, sparser punctures of head and mesonotum; apical joints antennæ shorter and normal (not rounded beneath); lateral sutures of enclosure faintly foveolate; a yellow spot below tegulæ; yellow spots on the propodeum much larger; apical half of the wings dark brown, not yellowish.

Boulder, Colorado. One male collected at flowers of *Helianthus pumilis*, July 31, 1908, by S. A. Rohwer.

Type.—Cat. No. 13749, U.S.N.M.

GORYTES (HOPLISUS) HELIANTHI, new species.

Female.—Length about 10 mm. Differs from *diversus* Fox only as follows: Front and mesonotum more shining, without the very fine striations; antennæ more robust about as in *diversus* male; enclosure with the striæ wanting or nearly beyond base; front yellow; a black diamond-shaped spot enclosing ocelli; enclosure black, base of dorsal segments 2, 3, and 4 black, the following segments rufous; propodeum without yellow, rufous; venation darker and the second discoidal cell fuscous.

Boulder, Colorado. One female collected at flowers of *Helianthus pumilis*, September 8, 1908, by S. A. Rohwer.

Type.—Cat. No. 13750, U.S.N.M.

GORYTES (HOPLISOIDES) KNABI, new species.

Belongs near *denticulatus* Packard, but vertex is flatter, the scutellum with sparser punctures, the clypeus not so angled above, the striæ of enclosure better defined, legs much darker, costa and stigma dark, and is slightly smaller.

Male.—Length 7 mm. Anterior margin of the clypeus truncate, the surface with fine close punctures, with a few large punctures scattered over it; front finely granular, with large, distinct, widely separate punctures; depression from the anterior ocellus distinct though not strong; postocellar line much greater than the ocellular line; eyes converging to clypeus but not strongly so; third antennal joint distinctly longer than fourth; flagellum thickened apically; dorsulum and scutellum with large, distinct punctures; suture between the dorsulum and scutellum foveolate; large punctures of the mesopleuræ and propodeum somewhat sparser than those on the dorsulum; enclosure of the propodeum not sharply defined with about sixteen carinæ; abdomen with large punctures, those of the first segment smaller and sparser; spines of the legs feeble. Black; scape in front, narrow line on most of inner orbits, line on pronotum, tubercles, spot behind, posterior border of scutellum, line on post-scutellum, large spots on metathorax, first dorsal segment except a large median basal spot, a narrow line on the dorsal and ventral segments 2-5 yellow; femora and tibiæ beneath brownish-yellow. Wings hyaline, radial cell clouded; venation brown.

Progreso, Yucatan, Mexico. One male collected August 6 by Mr. F. Knab (for whom the species is named) during an hour's stay on shore.

Type.—Cat. No. 13751, U.S.N.M.

Family TRYPOXYLONIDÆ.

Genus PISON Spinola.

PISON CRESSONI, new species.

Perhaps closest to *conformis* Smith, but differs in many important points from the description of that species.

Male.—Length 10 mm. Anterior margin of clypeus with three obtuse teeth, the middle one broader and truncate, the lateral ones rounded; false margin of clypeus wavy; space between the eyes at the clypeus somewhat greater than the space between them at the vertex; furrow from anterior ocellus slightly indicated; postocellar line subequal with ocellocular line; a faintly depressed, transverse area behind lateral ocelli; head, including clypeus to false margin, finely granular; antennæ thickened apically, first joint of flagellum longer than second; mesonotum with close, small distinct punctures; scutellum with larger and sparser punctures; propodeum not channeled and with the punctures somewhat more widely separated than those on the dorsulum; posterior face with the usual median channel, the lowest part faintly striated; propodeum laterally shining, with small, separate punctures; legs without spines; abdomen punctured like mesonotum, narrow apical margin of basal segments depressed. Black; three basal antennal joints ferruginous; tegulæ and tubercles brownish; with the exception of the sides of propodeum the insect is clothed with fuscous pile, the pile more evident on the orbital margins and propodeum dorsally. Costal margin of wings and area before basal nervure dark fuscous, the rest of the wings subhyaline; venation brown, stigma paler.

San Antonio, Nicaragua. Two males collected May, 1899.

Type.—Cat. No. 13752, U.S.N.M.

Named after Mr. E. T. Cresson.

Family LARRIDÆ.

Genus TACHYSPHEX Kohl.

TACHYSPHEX HELIANTHI, new species.

In Fox's table to the Nearctic species of *Tachyspex* this species runs in with *amplus* Fox, but it is quite different from any species of this section. It may be easily separated from the described species by the long antennæ, coarse sculpturing, and small size.

Female.—Length 6 mm. Clypeus rounded out medianly, the lateral angles obtuse, apical part shining, with large widely separated punctures, basal part with small close punctures; mandibles with two blunt teeth near inner middle; front with close, rather small, well-defined punctures, the punctures of the vertex sparser;

depression behind the lateral ocelli not sharply defined, with a median furrow; interocellar area indistinctly parted, front without an impressed line; space between the eyes at the vertex subequal with the length of the third antennal joint; antennæ slender, longer than the head and thorax united, scape shorter than the two following joints, third joint longer than fourth; mesonotum and scutellum with rather large, well-defined, separated punctures, those of the scutellum more widely separated, scutellum not impressed; dorsal aspect of propodeum coarsely granular, sides and posterior face punctured, posterior face with a median furrow which is separated from the dorsal aspect by a carina; legs feebly spined, inner calcarium of posterior tibiæ much shorter than the basitarsis; second cubital cell on radius longer than third; abdomen finely coriaceous, the first three dorsal segments broadly depressed apically; pygidium well defined, a little more than twice as long as wide at base, apically impunctate, basally finely granular with a few punctures. Shining black; apices of mandibles and tarsi piceous; scape in front, four basal flagellar joints and a spot on tegulæ ferruginous; wings dusky hyaline, the duskieness more prominent as a band below stigma, iridescent; venation blackish; insect almost nude.

Boulder, Colorado. One female collected on flowers of *Helianthus pumilus*, September 8, 1908, by S. A. Rohwer. The eyes in life are dark rufous.

Type.—Cat. No. 13754, U.S.N.M.

TACHYSPHEX GILLETTEI, new species.

Female.—Length 11 mm. Clypeus rounded out anteriorly with a small lateral tooth; region around the antennæ with close, rather fine punctures; front with larger and well separated punctures; interocellar area with the punctures denser than those on the front; vertex punctured like the front; space between the eyes at the vertex about equal to the length of antennal joints two and three; seen from the front the head between the eyes is emarginate; third antennal joint but little shorter than the fourth; mesonotum at the sides closely finely punctured; in the middle with a few scattered punctures, giving it a shining appearance; scutellum convex, shining, not impressed, sculptured like the mesonotum; dorsal aspect of propodeum finely granular, sides and posterior face finely, transversely striated; fovea of posterior face not very large; second cubital on the radius much wider than the third on the same nervure; legs rather strongly spinose; abdomen shining, impunctate; pygidium about twice as long as broad at base, with a few rather large punctures. Black; tegulæ testaceous; spines and tarsi beyond the first joint rufous; abdomen clear red; eyes (dry) greenish; wings hyaline, venation testaceous; entire insect almost nude.

Rocky Ford, Colorado. One female collected June 4, 1904. Collector unknown. Named in honor of Prof. C. P. Gillette.

Type.—Colorado Agricultural College.

In Fox's table this seems to be nearest to *T. amplus* Fox (New Mexico and Nevada), but that species does not have the occiput emarginate, the sculpture of the mesonotum is different, and the venation is not testaceous. Disregarding the space between the eyes at the vertex, it is close to *T. semirufus* (Cresson), but it is larger, more robust, the venation is not black, the mesonotum and pygidium are somewhat different.

TACHYSPEX COQUILLETTI, new species.

Related to *amplus* Fox. The female may be separated from this species by the smaller size and the different dentation of the clypeus.

Female.—Length 8 mm. The depressed margin of the clypeus crenulate, with five broad, rounded teeth, the lateral teeth subangulate; surface of the clypeus shining, with small separate punctures; front with close distinct punctures, those of the vertex larger and sparser; interocellar area strongly parted, the vertex not so strongly so; space between the eyes at the vertex subequal with the third antennal joint; antennæ hardly antennuate, the third joint slightly shorter than the fourth; mesonotum and scutellum rather coarsely granular, scutellum not parted; propodeum sharply truncate posteriorly, the dorsal and posterior aspects separated by a carina, dorsal aspect granular, sides striato-granular, posterior face striate; legs rather strongly spined; inner calcarium of the posterior tibiæ shorter than the hind basi-tarsis; second cubital cell longer on the radius than the third; abdomen shining, practically impunctate; pygidium poorly defined, not one and a half times as long as the basal width, broadly rounded apically. Black; tegulæ testaceous; abdomen and tarsi red or reddish; tibiæ and hind femora piceous; head, thorax, and legs with dense silvery pile; wings hyaline, iridescent; venation pale brown.

Male.—What may be the male hardly differs from Fox's description of the male of *amplus*, and until a specimen of *amplus* male has been examined can not be separated.

Los Angeles County, California. One female and two males collected by Mr. D. W. Coquillett, for whom the species is named.

Type.—Cat. No. 13755, U.S.N.M.

TACHYSPHEX ARGYROTRICHUS, new species.

Male.—Length about 8 mm. Clypeus subtruncate, with a small lateral tooth, basal portion finely, closely punctured; front and vertex finely, closely granular; no impressed line from the anterior ocellus; occiput flat; space between the eyes at the vertex about the same

as the length of antennal joints three and four; fourth antennal joint a little longer than third; mesonotum finely, closely punctured or granular; scutellum punctured with distinct punctures; dorsal aspect of propodeum closely granular, sides and posterior face finely, transversely striated; fovea of the posterior face not sharply defined; emargination of the fore femora rounded; inner calcarium of the posterior tibiæ about the same length as the basitarsus; second and third cubital cells on the radius of about the same width; abdomen above finely reticulated, more strongly so apically; eighth ventral plate broad, very shallowly circularly emarginate, lobes wanting. Black; tegulæ ferruginous; four apical joints of the tarsi rufous; three basal segments of the abdomen red; eyes (dry) greenish; wings yellowish hyaline, venation rather weak, testaceous; face clypeus; thorax and abdomen above with rather sparse silver pile.

Trinidad, Colorado. One male collected July 19, 1899. Collector unknown.

Type.—Colorado Agricultural College.

This species is closely related to *T. exsectus* Fox, but is distinguished from that species by the yellow wings, the testaceous venation and the clypeus being armed with a lateral tooth; the scutellum not being impressed.

TACHYSPHEX JOHNSONI, new species.

Female.—Length 8 mm. Anterior margin of the clypeus rounded out, with two rather small lateral teeth, near the eyes is a larger, sharper tooth; basal portion of clypeus finely, closely punctured; front with distinct, rather close punctures; vertex more finely and closely punctured; a furrow from the anterior ocellus to level of the antennæ; occiput flat; distance between the eyes at the vertex a little greater than the length of antennal joints two and three, but not as great as the length of antennal joints three and four; third antennal joints a little shorter than the fourth; mesonotum and scutellum finely, closely punctured; scutellum not impressed; dorsal aspect of propodeum finely granular; sides and posterior face transversely striated, the striæ on the posterior face stronger; posterior face with a somewhat heart-shaped fovea; legs not strongly spinose; inner calcarium of the posterior tibiæ as long as the basitarsis; second and third cubital cells of about equal width on the radius; abdomen apparently impunctate; pygidium a little more than twice as long as broad at the base, poorly defined with large widely separated punctures. Black; mandibles at the apex and apical joints of the tarsi rufous; tegulæ luteus; two basal segments of the abdomen clear red; eyes (dry) pale green; wings hyaline; venation testaceous and rather weak; face, clypeus, femora beneath, tibiæ and thorax more sparsely, and bands on the dorsal abdominal segments with silvery pile.

Cope, Colorado. One female collected August 9, 1905, by S. A. Johnson, for whom the species is named.

Type.—Colorado Agricultural College.

This species is close to *T. mundus* Fox, but may be distinguished from that species by the broader, poorer defined, sparser punctured pygidium; the absence of a transverse carina separating the dorsal aspect of propodeum from the posterior face; the more shining and finer sculptured front; the fewer punctures of the clypeus; and the bright red color of the abdomen.

TACHYSPHEX OPWANUS, new species.

Male.—Length 7.5 mm. Anterior margin of the clypeus rounded out, teeth small almost wanting; front finely granular; vertex with fine punctures; occiput flat; furrow from the anterior ocellus distinct; space between the eyes at the vertex greater than the length of antennal joints two and three, but not as great as the length of joints three and four; third antennal joint distinctly longer than the fourth; mesonotum and scutellum finely closely punctured; dorsal aspect of propodeum finely granular; sides shining very finely striated; posterior face not separated from the dorsal aspect by a transverse carina, rather coarsely transversely striated, fovea distinct sharply defined; emargination of the fore femora rounded; inner calcarium of the hind tibiæ almost as long as the basitarsus; second and third cubital cells of about equal width on the radius; abdomen very finely punctured; last ventral plate rather narrow, arcuately emarginate lobes narrow and short. Black; eyes (dry) green; tegulæ ferruginous; four apical joints of the tarsi two basal segments of the abdomen, except the base of the first rufous; wings slightly yellowish hyaline, venation pale brown; clypeus, femora beneath and bands on the dorsal abdominal segments covered with silvery pile; front with golden pile.

Golden, Colorado. One male collected in July, by C. P. Gillette.

Type.—Colorado Agricultural College.

This species is something like *T. exsertus* Fox. It is also similar to *T. mundus* Fox, but it may be known from both of these by the golden pile of the front and other characters.

The last three species described resemble each other in general appearance, but may be separated as follows:

- Front with golden pubescence; posterior face of the propodeum coarsely striated; teeth of the clypeus small.....*opwanus*.
 Front without golden pubescence; posterior face of the propodeum not coarsely striated; teeth of the clypeus larger..... 1.
 1. Anterior margin of the clypeus with two lateral teeth; apical third of the clypeus smooth with large scattered punctures; inner calcarium of the hind tibiæ as long as the basitarsus.....*johnsoni*.
 Anterior margin of the clypeus with one lateral tooth; entire clypeus closely punctured; inner calcarium of the hind tibiæ shorter than the basitarsus.....*arygrotrichus*.

TACHYSPHEX MAURUS, new species.

The female runs in Fox's table to *nigrior* Fox, but the clypeus has two small lateral teeth, and the punctures of the mesonotum are small and widely scattered. The male runs in the same table to *mundus* Fox, but the first joint of the flagellum is one-half as long as the second, and the inner calcarium of the hind tibiæ is shorter than the hind basitarsis.

Female.—Length 9 mm. Front with small separate punctures, closer along the inner orbits; interocellar area closely punctured, indistinctly parted; vertex with widely separated punctures, and a Y-shaped impressed line; space between the eyes at the vertex greater than the length of the second and third antennal joints, but much less than the length of the third and fourth; third joint much shorter than the fourth, the fourth and fifth subequal; propodeum granular dorsally, punctured laterally, striate posteriorly; second cubital cell longer on the radius than the third; inner calcarium of the hind tibiæ subequal with the length of the hind basitarsis; hind basitarsis curved basally; apical third of the dorsal abdominal segments depressed; pygidium well defined twice as long as the basal width, with well-separated punctures, apex narrowly truncate. Black; tegulæ, spines, and calcaria testaceous; rather densely clothed with silvery pile; wings hyaline, iridescent, venation dark brown.

Male.—Length 6 mm. Clypeus sharply rounded medially, the teeth small; front closely and uniformly punctured; abdominal segments not as broadly depressed as in the female; last ventral segment squarely emarginate, lobes sharp, narrow; hind basitarsis not curved. Otherwise as in the female.

Lee County, Texas. Two females and two males collected by Rev. G. Birkmann in May, June, and August.

Type.—Cat. No. 13756, U.S.N.M.

TACHYSPHEX NEOMEXICANUS, new species.

Belongs in with *montanus* (Cresson) *pauillus* Fox, and *consimilis* Fox, but may be separated from these by the conformation of the clypeus, the size and the color.

Female.—Length 12 mm. Anterior margin of the clypeus crenulate, the lateral angles not sharp; clypeus strongly convex, the lower portion smooth, shining, with large, separate punctures, basal portion with close, small, distinctly defined punctures; front with distinct, close, well-defined punctures; the punctures of the vertex separated; antennal foveæ sharply defined above, large; occiput seen from above straight; an impressed line extending from occiput to between bases of antennæ, interrupted only by the subtriangular-shaped depression behind the lateral ocelli and the anterior ocellus; space between the eyes at vertex greater than the length of antennal

joints two and three, but less than the length of joints three and four; antennæ of the normal type, the third joint but little shorter than the fourth; mesonotum and scutellum shining, with rather large, separate, well-defined punctures; scutellum not impressed; mesopleuræ more closely punctured than the notum; dorsal aspect of the propodeum coriaceous, sides and posterior face striate, posterior face with a shallow median fovea; legs strongly spinose, inner calcarium of posterior tibiæ shorter than the basitarsis, the abscissæ of the radius are, in order of their length, the longest first, 4123; broad apical margin of first and second segments depressed; abdomen dulled with very fine tessellation; pygidium well margined, with large, widely separated punctures. Black; outer margin of tegulæ pale brown; apical tarsal joints reddish; abdomen bright red; wings hyaline, slightly dusky, vitreous; venation pale brown, costa and stigma black, sparsely clothed with silvery pile.

Rio Ruidoso (altitude about 6,500 feet), White Mountains, New Mexico. One female collected August 7 "under dead pine bark," by C. H. T. Townsend.

Type.—Cat. No. 13757, U.S.N.M.

TACHYPHEX FEDORENSIS, new species.

Female.—Length 15 mm. Anterior margin of the clypeus rounded out, with two distinct lateral teeth, and slightly emarginate in the middle; the apical half shining, with a few large punctures; the basal part finely granular. Front and vertex closely punctured; a distinct median furrow from between base of antennæ almost to the occiput; space between the eyes at the top about equal to the length of antennal joints three and four; third and fourth antennal joints about equal; mesonotum closely, finely punctured, appearing almost granular; scutellum not impressed, punctures separated and distinct; mesopleuræ granular, dull; dorsal aspect and sides of propodeum granular; posterior face finely striated, with a distinct furrow which broadens above into a V-shaped fovea; legs robust, strongly spinose; second and third cubital cells of about equal length at the top; abdomen above dull; finely granular; a little more shining ventrally, a series of large punctures along the apical ventral margins; pygidium shining, with rather large sparse punctures; about twice as long as broad at base. Black; tarsi and spines brownish; wings smoky, venation pale brown; face and clypeus slightly, mandibles and apical margins of abdominal segments one to three with fine silvery pile.

Male.—Length 10 mm. Clypeus slightly produced in the middle, without teeth; punctured all over, the apical part with the punctures a little larger and more separated; the middle furrow of front not as distinct as in the female; dorsal aspect of a propodeum slightly

impressed in the middle; legs not so strongly spinose as in female; emargination of the fore femora rounded; emargination of the eighth ventral plate broad, rather shallow, arcuate; lobes short, triangular. Pubescence of face and clypeus denser than in female; the thorax with silvery pubescence.

Fedor, Lee County, Texas. Females and males collected in May and June by Rev. G. Birkmann.

Type.—Cat. No. 13758, U.S.N.M.

This insect belongs near *punctifrons* Fox. It may be known from *punctifrons* by the presence of two teeth on the clypeus and the absence of "dense sericeous pile." The wings are as dark as some specimens of *æthiops* Cress. The male is separated from the male of *punctifrons* by the greater space between the eyes at the top; in *punctifrons* it is about equal to the antennal joints three and four; in *fedorensis* it is greater than joints three and four. The male is separated from *intermedius* Viereck by the denser punctured mesonotum, etc.

TACHYSPHEX BRUESI, new species.

Separated from *tenuipunctus* Fox, its nearest ally, by the sculpture of the propodeum and black abdomen.

Female.—Length 8 mm. Clypeus broadly rounded apically with two small lateral teeth, its surface and the front coarsely granular; vertex and interocellar area closely punctured, neither distinctly parted; depression of the vertex shallow, poorly defined; the space between the eyes at the vertex greater than the length of the second and third antennal joints, but less than the third and fourth; the third and fourth antennal joints subequal; mesonotum with large separate punctures, those on the sides closer; scutellum with well separated punctures, not impressed; propodeum subtruncate and transversely striate posteriorly, dorsally finely reticulate, laterally striato-reticulate; third cubital cell longer on the radius than the second; legs not strongly spined, inner calcarium not as long as the hind basitarsis; apical margins of the dorsal abdominal segments narrowly depressed; pygidium well defined, two and a half times as long as broad; sparsely punctured, the apex narrowly truncate. Black; tarsi and tegulae somewhat brownish; wings dusky-hyaline, iridescent; venation brown.

Milwaukee County, Wisconsin. One female from the F. Rautenberg collection. Also one female in the same collection from Florida.

Type.—Public Museum of Milwaukee, Wisconsin.

Paratype.—Cat. No. 13759, U.S.N.M.

Named for Mr. C. T. Brues, who sent the specimens for study.

TACHYSPHEX SPHECODOIDES, new species.

Female.—Length about 7 mm. Median part of clypeus margined anteriorly, the lateral angles sharp, with a short, obtuse median tooth; basal portion of the clypeus convex, densely punctured; front with large separate punctures, vertex more sparsely punctured than the front; furrow from anterior ocellus distinct; occiput flat a little lower than the eyes; distance between the eyes at the vertex about the same as the length of the antennal joints three and four; third and fourth antennal joints about equal; anterior third of the mesonotum finely, closely punctured, the posterior part shining, sparsely punctured; scutellum convex shining, punctured like the posterior part of the mesonotum; mesonotum finely, closely punctured; dorsal aspect of propodeum finely granular, at the base there are a number of short longitudinal carinæ, the middle one the longest; sides finely striated, near the top the striæ are broader and more distinct; posterior face shining, finely transversely striate; fovea very well defined, pointed beneath; second and third cubital cells about equal on the radius; abdomen shining, impunctate; pygidium not well defined, smooth, almost without punctures; about twice as long as wide at base. Black; tegulæ on the outer margins ferruginous; eyes (dry) dark green; mandibles at apex and two apical joints of tarsi dark rufous; abdomen clear red. Wings clear hyaline, iridescent; venation brown; face, clypeus, pleuræ, small patches on sides of abdomen and the anterior femora beneath with silvery pubescence; antennæ clothed with fine white pile.

Rocky Ford, Colorado. One female collected May 12, 1905. Collector unknown.

Type.—Colorado Agricultural College.

A very distinct species, perhaps most closely related to *T. punctulatus* H. S. Smith, but the sculpture of the mesonotum and propodeum, and the clearer wings, will easily separate it from that species.

TACHYSPHEX LEENSIS, new species.

Female.—Length about 7 mm. Anterior margin of the clypeus rounded, the middle broadly produced, the angles evident but not sharp; anterior part of the clypeus shining, with large separate punctures, the sculpture of the basal part not clearly seen on account of the pubescence; head opaque, very finely granular; space between the eyes at the vertex a little greater than the length of the antennal joints two and three; third and fourth antennal joints about equal; entire thorax very finely granular; scutellum not impressed; posterior face with an oval-shaped fovea; radial cell obliquely truncated; third cubital cell wider on the radius than the second; legs feebly spined, spines feeble and pallid; tarsal bristles long; piccous; abdomen subopaque, microscopically punctured; pygidium well defined,

narrow, acute at apex, very sparsely punctured. Black; mouth parts and tegulæ pale brown; two basal segments of the abdomen, with the exception of a spot on the second, red. (Undoubted specimens will be found with the abdomen entirely black.) Wings dusky hyaline, iridescent; venation brown; clypeus and front with close silvery pile; thorax and abdomen in certain lights with close silvery pile.

Lee County, Texas. Collected May 8, 1906, by Rev. G. Birkmann.

Type.—Cat. No. 13760, U.S.N.M.

The space between the eyes at the vertex would place this species in the *tarsatus* group, but it is not any of these being nearest to *punctulatus*, from which it may be distinguished by the different sculpture, the fourth antennal joint not longer than the third, and other characters. It has some resemblance, in general habitus, and in the inner calcarium of the posterior tibiæ being a little longer than the basitarsus, to *mundus* Fox; but that species has the posterior face of metathorax transversely striated, the dorsulum and scutellum punctured and the eyes are closer together at the vertex. It is also somewhat like *consimilis* Fox, but the sculpture of the thorax and distinct pubescence on the abdomen will distinguish it from this species.

TACHYSPHEX WHEELERI, new species.

Female.—Length a little over 5 mm. Anterior margin of the clypeus rounded out, with two small, distinct lateral teeth, basal portion finely granular; front finely granular, vertex finely punctured; depression behind lateral ocelli rather deep, parted by a furrow; interocellar area by a deep furrow, which extends to between the bases of the antennæ, but is not as strong below the anterior ocellus; distance between the eyes at the vertex about the same as the length of the antennal joints two and three; antennæ normal, third joint a little shorter than the fourth, mesonotum and scutellum finely punctured, the punctures of the scutellum a little more separated than those of the mesonotum, scutellum not impressed; dorsal aspect of propodeum finely granular, without an impressed line; sides finely striato-granular; posterior face separated from the dorsal aspect by a carina, which is broken in the middle by the upper part of the triangular-shaped fovea, transversely striated; radial cell obliquely truncate, second cubital cell wider on the radius than third; legs feebly spinose, spines feeble and pallid; abdomen shining, apparently impunctate; pygidium well defined for species of this group, with large well separated punctures, acute at apex, and a little more than twice as long as broad at base. Black; palpi and tegulæ brownish; apex of mandibles piceous; abdomen clear red; usual silvery facial pubescence; thorax and abdomen in certain lights, with silvery pile.

Lee County, Texas. Collected in May, 1907, by Rev. G. Birkmann.

Type.—Cat. No. 13761 U.S.N.M.

This species, which is named in honor of Dr. W. M. Wheeler, belongs to the group composed of *tarsatus* (Say); *semirufus* (Cresson), *punctulatus* H. S. Smith, *hitei* Rohwer, and *antennatus* Fox. The members of this group have the abdomen clear red, the space between the eyes at the vertex about the same as the length of the second and third antennal joints; and the pygidial area rather poorly defined. The females may be separated as follows:

“Flagellum long, not setaceous, sparsely acuminate apically” (Fox); clypeus with one lateral tooth (pygidium two and one-half times as long as broad at base).

Texas..... *antennatus* Fox.

Flagellum normal, acuminate apically..... 1.

1. Pygidium not twice as long as broad at base, broad, poorly defined (clypeus with two lateral teeth). Colorado..... *hitei* Rohwer.

Pygidium twice or more than twice as long as broad at base..... 2.

2. Mesonotum very closely punctured, the punctures not becoming sparser posteriorly; scutellum similar (clypeus with two lateral teeth). Eastern United States..... *tarsatus* (Say).

Mesonotum more sparsely punctured, especially posteriorly; scutellum shining, usually more sparsely punctured than the dorsulum..... 3.

3. Clypeus with two lateral teeth; leg spines pallid..... *wheeleri* Rohwer.

Clypeus with one lateral tooth; leg spines black or piceous..... 4.

4. Clypeus with large, widely scattered punctures..... *punctulatus* H. S. Smith.

Clypeus granular; front granular..... *semirufus* (Cresson).

What may be the male of *wheeleri* may be described as follows: Length 4 mm. Slender; clypeus rounded on the anterior margin, without lateral teeth; front very finely granular, vertex punctured; space between the eyes at the vertex about the same as the length of antennal joints three and four; third antennal joint a little shorter than the fourth; mesonotum and scutellum shining, sparsely punctured; scutellum rather strongly convex, not impressed; dorsal aspect of propodeum granular, sides and posterior face finely transversely striated; legs almost spineless, the spines small and white; radial cell obliquely truncate; second and third cubital cells about equal on the radius; abdomen shining, almost impunctate; eight ventral plate rather deeply circularly emarginate, lobes rather broad. Black; palpi, tegulae, and apex of the tarsi brownish; two basal segments of abdomen red; front and clypeus with silvery pubescence. Wings hyaline, iridescent; venation brown.

The male was collected by Rev. G. Birkmann in Lee County, Texas, August 8, 1905.

Genus TACHYTES Panzer.

TACHYTES CHRYSOCERCUS, new species.

Distinct in the large size, yellowish and dusky wings, red legs, golden pubescence of the pygidium and subequal first and second flagellar joints.

Female.—Length 16 mm. Anterior margin of the clypeus rounded, somewhat crenulate laterally; head and thorax dull, finely closely punctured; ocellar area parted by a furrow, area behind the ocelli slightly depressed; third antennal joint slightly longer than the fourth; scutellum not impressed; propodeum finely granular, furrow on the posterior face distinct, a triangular-shaped fovea on apex of dorsal aspect; legs strongly spined; second cubital cell about twice as long on the radius as the third; abdomen hardly as long as the head and thorax; pygidium sharply defined, the apex rounded. Black; mandibles, legs below bases of femora and abdomen (the abdomen is darker) ferruginous; tegulæ paler than the femora; densely clothed with golden pile, scape, head, and metathorax with long fuscous hair; pubescence of abdomen and pygidium especially bright and dense. Wings yellowish, apices dusky; venation reddish yellow. Pulvilli black.

Meadow Valley, Mexico. One female collected by Mr. C. H. T. Townsend.

Type.—Cat. No. 13762, U. S. N. M.

TACHYTES XENOFERUS, new species.

From the descriptions evidently belongs near *vicinus*, but is distinguished by the space between the eyes at vertex being greater than the length of the second and third antennal joints not "nearly the length of;" the ventral segments do not bear "a dense tuft of longish brownish hair;" the wings can hardly be said to be "flavo-hyalinis," although they are slightly yellowish.

Female.—Length 10 mm. Anterior margin of the clypeus rounded, armed laterally with six small teeth, the two inner ones larger, surface with distinct separate punctures; front finely granular, impressed line wanting; ocellar and surrounding area gently raised; vertex finely punctured, the depression shallow; space between the eyes at vertex greater than the length of the second and third antennal joints, but much less than the length of the third and fourth joints; scape pilose hairy beneath, flagellum pilose, the third and fourth joints equal; thorax with close, fine punctures; propodeum rounded posteriorly, distinctly shorter than the mesonotum, no well-defined channel on the transversely striato-punctate posterior face; third cubital cell slightly longer on the radius than the third; legs rather robust, feebly spined; ventral segments almost without hair; pygidium broad, well

defined, apex rather acutely rounded. Black; palpi tegulæ, and calaria testaceous; tarsi and tibiæ somewhat piceous; densely clothed with silvery pile, that of the thorax slightly yellowish; pygidium with silvery hair. Wings hyaline, iridescent, faintly yellowish; venation testaceous.

Male.—Length 9 mm. Clypeus rounded, without teeth; third antennal joint shorter than the fourth; anterior coxæ without spines; pygidium truncate; last ventral plate deeply, broadly, arcuately emarginate, lobes narrow rounded at apex. Otherwise very like the female.

Deesa, India. Described from a stylopized male and female, collected June, 1898, by Lieut. Col. C. G. Nurse.

Type.—Cat. No. 13763, U.S.N.M.

This may only be a stylopized aberration of *Tachytes vicinus* Cameron, but at present it is impossible to prove such to be the case.

Genus LARROPSIS Patton.

Type.—*Larrada tenuicornis* Smith (original designation).

Patton in describing¹ the genus *Larropsis* designated as the type *Larrada tenuicornis* Smith. His description of the genus does not apply to this species which led Kohl and Fox to treat it as an unknown genus. The type-species is, however, a well-known species and is congeneric with *Larrada distincta* Smith, the chosen type of *Ancistromma* Fox. Fox's genus being described a year later must rank as a synonym of Patton's.

LARROPSIS PATTON, Ent. News, vol. 3, 1892, p. 90.

Ancistromma FOX, Proc. Acad. Nat. Sci. Phila., 1893, p. 487.

LARROPSIS FILICORNIS, new species.

Female.—Length about 11 mm; antennæ about 7 mm. Slender; the shape of the head recalls that of the genus *Lyroda*. Anterior margin of the clypeus rounded out, not distinctly dentate, but laterally there are faint indications of teeth; anterior part of the clypeus is coarsely, irregularly punctured, the basal part is like the front; eyes not nearly as strongly converging as usual, the distance between them at the vertex a little greater than the length of antennal joints two to four; front with an indistinct impressed line; depression behind the lateral ocelli not strong; front and vertex rather closely punctured. Antennæ long and slender; the third joint a little shorter than the fourth; apical joint equal in length with the preceding; mesonotum, scutellum, and mesopleuræ punctured similar to the front, scutellum not impressed; dorsal aspect of propodeum rather finely reticulato-granular, at some angles appearing finely obliquely striated from the median furrow; a deep, longitudinal, foveolated

¹ Ent. News, vol. 3, 1892, p. 90.

furrow from the base to almost the apex; posterior face granular with a few transverse striæ, the upper margin with a distinct transverse carina; sides granular; legs rather robust, but not very strongly spined; tarsal comb of short bristles as in *Tachytes*; the inner calcarium of the posterior tibiæ not as long as the basitarsus; third cubital on radius equal to a little longer than the second; abdomen shining, finely reticulate; pygidium well defined, apparently twice as long as broad at base, smooth, with a few scattered punctures, rounded at the apex. Black; palpi, tegulæ, apices of tarsi and calcarium reddish testaceous; head, thorax, and abdomen with short white pile; wings distinctly dusky, especially at the tips; venation pale brown.

Lee County, Texas. Collected May 10, 1898. Collected by Rev. G. Birkmann at the town of Fedor.

Type.—Cat. No. 13764, U.S.N.M.

The pygidium of the paratype is reddish, and the furrow of the propodeum is not so distinct, the striate being longer.

Related to *Larropsis tenuicornis* (Smith), but may be separated by the greater space between the eyes at the top, and the sides of propodeum not being striate.

LARROPSIS PORTIANUS, new species.

In Fox's table to the species of *Ancistromma* this species runs to *conferta* Fox, but is quite different from that species. The male has, judging from the description, a superficial resemblance to *L. tachysphæcoides* (Viereck), but the distance between the eyes at the vertex is not as great as in that species.

Female.—Length 7.5 mm. Anterior margin of the clypeus subtruncate, very slightly emarginate, with two lateral teeth, the outer tooth the larger, surface with small, distinct, separated punctures, some larger ones near the anterior margin; front with close, distinct punctures, vertex with the punctures somewhat more separated; an impressed line from anterior ocellus to between bases of antennæ; depression behind the lateral ocelli triangular in outline, with a longitudinal impressed line in the middle; space between the eyes at vertex a little greater than the length of second and third antennal joints; antennæ robust, scape large, not as long as the two following joints, pedicellum but longer than wide, third and fourth joints subequal in length; mesonotum and scutellum with rather large, distinct, well-separated punctures; scutellum indistinctly impressed; mesopleuræ granular; dorsal aspect of propodeum with a broad, shallow median furrow, striato-granular, the striæ poorly defined, oblique from center; posterior face sculptured like dorsal aspect with an acute median triangle, the point downward; sides of propodeum with the striæ stronger than on the dorsal surface; legs strongly spined, the inner calcarium of posterior tibiæ longer than the basi-

tarsus; first abscissa of the radius longer than second, third much longer than the second but shorter than the fourth; abdomen with distinct, small, separate punctures; pygidium not sharply defined, with large, separate punctures, about one and a half times as long as broad at base, apex obtusely rounded. Black; base of mandibles scape beneath, flagellum beneath apically, tegulæ, legs except a black spot on coxæ above, and abdomen red; head and thorax with silvery pubescence, abdomen almost nude; wings hyaline, iridescent venation testaceous.

A paratype has the second and third abscissa of the radius subequal.

Male.—Length 6.25 mm. Anterior margin of the clypeus rounded out, hardly dentate; sides of propodeum not as strongly striate as in the female; mandibles, antennæ, coxæ, anterior femora, bases of the four posterior femora black; abdomen ornamented with silvery pile. Except where mentioned, the male agrees with the above description of the female.

Las Cruces, New Mexico. Type female collected on staminate flowers of *Croton neomexicanum* September 25, 1895; two paratype females collected October 5, 1895; type male collected September 23, on *Gutierrezia sarothræ*, var. *microcephala*. All were collected by Prof. T. D. A. Cockerell.

Type.—Cat. No. 13765, U.S.N.M.

Genus NOTOGONIA Costa.

NOTOGONIA BELLA, new species.

Seems to be closest structurally to *Notogonia truncata* Cameron, but that species is colored differently.

Female.—Length about 10 mm. Clypeus with distinct, median size punctures, apical margin shining and with a rounded notch in the middle; head and dorsulum finely granular, scutellum somewhat shining, with distinct punctures; depression from the anterior ocellus nearly breaking all the way through the crest; depression above lateral ocelli triangular; scape carinated ventrally; third and fourth antennal joints equal; propodeum granular; longitudinal furrow of propodeum dorsally shallow; carina separating the posterior face from the dorsal aspect not sharp; femora rather robust; abdomen dull; pygidium (under high power) covered with short spines; third cubital cell a little wider on the radius than the second. Black; femora and tibiæ clear red; covered with close golden pile, longer and denser on the propodeum. Wings light amber-yellow, with a apical third streaked with lavender; venation except the pale brown costa and stigma, the color of the wing.

Tabernilla, Canal Zone, Panama. One female collected June 4, 1907, by Mr. A. Busck.

Type.—Cat. No. 13766, U.S.N.M.

Genus ZOYPHIUM Kohl.

ZOYPHIUM RUFIPES, new species.

Should easily be recognized by the red legs, size, and two small teeth on the sides of the clypeus.

Female.—Length 6.5 mm. Emargination of the mandibles deep; depressed, shining, median portion of the clypeus gently rounded, laterally with two small teeth; space between the antennæ at the base not quite twice as great as the space between the base of antenna and eye margin; scape subequal in length with the distance between the base of antenna and eye margin; antennæ short, thickening apically, pedicellum globose about half as long as the third antennal joint third joint distinctly longer than the fourth, apical joint obtusely pointed not as long as the two proceeding joints; head rather coarsely granular; eyes strongly diverging to the clypeus; postocellar line at least three times as long as the ocelloccipital line; pronotum somewhat declivitous; mesonotum and scutellum closely, rather coarsely punctured; suture between mesonotum and scutellum strongly foveolate; mesopleuræ rather finely punctured; propodeum dorsally and posteriorly with fine, separated punctures, sides shining almost impunctate; dorsal aspect with a broad U-shaped depression, basally with a longitudinal carina; posterior face with a large somewhat Y-shaped fovea, the tail at ventral end rounded, the arms subfoveolate outside; a strong carina separating the sides of propodeum from the dorsal and posterior aspects; femora very robust, inner calcarium of posterior tibiæ nearly as long as basitarsis; venation very like *Z. sericeum* Kohl; abdomen shining, finely closely punctured, first segment with the punctures well separated; pygidium triangular, apex rounded, densely covered with short bristle-like spines; second dorsal segment with the apical fourth depressed. Black; spot on mandibles, flagellum beneath, tubercles, tegulæ, dorsal part of pronotum (except two yellow spots), scutellum, metanotum, legs below trochanters rufous; rather densely covered with sercious pile; wings hyaline, iridescent; venation testaceous.

Duariga, Dawson District, North Queensland. One female from Mr. W. F. H. Rosenberg.

Type.—Cat. No. 13767, U.S.N.M.

Genus SOLIERELLA Spinola (following Kohl).

Dr. F. F. Kohl¹ divides the genus *Solierella* Spinola into four sections. The species grouped together in his genus can be divided into groups on the mandibles in the following manner:

Mandibles not emarginate exteriorly.....*Silaon* Piccioli.
Mandibles distinctly or shallowly emarginate exteriorly.....*Solierella* Spinola.

¹ Die Gattungen der Sphegiden, 1896, pp. 451-453.

Whether such groups should be considered as genera or not is a matter of opinion. For the present it may be well to recognize them as such.

Genus SOLIERELLA Spinola.

As far as known to the author this group divides itself into two, as follows:

Emargination of the mandibles strong; transverse median and basal vein interstitial or nearly.....*Solierella* Spinola.

Emargination of the mandibles weak; transverse median basad of basal vein.

Niteliopsis S. Saunders.

Kohl's group 3,¹ which is *Niteliopsis*, is not correctly defined according to Saunder's description. Kohl says, "Die Basalader entspringt interstitial." Saunder's figure shows it quite free and basad of the basal vein. The mandibles are originally described thus: "Mandibulae curvatæ, basi robustæ prope medium excavatæ, apice acutæ edentulæ."

Genus SILAON Piccioli.

Sylaon is an emendation. All the American species referred to *Niteliopsis* belong here. The species known to the author may be divided into the following groups:

Transverse median basad of basal vein; first cubital cell receiving a recurrent vein.
group *compeditus* Piccioli.

Transverse median beyond basal vein; second cubital cell receiving both recurrent veins or the first recurrent interstitial with the first transverse cubitus.

group *vierecki* Rohwer.

Transverse median and basal veins interstitial or nearly so..... 1.

1. First recurrent vein received by the first cubital cell.....group *chilensis* Kohl.

First recurrent vein received in the second cubital cell or interstitial with the first transverse cubitus.....group *plenoculoides* Fox.

The Nearctic species would be grouped as follows, according to the above arrangement:

Group *compeditus*.

sayi (Rohwer).

Group *chilensis*.

lucidus (Rohwer).

parvus (Rohwer).

niger (Rohwer).

affinis (Rohwer).

inermis (Cresson).

mexicanus (Rohwer).

Group *vierecki*.

vierecki (Rohwer).

fossor (Rohwer).

foxii (Viereck) from description.

Group *plenoculoides*.

plenoculoides (Fox).

striatipes (Ashmead) (male, not female).

modestus (Rohwer).

¹ Die Gattungen der Sphegiden, 1896, p. 453.

SILAON MEXICANUS, new species.

Closest to *inermis* (Cresson), but differs in the entire last ventral abdominal segment and other characters.

Male.—Length 4.75 mm. Middle of the clypeus produced into a broad, truncate lobe, anterior margin impunctate, shining, basally finely granular as in the rest of the front; carinæ as in *inermis* but not as strong; vertex and occiput with distinct close punctures; ocelli in nearly an equilateral triangle; pronotum rounded, neither angled or crested; dorsulum, scutellum, and mesopleuræ with rather large, distinct, rather close punctures; triangular area of the propodeum with close longitudinal striæ; propodeum laterally and posterior face finely striato-granular; legs and venation as in *inermis*; abdomen very finely sculptured, apical ventral plate entire at apex. Black; mandibles, line on pronotum, tubercles, anterior femora apically more broadly so beneath, spot on intermediate femora beneath, four anterior tibiæ and tarsi, and posterior tarsi yellowish; tegulæ and hind tibiæ brown; usual sparse silvery pubescence; wings dusky, venation black. Antennæ robust, somewhat flattened.

San Ragaël, Jicoltepec, Mexico.

Type.—Cat. No. 13768, U.S.N.M.

Belongs to species group *chilensis* in the foregoing arrangement.

Genus MISCOPHINUS Ashmead.

MISCOPHINUS NIGRICEPS, new species.

Related to *M. texanus* Ashmead, but the thorax is entirely rufous and the median carina of the propodeum is incomplete.

Female.—Length 7 mm. Clypeus broadly rounded anteriorly with the usual lateral narrow notch; head finely, opaquely, granular; no impressed line from the anterior ocellus; anterior ocellus not surrounded by a depression; third antennal joint distinctly longer than the fourth; pro- and mesothorax with fine separate punctures; propodeum without a complete median carina, finely, obliquely striate, posterior face not so closely striate, separated from the dorsal surface by a fine carina, with a median depression; abdomen, legs, and wings normal. Rufo-ferruginous; apex of abdomen dusky; head black, clypeus, mandibles (apices piceous) and first three joints of antennæ rufo-ferruginous. Wings hyaline, apical margin broadly dusky; venation dark brown.

Santa Monica, California. One female collected by Mr. C. E. Hutchinson, September 15, 1901.

Type.—Cat. No. 13553, U.S.N.M.

PRELIMINARY NOTICES OF SOME NEW PACIFIC
CEPHALOPODS.

By S. STILLMAN BERRY,
Of Stanford University, California.

Pending the publication in a forthcoming report of complete descriptions with the necessary figures, it has been thought best to present in advance brief diagnoses of certain West American squids and devilfish, which appear to be new in the collections at my disposal. Most of the material was obtained by the U. S. Bureau of Fisheries steamer *Albatross*. The region concerned is faunally a very rich one, but as its teuthology has been hitherto practically unknown, the fact that a number of its most common and characteristic species are undescribed need be in no way surprising.

CIRROTEUTHIS MACROPE, new species.

Body of rather small size, subgelatinous, elongate for a decapod, with a broad oar-like fin on either side. Mantle opening full and very wide, reaching to a point just behind each eye.

Head wide, flattened; eyes large and prominently protruding. Funnel large and broad, the funnel organ comprising a pair of small oval whitish pads, situated one at either side on the dorsal wall of the cavity near the apex.

Arms connected by a thin umbrella reaching nearly or quite to their tips; very delicate and not well preserved; suckers small, flanked on either side by a row of rather large papilla-like cirri.

Radula well developed, contrary to one of the supposed characteristics of the family Cirroteuthidæ. There are seven rows of teeth.

Type.—Cat. No. 214317, U.S.N.M. From *Albatross* station 4393, near San Diego, California.

Length (total) 99 mm.; to base of umbrella 58 mm.

ELEDONELLA HEATHI, new species.

Body smooth, inflated, of a semimembranous consistency; mantle opening very wide and full, extending slightly past the center of each eye.

Head short, broad, compressed; eyes very large, lens much protruding. Funnel thin walled and broad; the funnel organ consisting of a tripartite pad shaped like an inverted V, its apex free and flap like.

Arms of moderate length, attenuate, the third pair much the largest and longest, the others nearly of a length; umbrella well developed; suckers in a single row, large, much elevated, and showing the peculiar constriction near the apex as observed in other species of the genus.

Gills very large, comprising about eight lamellæ.

Type.—Cat. No. 214318, U.S.N.M. From *Albatross* station 4396, off Santa Catalina Island, California.

Length (total) 117 mm.; of mantle 50 mm.

POLYPUS CALIFORNICUS, new species.

Body of moderate size, short, rounded, compact; surface covered with numerous large stellate papillæ which become smaller and nearly obsolete ventrally; above each eye a rounded flattened tubercle slightly larger than the rest.

Head short and broad, separated from the body by a slight constriction; eyes of moderate size. Funnel rather long, conical, broadly adherent to the head for the greater part of its length.

Arms stout, moderately long, their length from two and one-half to three times that of the head and body; relative order of length variable; their basal quarter webbed. In the male the third right arm considerably shorter than the others; its hectocotylyzed portion large and prominent, narrowly and deeply channeled, the excavation distinctly rugose with numerous flattened transverse grooves and ridges. Suckers in two rows, rather large.

Color in alcohol a pinkish brown.

Type.—Cat. No. 214321, U.S.N.M. From *Albatross* station 4325, in the vicinity of San Diego, California.

Length (total) 308 mm.; posterior tip of body to base of dorsal arms 89 mm.

POLYPUS LEIODERMA, new species.

Body of moderate size, wider than long; nearly smooth except for a few rather distant simple papillæ on the dorsal surface, as well as a narrow (though distinct) membranous fold bounding the outer periphery.

Head short and broad with large eyes. Funnel long and rather slender.

Arms not very long, their order 1, 2, 3, 4, the dorsal pair decidedly the stouter and longer, the ventral the reverse; umbrella well developed, extending between the dorsal and lateral arms for over a fourth of their length, but much shorter between the ventral pair; suckers in two rows, small, and relatively very numerous.

Color very pale over the body; arms and umbrella darker.

Type.—Cat. No. 214322, U.S.N.M. From *Albatross* station 4293, Shelikof Strait, Alaska.

Length (total) 210 mm.; posterior tip of body to base of dorsal arms 45 mm.

ROSSIA PACIFICA, new species.

Body moderately small, sepioliform, with large subcordate lateral fins.

Head large; arms stout and rather short, the order of length 3, 4, 2, 1; umbrella rudimentary; suckers spherical, oblique, in two rows at the base and tip of all the arms, but often extremely crowded along the middle where they are apparently ranked in three or even four rows. Both dorsal arms in the male hectocotylized, strongly recurved, their suckers greatly reduced, usually in two rows until just before reaching the tip, when they become more crowded; the bases of the suckers transversely compressed to form a series of rugose folds. Tentacles variable in size and proportion, the club but slightly expanded; at the middle with about eight rows of small delicately toothed suckers.

Type.—Cat. No. 214323, U.S.N.M. From *Albatross* station 4233, Behm Canal, Alaska.

Length (total) 74 mm.; length of mantle (dorsal) 32 mm.

This species is nearly allied to *R. macrosoma* Delle Chiaje but appears to differ in a number of small details.

LOLIGO OPALESCENS, new species.

Body of moderate size, elongate, slightly swollen near the middle, thence tapering acutely to a rather sharp point; fins large, sagittate, about half as long as the mantle; mantle margin produced above into a prominent squarish rostrum.

Head small, square; eyes large.

Arms stout and rather short, unequal, the dorsal arms considerably the shortest; umbrella rudimentary, but keels and swimming membranes well developed, especially on the third arms where the ventral membrane becomes wider than the arm itself. Suckers small, notched above, regularly alternating in two rows; horny rings with 9 to 12 bluntly rounded squarish teeth. Left ventral arm of the male conspicuously hectocotylized; along the proximal two-thirds of the arm the suckers are unmodified, but along the distal third their pedicels become greatly elongate and transversely flattened; also the cupules undergo great reduction although persisting to the tips, those of the dorsal row being the most modified.

Tentacular club slightly expanded, with two lateral rows of small suckers and two median rows of large ones, the horny rings of the latter armed all round with about thirty-five small, rather elongate, bluntly conical teeth.

Buccal membrane seven-pointed, each point bearing two rows of extremely minute toothed suckers.

Gladius broadly lanceolate, thin, its margins little if at all thickened.

Type.—In the Stanford University collection. From Puget Sound, Washington (shrimp fishermen). Ranges to San Diego, California.

Length (total) 177 mm.; of mantle (dorsal) 132 mm.; of fins 61.5 mm.

GALITEUTHIS PHYLLURA, new species.

Body of moderate size, translucent, membranous, smooth; elongate and becoming excessively attenuate between the long narrow lanceolate fins; the latter as broad as the body, thin and leaf-like; mantle firmly attached to the head at three points as in *G. armata*.

Head small, rather elongate; eyes enormous, globular, sessile, with small openings.

Arms moderately short, their order 4, 3, 2, 1, each bordered by a delicate hyaline swimming membrane. Suckers small, subspherical, with smooth horny rings. Tentacles long; the club slightly expanded and armed with twelve delicate hooks besides a few minute suckers at the tip; fixing apparatus consisting of a group of about eight small suckers and as many pads on the carpal portion of the club, whence two rows of minute flattened suckers and pads alternate in pairs down the stalk nearly to the base.

Type.—Cat. No. 214325, U.S.N.M. From *Albatross* station 4529, Monterey Bay, California.

Length (total) 350 mm.; length of mantle (dorsal) 230 mm.

Very close to *G. armata* Joubin from the Mediterranean.

FRESH-WATER SPONGES IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM.—PART V. A NEW GENUS PROPOSED, WITH HETEROMEYENIA RADIOSPICULATA MILLS AS TYPE.

By NELSON ANNANDALE,
Superintendent of the Indian Museum, Calcutta.

The free microscleres (as distinct from those associated with the gemmule) have not been regarded as of much systematic importance by writers on the Spongillidæ, but there seems to be no valid reason why they should not be considered in defining the genera of this family. I propose, therefore, to recognize an American species (*Heteromeyenia radiospiculata* Mills) as the type of a new genus on account of the peculiarities exhibited by these spicules, and in so doing I may state that I am of the opinion that the genus *Dosilia* Gray should be revived for the same reason, with *Spongilla plumosa* Carter as its type.

ASTEROMEYENIA, new genus.

Type.—*Heteromeyenia radiospiculata* Mills.

Spongillidæ which have birotulate gemmule spicules of two types and free microscleres in the form of anthasters.

The anthasters of this genus and of *Dosilia* are probably not homologous with those of most of the marine sponges in which spicules of the kind occur, but are produced by the secondary fusion of amphioxous or rotulate microscleres. In *Dosilia plumosa* monaxon microscleres are sometimes found, while the tips of the branches of asteroid microscleres often approximate to the rotulate form.

Two species, both confined (so far as we know) to North America, may be assigned to the new genus, namely *Heteromeyenia radiospiculata* Mills¹ and *H. plumosa* Weltner.² They may be distinguished most readily one from the other by the form of the terminal

¹ Ann. Mag. Nat. Hist., ser. 6, vol. 1, 1888, p. 313.

² Arch. f. Naturgesch., 1895, vol. 1, p. 127; see also Annandale, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 405, fig. 3.

spines of the longer gemmule spicules, for in *A. plumosa* these spines have a simple curve, while in *A. radiospiculata* the tips are distinctly recurved so that the whole spine as seen in profile has almost the form of a capital J.

Both of these species appear to be rare. *A. radiospiculata* was originally described from Cincinnati, Ohio, and some fine specimens have recently been acquired by the U. S. National Museum from Granite City, Illinois. The largest of these specimens, which were obtained by Mr. B. Donaldson in the settling tanks of the city waterworks in August, 1910, measures no less than 42 by 12 by 8 cm.; they are all, in a dry condition, of a dark gray color. The only locality whence *A. plumosa* was hitherto known was Pinto Creek, Kinney County, Texas, but a very beautiful specimen from Shreveport, Louisiana, has recently been added to the National collection. It is almost circular in outline, nearly flat, and of a pale brown color in the dry state, measuring 28.75 by 24.7 cm. Both it and a specimen of *Trochospongilla leidyi* found with it are permeated by the tubes of a bryozoon of the genus *Plumatella*. It was obtained, like the gigantic specimen of *A. radiospiculata* to which allusion has been made, from the settling tanks of the city waterworks, a situation which might be expected to be favorable for the growth of sponges.

A REVISION OF THE FORMS OF THE HAIRY WOODPECKER (*DRYOBATES VILLOSUS* [LINNAEUS]).

By HARRY C. OBERHOLSER,

Assistant Ornithologist, Department of Agriculture.

A cursory examination of the hairy woodpeckers (*Dryobates villosus* [Linnaeus]), made some time ago, showed conclusively that they were much in need of revision. This task I finally undertook, largely at the request of Mr. Ridgway, who generously placed at my disposal all the material he had gathered, and all the measurements he had made for use in preparing his account of this species for the forthcoming fifth part of his "Birds of North and Middle America." This material consists of altogether 1,070 specimens, and comprises the collections of the United States National Museum, including that of the Biological Survey; the American Museum of Natural History; the Museum of Comparative Zoology at Cambridge, Massachusetts, including the Bangs collection; the Academy of Natural Sciences of Philadelphia; the Carnegie Museum of Pittsburg, Pennsylvania; and the Field Museum of Chicago. With this excellent series, which represents all the forms of the species, most of them very satisfactorily, it has been possible to work out the distribution of the various races in considerable detail, which the accompanying map graphically represents.

The hairy woodpecker, as a species, ranges from Alaska and northern Canada south to Panama, and has 14 currently recognized forms, which the present investigation increases to 20. It is preeminently a bird of the forest, and in eastern and northern North America frequents both lowlands and highlands indiscriminately; but in the arid western United States and Mexico perforce, in Central America apparently from choice, it is an inhabitant of the mountains. Most of the forms are sedentary, but three—*Dryobates villosus septentrionalis*, *Dryobates villosus villosus*, and *Dryobates villosus harrisi*—have a well-marked southward movement in autumn and winter. Nearly all conform very well to the boundaries of the life zones, as now understood, although they range usually through two or exceptionally even three zones. The distribution of a few of the

racés is somewhat interesting, and is worthy of mention here. The Newfoundland bird, *Dryobates villosus terraenovae*, is most closely allied to *Dryobates villosus leucothorectis*,¹ from New Mexico and Arizona, and very different from the races that occupy the intervening 2,000 miles; while both *Dryobates villosus harrisi* and *Dryobates villosus picoideus*, from Alaska and British Columbia, approach much nearer, in color at least, to *Dryobates villosus hylobatus*² and *Dryobates villosus enissomenus*,³ from central Mexico, than to the races that are geographically adjacent. The northern Bahama Islands are occupied by two forms, which have become differentiated, in the color of the lores, from all the other subspecies, probably by isolation. Furthermore, there is almost a regular increase of size toward the north, from the smallest race, *Dryobates villosus extimus*, of Panama, to the two largest, *Dryobates villosus monticola*, of Montana and British Columbia, and *Dryobates villosus septentrionalis* of Mackenzie and Alaska.

The adult female hairy woodpecker differs from the male only in somewhat smaller size and in the absence of the red occipital band. The juvenals of both sexes closely resemble the adults, except that nearly the whole top of the head is red.

In the measurements given under the various forms, none but perfectly typical specimens have been used, except in a few cases where such exclusion was rendered inadvisable by the smallness of the series available; for to include intermediates in measurement averages manifestly obscures the differences that really exist. The length of the tail is less reliable than other dimensions, as it is in all woodpeckers, since, on account of the unusual amount of wear to which the feathers are subject, it varies greatly. All measurements are in millimeters. In the lists of specimens examined, each locality is to be regarded as a breeding station unless specific statement is made to the contrary.

The following key may serve for an aid in distinguishing the various forms, in addition to setting forth their salient characters more clearly than do the descriptions.

KEY TO THE SUBSPECIES OF DRYOBATES VILLOSUS.

a. Lores entirely white.

b. Inner webs of outer tail-feathers without black spots. *Dryobates villosus maynardi*.

b'. Inner webs of two or three outer pairs of tail-feathers with subterminal black spots.....*Dryobates villosus piger*.

a'. Lores partly black.

b. Upper wing-coverts with many and conspicuous white spots.

c. Size smaller; spots on wing-coverts smaller; lower parts purely white.

Dryobates villosus auduboni.

c'. Size larger; spots on wing-coverts larger; lower parts usually pure white.

d. Smaller, wing of male usually less than 128 mm. (average, 120.9).

Dryobates villosus villosus.

¹ See p. 608.

² See p. 617.

³ See p. 614.

d'. Larger, wing of male usually more than 128 mm. (average, 132.4).

Dryobates villosus septentrionalis.

b'. Upper wing-coverts with few or no white spots.

c. Lower parts white or brownish white.

d. Lower surface pure white.

e. Larger, wing of male averaging more than 130 mm.

Dryobates villosus monticola.

e'. Smaller, wing of male averaging less than 130 mm.

f. Dorsal white stripe without spots or bars of black; superior wing-coverts with less white; size slightly smaller.

Dryobates villosus leucothorectis.

f'. Dorsal white stripe often with spots or bars of black; superior wing-coverts with more white; size slightly larger.

Dryobates villosus terraenovae.

d'. Lower surface brownish white.

e. Larger, wing of male over 126 mm. (averaging 129.1).

Dryobates villosus orius.

e'. Smaller, wing of male less than 126 mm. (averaging 121.7).

f. Bill much larger.....*Dryobates villosus hyloscopus.*

f'. Bill much smaller.....*Dryobates villosus icastus.*

c'. Lower parts smoky brown.

d. Lower surface lighter—usually light smoky brown.

e. Larger; ventral surface paler.....*Dryobates villosus intermedius.*

e'. Smaller; ventral surface usually darker.

f. Red occipital band of male wider; lower parts more rusty brown.

Dryobates villosus fumeus.

f'. Red occipital band of male more narrow; lower parts more grayish brown.

Dryobates villosus enissomenus.

d'. Lower surface darker—deep smoky brown.

e. Light dorsal stripe and white tail-feathers more or less spotted or barred with black.....*Dryobates villosus picoides.*

e'. Light dorsal stripe and white tail-feathers without spots or bars of black.

f. Larger (wing of male usually more than 125 mm., averaging 127.8 mm.; exposed culmen usually more than 29 mm., averaging 31.7 mm.); lower parts paler, more grayish, brown....*Dryobates villosus harrisi.*

f'. Smaller (wing of male less than 125 mm., averaging under 124 mm.; exposed culmen less than 29 mm., averaging under 28 mm.); lower parts darker, more rufescent, brown.

g. Under surface lighter; size larger (wing of male more than 113 mm., averaging over 114 mm.).

h. Smaller (wing of male less than 120 mm.).

Dryobates villosus jardinii.

h'. Larger (wing of male more than 120 mm.).

Dryobates villosus hylobatus.

g'. Under surface darker; size smaller (wing of male less than 113 mm., averaging under 112 mm.).

h. Larger (wing of male usually more than 107 mm., averaging 109.4 mm.); dorsal stripe darker, more brownish.

Dryobates villosus sanctorum.

h'. Smaller (wing of male usually less than 107 mm., averaging 102.8 mm.); dorsal stripe paler, more whitish.

Dryobates villosus extimus.

DRYOBATES VILLOSUS VILLOSUS (Linnaeus).

Picus villosus LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 175.

Picus leucomelas BODDAERT, Tabl. Planch. Enlum., 1783, No. 345, fig. 1, p. 21 (Canada).

Picus canadensis GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 437 (Canada).

Picus leucomelanus WAGLER, Syst. Avium, 1827, Picus No. 18, p. 20 (Canada).

Picus martini AUDUBON, Birds Amer. (folio), vol. 4, 1838, pl. 417, figs. 1, 2 (Toronto, Ontario, Canada).

Picus philippsi AUDUBON, Birds Amer. (folio), vol. 4, 1838, pl. 417, figs. 5, 6 (Massachusetts).

Picus martinæ AUDUBON, Ornith. Biog., vol. 5, 1839, p. 181 (Toronto, Ontario, Canada) (nom. emend. pro *Picus martini* AUDUBON).

Picus villosus, var. *medius* BAIRD, Rep. Explor. and Surv. R. R. Pac., vol. 9, 1858, p. 84 (Middle States [of United States]).

Chars. subsp.—Size medium (wing of male averaging 120.9 mm.); lower parts white; upper wing-coverts heavily spotted with white.

Description.—Adult male, No. 101565, U.S.N.M.; Chester County, Pennsylvania, January 6, 1885; B. H. Warren. Upper parts generally, sides of head and neck, a broad malar stripe, wings, and middle tail-feathers, black; occipital band scarlet; nasal tufts grayish white; a broad superciliary stripe, a broad rictal stripe prolonged to the side of the cervix, a broad dorsal stripe, large spots on both webs of remiges, and on most of the upper wing-coverts, with all of the two outer rectrices (including the dwarfed outermost one), most of the third, and terminal portion of fourth, and entire lower surface of body, pure white.

Measurements.—Male:¹ Wing, 118–124 (average, 120.9) mm.; tail, 65–77 (71.7); exposed culmen, 27–33 (29.4); tarsus, 21–23 (22); middle toe, 13–15.5 (14.5).

Female:² Wing, 115–121.5 (118.6); tail, 69–78.5 (73.5); exposed culmen, 25–30 (26.9); tarsus, 20–22.5 (21); middle toe, 13–14.5 (13.9).

Type-locality.—Racoon, New Jersey (ex Kalm).

Geographical distribution.—Canadian, Transition, and Upper Austral zones of the eastern United States and southern Canada: east to the Atlantic coast; north to Nova Scotia; New Brunswick; Magdalen Islands, Gaspé Peninsula, and Rideau River (near city of Quebec), in southern Quebec; Emsdale, south central Ontario; and Moose Lake, southwestern Keewatin; west to Manitoba; central North Dakota; central South Dakota; central Nebraska; Dry Willow Creek (Yuma County) and Fowler, in eastern Colorado; and Lipscomb and San Angelo, in middle Texas; south to Mason, central Texas; Van Buren, central western Arkansas; Endy, southeastern Missouri; Odin, southern Illinois; Brookville, southern Indiana; Guthrie, southwestern Kentucky; Huntsville, northern Alabama; Mitchell County, northwestern North Carolina; Washington County, southwestern

¹ Twenty specimens, from New York, Pennsylvania, Maryland, and the District of Columbia.

² Seventeen specimens, from the same localities.

Virginia; and central Virginia. In winter it occurs south to Raleigh, central North Carolina; Wheatland, southwestern Indiana; and Mount Carmel, southeastern Illinois.

This, the first form of the species to receive a binomial name, is really an intermediate between the small Florida *Dryobates villosus audubonii*, on the one hand, and the large Canadian *Dryobates villosus septentrionalis*, on the other, from both of which it differs chiefly in size. The amount of difference between birds from Florida and those from Mackenzie, Canada, is, however, very great, and it seems much better to recognize three forms than to divide all the birds from the wide middle area between only two—a large northern and a small southern race. Further division of these eastern birds does not, however, after careful study, appear to be advisable. Specimens from the States of New York, Pennsylvania, and Maryland, which are of practically the same size, seem most satisfactorily to represent the middle race, *Dryobates villosus villosus*, the type of which came from New Jersey; and these have, therefore, been taken to establish the standard of size. With this criterion, fairly satisfactory ranges may be worked out, which, in a general way, are seen to correspond to the currently accepted life zones.

Examples from southern Ontario and from New Brunswick average noticeably larger than those from Pennsylvania and New York, the difference being about 4 mm. in the length of the wing, but they are evidently referable to *D. v. villosus*. Two breeding birds from southeastern Maine are large enough for *Dryobates villosus septentrionalis* (wings, respectively, 129 and 130 mm.), but surrounded, as they are, by smaller birds, it seems best to consider them abnormal individuals of *D. v. villosus*. Specimens from western North Carolina and middle and eastern Tennessee average smaller (2 to 3 mm. in length of wing) than typical *D. v. villosus*, and have also somewhat less white on the wing-coverts, but are nevertheless nearer this form than to *Dryobates villosus audubonii*.

The hairy woodpecker was first described by Linnaeus as *Picus villosus*,¹ and based upon Kalm,² Catesby,³ and Brisson.⁴ Kalm's bird is from New Jersey, and represents the middle eastern race; Catesby's from South Carolina, and thus the form now called *Dryobates villosus audubonii*; while Brisson's is a mixture of the two, but applies chiefly and properly to the former. The first author to restrict the name *villosus* was Swainson,⁵ who described the small southern bird as *Picus audubonii*,⁵ and called the more northern form *Picus villosus*. This arrangement has been generally followed by subsequent authors; and there is no reason why it should now be changed.

¹ Syst. Nat., ed. 12, vol. 1, 1766, p. 175.

² Resa Norra Amer., vol 3, 1761, p. 43.

³ Nat. Hist. Carolina, vol. 1, 1731, p. 19, pl. 19.

⁴ Ornith., vol. 4, 1760, p. 48.

⁵ Fauna Bor.-Amer., vol. 2, 1831 (1832), p. 306.

The *Picus martini* of Audubon,¹ from Toronto, Ontario; his *Picus philippsi*,² from Massachusetts; and his *Picus martinæ*,³ are all referable to the present race, as their measurements clearly indicate. The *Picus villosus*, var. *medius* of Baird⁴ also evidently belongs here. The status of *Picus leucomelas* Boddaert,⁵ *Picus canadensis* Gmelin,⁶ and *Picus leucomelanus* Wagler,⁷ which have commonly been referred to the large northern Canada race, are fully discussed under *Dryobates villosus septentrionalis*.⁸

Of this form, 115 specimens have been examined, from the following localities:

Keewatin.—Moose Lake.

Manitoba.—Lake Manitoba; Carberry.

New Brunswick.—Gulquac Lake (Victoria County); Forks of Tobique River (Victoria County); Restigouche River.

Nova Scotia.—Yarmouth; Wolfville; Newport.

Ontario.—Toronto; Emsdale.

Alabama.—Huntsville.

Arkansas.—Van Buren.

Colorado.—Dry Willow Creek (Yuma County); Lamar; Holly; Swink; Fowler.

Connecticut.—Washington; Lyme.

District of Columbia.—Rock Creek; Takoma.

Illinois.—Grand Chain; Lewistown; Jacksonville; Worth; McHenry; Mount Carroll; Lake Forest; Mount Carmel.⁹

Indiana.—Brookville; Wheatland.⁹

Iowa.—Hardin County; Knoxville; Winnebago County; Delaware; Dickinson County.

Kansas.—[No further locality.]

Kentucky.—Barbourville; Lexington; Guthrie.

Maine.—Sebec Lake; Upton; South Twin Lake (Penobscot County); Turkey Tail; Columbia Falls; King and Bartlett Lake (Somerset County).

Maryland.—Finzel; Bittinger; Takoma; Prince George County; Laurel; Jefferson.

Massachusetts.—Newton; Cambridge; Brookline; Belmont; Wayland; Newtonville; Cotuit; Lincoln; Waltham; Lexington.

Michigan.—Manchester; McKinley (Oscoda County); Kalamazoo County; Washington Harbor, Isle Royale.

Minnesota.—Hinckley; Fort Snelling; Kittson County.

Missouri.—Marble Cave; Thayer; Casto Valley, near Endy (Shannon County); Spring Valley, near Endy (Shannon County).

¹ Birds Amer. (folio), vol. 4, 1838, pl. 417, figs. 1, 2.

² Birds Amer. (folio), vol. 4, 1838, pl. 417, figs. 5, 6.

³ Ornith. Biog., vol. 5, 1839, p. 181.

⁴ Rep. Explor. and Surv. R. R. Pac., vol. 9, 1858, p. 84.

⁵ Tabl. Planch. Enlum., 1783, p. 21.

⁶ Syst. Nat., vol. 1, pt. 1, 1788, p. 437.

⁷ Syst. Avium, 1827, Picus No. 18, p. 20.

⁸ See p. 604.

⁹ Not breeding at this locality.

New Hampshire.—Shelburne; Epsom; Franconia; Hampton; Ossipee.

New Jersey.—Cape May County; Egg Harbor; Tuckerton; Hoboken; Haddonfield.

New York.—Steuricke; Canandaigua; Stamford; Highland Falls; Lake Grove; Plateau Mountain, Catskill Mountains; Chataugay Lake; Ithaca; Syracuse; Long Island; Saint Regis Lake; Leyden; Hilton (Monroe County); Kiskatom; Suspension Bridge.

North Carolina.—Mitchell County; Raleigh.¹

Pennsylvania.—Shade Gap (Huntington County); Mapleton; Belsano; Greenwood Furnace; Ohio Pyle; Crumb; Kimbleville (Chester County); Westtown; Wilkesburg; Riddlesburg; Carlisle; West Goshen; Erie; Coudersport; Leasuresville; Bear Lake (Warren County); Laughlinstown; Conneaut Lake; Spruce Creek; Cherry Spring (Potter County).

South Dakota.—Fort Randall.

Tennessee.—Lexington; Cross Mountain; Briceville; High Cliff; Rockwood; Roan Mountain.

Texas.—Lipscomb; Cisco; Carbon; Eastland County.

Vermont.—Clarendon.

Virginia.—Prince William County; Gainesville; Falls Church; Washington County.

Wisconsin.—Kenosha; Sayner; Solon Springs; Camp Douglas; De Pere; Beloit; Woodruff (Vilas County).

DRYOBATES VILLOSUS AUDUBONII (Swainson).

Picus audubonii SWAINSON, Fauna Bor.-Amer., vol. 2, 1831 (1832), p. 306.

Picus villosus, var. *minor* BAIRD, Rep. Explor. and Surv. R. R. Pac., vol. 9, 1858, p. 85 (Southern States [of United States]).

Chars. subsp.—Similar to *Dryobates villosus villosus*, but smaller; white spots on upper wing-coverts smaller and less numerous.

Measurements.—Male:² Wing, 110.5–117.5 (average, 113.9) mm.; tail, 58–69 (65.1); exposed culmen, 26.5–30.5 (28.3); tarsus, 19.5–21.5 (20.6); middle toe, 13–14.5 (13.7).

Female:³ Wing, 108.5–115.5 (112.6); tail, 59–70 (64.8); exposed culmen, 25–27.5 (26.2); tarsus, 19–20 (19.5); middle toe, 12.5–14 (13.2).

Type-locality.—Georgia, U. S. A.

Geographical distribution.—Lower Austral Zone of the southeastern United States: east to the Atlantic seaboard; south to the Gulf of Mexico, and in Florida to Bassinger and Fort Meyer; north to Lake Drummond, southeastern Virginia; Raleigh, central North Carolina; Caesar's Head, northwestern South Carolina; central Georgia; cen-

¹ Not breeding at this locality.

² Ten specimens, from Florida.

³ Ten specimens, from Florida and southern Georgia.

tral Alabama; Burnsville, northeastern Mississippi; central Arkansas; and up the Mississippi and Ohio valleys to Cushion Lake, in southeastern Missouri, Sugar Creek Prairie (Richland County) and Mount Carmel, in southeastern Illinois, and Wheatland in southwestern Indiana; west to Jefferson and Austin in eastern Texas.

Birds from Florida are very small and have least white on the wing-coverts, representing thus the extreme development of this form, and for this reason we have used them as the basis of comparisons.

Specimens from southern Georgia, Louisiana, and eastern Texas are quite as small as those from Florida, but in South Carolina and North Carolina they become somewhat larger. A single adult male from Lake Drummond, Dismal Swamp, southeastern Virginia, is considerably larger, and verges toward *Dryobates villosus villosus*, but has a smaller amount of white on the wing-coverts, and seems to be nearer the present race. Breeding birds from the *bottomlands* of the lower Wabash Valley, in Richland and Wabash counties, southeastern Illinois, and in Knox County, southwestern Indiana, while somewhat larger than typical *D. v. audubonii*, are, nevertheless, nearer to this than to *D. v. villosus*; which latter form, however, occupies the neighboring uplands, and descends to the river bottoms in winter.

I have examined 112 examples of this race, representing the following localities:

Arkansas.—Mississippi County; Armorer.

Florida.—Enterprise; Whitfield; Mullet Lake; Kissimmee River at Fort Gardner; Arbuckle; Osceola County; Moses Creek; Pilot Town; Jacksonville; Winter Park; Ilibernia; Lake Hatch-ne-haw; Kissimmee; Lake Kissimmee; San Mateo; Fort Thompson; Tarpon Springs; Magnolia; Welaka; Rosewood; Smyrna; Sebastian River; Hollyhill.

Georgia.—LeConte Plantation, Riceboro; Washington County; St. Marys; Liberty County.

Illinois.—Sugar Creek Prairie (Richland County); Mount Carmel; Mound City; Olive Branch.

Indiana.—Wheatland.

Louisiana.—Houma; Natchitoches; Belair; Mandeville.

Mississippi.—Burnsville; Washington.

Missouri.—Cushion Lake.

North Carolina.—Raleigh.

South Carolina.—Lanes; Kershaw County; Mount Pleasant; Aiken County; Port Royal; Cæsar's Head.

Texas.—Giddings; Hempstead; Sour Lake; Jefferson.

Virginia.—Lake Drummond, Dismal Swamp.

DRYOBATES VILLOSUS MAYNARDI Ridgway.

Picus insularis MAYNARD, Sale Catalogue Bahama Birds, Aug. 1, 1884, p. — (nec *Picus insularis* GOULD, 1862, qui *Dryobates insularis* [GOULD]).

Dryobates villosus maynardi RIDGWAY, Man. North Amer. Birds, 1887, p. 282 (nom. nov. pro *Picus insularis* Maynard, praeocc.).

Chars. subsp.—Similar to *Dryobates villosus audubonii*, but lores entirely white, instead of mostly black; wing-coverts more heavily spotted with white; size smaller.

Measurements.—Male:¹ Wing, 103–109 (average, 107.3) mm.; tail, 61.5–68 (65.2); exposed culmen, 26–29.5 (27.7); tarsus, 19–20.5 (19.8); middle toe, 13–14.5 (13.7).

Female:² Wing, 100.5–108.5 (104); tail, 61–68.5 (63.9); exposed culmen, 23.5–27 (25); tarsus, 17.5–19.5 (19); middle toe, 12.5–13.5 (12.8).

Type-locality.—Nassau, New Providence Island, Bahama Islands.

Geographical distribution.—Bahaman Upper Tropical Zone, on New Providence and Andros Islands, Bahama Islands.

Specimens from the island of Andros are practically identical in measurements with those from New Providence Island.

Forty specimens have been available, from the subjoined localities:

Bahama Islands.—Nassau, New Providence Island; Blue Hills, New Providence Island; south side of New Providence Island; Southern Bight, Andros Island; Staniard Creek, Andros Island; Nicol's Town, Andros Island; Red Bays, Andros Island.

DRYOBATES VILLOSUS PIGER G. M. Allen.

Dryobates villosus piger G. M. ALLEN, Auk, vol. 22, 1905, p. 124.

Chars. subsp.—Similar to *Dryobates villosus maynardi*, but outer (long) tail-feathers usually with black spots on terminal portion of inner webs.

Measurements.—Male:³ Wing, 105.5–110 (average, 107) mm.; tail, 62.5–65.5 (64); exposed culmen, 27.5–29.5 (28.5); tarsus, 20–20.5 (20.3); middle toe, 12.5–14 (13.4).

Female:⁴ Wing, 100–109.5 (104.2); tail, 60–68 (63.3); exposed culmen, 22.5–27 (24.4); tarsus, 18–20.5 (19); middle toe, 12–14 (13).

Type-locality.—Great Bahama Island, Bahama Islands.

Geographical distribution.—Bahaman Upper Tropical Zone, on Abaco and Great Bahama islands, Bahama Islands.

While the character of spots on the rectrices, which distinguishes this race from *Dryobates villosus maynardi*, is not entirely constant, it is sufficiently so to warrant the recognition of *Dryobates villosus piger*.

¹ Thirteen specimens, from the islands of Andros and New Providence, Bahama Islands.

² Thirteen specimens, from the same two islands.

³ Six specimens, from the islands of Abaco and Great Bahama, Bahama Islands.

⁴ Twelve specimens, from the same two islands.

Birds from Abaco Island are of practically the same size as those from the island of Great Bahama.

Specimens examined, 19, from the localities that follow:
Bahama Islands.—Abaco Island; Great Bahama Island.

DRYOBATES VILLOSUS SEPTENTRIONALIS (Nuttall).

Dryobates villosus leucomelas Auctt. rec., nec Boddaert.

Picus septentrionalis NUTTALL, Man. Ornith. U. S. and Canada, ed. 2, vol. 1, 1840, p. 684.

Picus villosus, var. *major* BAIRD, Rep. Explor. and Surv. R. R. Pac., vol. 9, 1858, p. 84 (northern and western regions [of North America]).

Picus cuvieri MALHERBE, Mon. Piciées, vol. 1, 1861, p. 85, pl. xxii, fig. 3 (North America).

Chars. subsp.—Similar to *Dryobates villosus villosus*, but decidedly larger.

Measurements.—Male:¹ Wing, 128–138 (average, 132.4) mm.; tail, 77.5–87 (83.5); exposed culmen, 31.5–37.5 (35.8); tarsus, 22–25 (23.5); middle toe, 14.5–16 (15.3).

Female:² Wing, 128–136.5 (130.8); tail, 78.5–90.5 (84.8); exposed culmen, 29.5–33.5 (31.7); tarsus, 22–23.5 (22.7); middle toe, 13.5–15.5 (14.4).

Type-locality.—Saskatchewan River, Saskatchewan, Canada.

Geographical distribution.—Hudsonian and Canadian zones of northern North America: east to the Eskimo River, northeastern Quebec [formerly Labrador]; south to Pointe de Monts (probably) and Temiskaming, in central Quebec; northern Ontario; southeastern and south central Keewatin; Fort Union, northwestern North Dakota; Glasgow and Big Snowy Mountains, in northeastern Montana; southern Alberta; and Soda Creek (Caribou District), south central British Columbia; west to Fort Grahame, north central British Columbia; and Homer (Kenai Peninsula), middle southern Alaska; north to Fort Reliance, central Yukon; Lake Hardisty, central Mackenzie; Fort Churchill, central Keewatin; Moose Factory, northern Ontario; and the Hamilton River, northern Quebec. In winter it wanders southward as far as Rat Portage, western Ontario; Roseau River (Kittson County), northern Minnesota; Fort Randall, southern South Dakota; Harrison, northwestern Nebraska; Fort Keogh and Corvallis, south central Montana; and the Similkameen River, southern British Columbia.

There is surprisingly little difference in size in this subspecies between examples from Montana and those from Mackenzie and Alaska. Birds from northern Montana and central British Columbia have somewhat less white on the superior wing-coverts, showing thus a tendency toward *Dryobates villosus monticola*. A single summer female from

¹ Twelve specimens, from Montana, Saskatchewan, and Mackenzie.

² Nine specimens, from Quebec, Alberta, Mackenzie, Yukon, and Alaska.

Temiskaming, Quebec, is rather small, but altogether too large for *Dryobates v. villosus*, and doubtless represents the breeding form of that region. This is the southernmost breeding locality for *Dryobates v. septentrionalis* in eastern North America.

This large northern hairy woodpecker has hitherto been called *Dryobates villosus leucomelas* (Boddaert),¹ apparently because of the Canadian habitat assigned; but an examination of the origin of this name shows this view to be erroneous. Boddaert based his *Picus leucomelas*² on D'Aubenton's Planches Enluminées, No. 345, fig. 1; Buffon's "Épéiche du Canada"; and Brisson's "*Picus varius canadensis*"³. Buffon derived his description wholly from Brisson, so the matter resolves itself into an identification of D'Aubenton's plate and Brisson's description. Fortunately the measurements given by Brisson, of which the most satisfactory is the length of the bill, and the dimensions obtainable from D'Aubenton's drawing leave no doubt that the bird of both is altogether too small for the large race of northern Canada, and is none other than typical *Dryobates villosus villosus* of southern Canada and the northeastern United States. Boddaert's name⁴ becomes therefore a synonym of *Dryobates villosus villosus*. Gmelin's *Picus canadensis*⁵ and Wagler's *Picus leucomelanus*⁶ have practically the same basis as Boddaert's name, and are consequently identical in application. The earliest tenable subspecific term for the present race becomes, therefore, (*Picus*) *septentrionalis* of Nuttall,⁷ which is a new name for *Picus canadensis* Audubon,⁸ not Gmelin.

Forty-four specimens have been examined, and the following localities are represented:

Alaska.—Homer.

Alberta.—Canadian National Park; Grand Cache River, 70 miles north of Jasper; Grand Cache, Smoky River; Smith Landing, Slave River; near outlet of Athabaska Lake.

British Columbia.—Soda Creek (Caribou District); Fort Grahame; Similkameen River.⁹

Mackenzie.—Fort Liard; Liard River; Fort Smith; Fort Simpson; Fort Providence; Fort Resolution.

Ontario.—Toronto;⁹ Rat Portage;⁹ New Liskeard.

Quebec.—Temiskaming.

Saskatchewan.—Wingard; Saint Louis.

¹ *Picus leucomelas* Boddaert, Tabl. Planch. Enlum., 1783, No. 345, fig. 1, p. 21.

² Tabl. Planch. Enlum., 1783, No. 345, fig. 1.

³ Ornith., vol. 4, 1760, p. 45.

⁴ *Picus leucomelas*, Tabl. Planch. Enlum., 1783, p. 21.

⁵ Syst. Nat., vol. 1, 1788, p. 437.

⁶ Syst. Avium, 1827, *Picus* No. 18, p. 20.

⁷ Man. Ornith. U. S. and Canada, ed. 2, vol. 1, 1840, p. 684.

⁸ Ornith. Biog., vol. 5, 1839, p. 188.

⁹ Not breeding at this locality.

Yukon.—Fifty-mile River, Yukon River; Fort Reliance.

Minnesota.—Roseau River (Kittson County).¹

Montana.—Big Snowy Mountains; Glasgow; Fort Keogh;¹ Corvallis.¹

Nebraska.—Harrison (Sioux County).¹

North Dakota.—Fort Union; Pembina.¹

South Dakota.—Fort Randall.¹

DRYOBATES VILLOSUS MONTICOLA Anthony.

Dryobates villosus montanus ANTHONY, Auk, vol. 13, 1896, p. 32 (nec *Picus montanus* BREHM, qui *Dryobates major* [LINNAEUS]).

[*Dryobates villosus*] *monticola* ANTHONY, Auk, vol. 15, 1898, p. 54 (nom. nov. pro *Dryobates villosus montanus* ANTHONY, praeocc.).

Chars. subsp.—Similar to *Dryobates villosus septentrionalis*, but upper wing-coverts with few and small white spots or none.

Measurements.—Male:² Wing, 130–137.5 (average, 133.3) mm.; tail, 78.5–89.5 (82.5); exposed culmen, 28–34 (32.6); tarsus, 22–24.5 (22.7); middle toe, 14–16 (14.7).

Female:³ Wing, 126.5–134.5 (131.1); tail, 71.5–87.5 (79.8); exposed culmen, 28–31 (29.5); tarsus, 21.5–23.5 (22.1); middle toe, 13.5–15.5 (14.3).

Type-locality.—Boulder County, Colorado.

Geographical distribution.—Canadian and Transition zones in the Rocky Mountains of the United States and southern British Columbia: south to the town of Florida, in southwestern Colorado; and Pecos Baldy, central northern New Mexico; east to Chico Springs, northeastern New Mexico; Pueblo, Denver, and Loveland, in eastern Colorado; Laramie Peak, southeastern Wyoming; Harrison, northwestern Nebraska; Elk Mountain, western South Dakota; and Fort Keogh, eastern Montana; north to the Big Bend of the Mussellshell River, central Montana; Chief Mountain Lake, northwestern Montana; and Lac La Hache, south central British Columbia; west to the Similkameen River, central southern British Columbia; Conconully and Spokane, northeastern Washington; the Sawtooth Mountains and Bridge, middle Idaho; Parley's Park (Wasatch Mountains) and the Uinta Mountains, in northeastern Utah; and Rio Blanco County and Montrose, western Colorado.

This race differs from the eastern *Dryobates villosus villosus* as from *Dryobates villosus septentrionalis*, and additionally in much greater size. It nearly always has a little white on the wing-coverts, but this is sometimes absent. Birds from Montana have more of such white spotting than those from typical regions, and are more or less inter-

¹ Not breeding at this locality.

² Ten specimens, from Colorado, Wyoming, South Dakota, and Montana.

³ Eight specimens, from Colorado, Utah, Idaho, and Montana.

mediate between the present form and *Dryobates villosus septentrionalis*.

Of this subspecies, 134 examples have been available in the present connection, these representing the following localities:

British Columbia.—Similkameen River; Crater Mountain, Ashnola River; Vernon; Lac La Hache; Okanogan; Okanogan Landing; Okanogan Mission; between Penticton and Okanogan; Ashcroft; Kamloops.

Colorado.—Estes Park; Rio Blanco County; Reed Mills; Montrose; Deer Creek; Fort Garland; Pueblo; Colorado City; Colorado Springs; Pagosa; Denver; Boulder; Loveland; Palmer Lake; Florida (La Plata County).

Idaho.—Salmon River Mountains; Priest Lake; Bridge.

Montana.—Stillwater; Saint Marys Lake; Summit; Bear Tooth Lake; Fort Custer; Lame Deer; Fort Keogh; Chief Mountain Lake; Hellgate; Jefferson River; Fort Benton; Cinnabar; Florence; Big Bend of Musselshell River; Darnall's; Zortman; Bitterroot Valley.

Nebraska.—Harrison (Sioux County); Squaw Canyon (Sioux County).

New Mexico.—Tierra Amarilla; Pecos Baldy; Costilla River; Twinning; Tres Piedras; Cieneguilla; Arroyo Seco; La Jara Lake; Oak Canyon, Raton Range; Stinking Spring Lakes; Arroyo Hondo; Santa Clara Canyon; Chico Springs.

South Dakota.—Elk Mountain.

Utah.—Uinta Mountains; Parley's Park (Wasatch Mountains).

Washington.—Fort Spokane; Usk (Stevens County); Conconully.

Wyoming.—Powder River; La Barge Creek; Wind River Mountains; South Pass City; Devils Tower; Springhill; Shirley Mountains; Rawhide Butte; Fort Bridger; Laramie Peak; Green River; Pahaska; Valley; Head of Trapper's Creek, Bighorn Mountains; Crook County.

DRYOBATES VILLOSUS TERRAENOVAE Batchelder.

Dryobates villosus terraenovae BATCHELDER, Proc. New Engl. Zool. Club, vol. 4, June 24, 1908, p. 37.

Chars. subsp.—Similar to *Dryobates villosus monticola*, but smaller; upper wing-coverts with somewhat more white; white dorsal stripe often spotted or irregularly barred with black.

Measurements.—Male:¹ Wing, 126–133.5 (average, 128.4) mm.; tail, 80.5–90 (83.4); exposed culmen, 29.5–32 (30.7); tarsus, 21.5–23.5 (22.4), middle toe, 15–16 (15.4).

Female:² Wing, 122–128 (124.8); tail, 80.5–86 (82.8); exposed culmen, 25.5–27 (26.3); tarsus, 21.5–23.5 (22.2); middle toe, 14–15 (14.6).

Type-locality.—Placentia, Newfoundland.

¹ Six specimens, from Newfoundland.

² Five specimens, from Newfoundland.

Geographical distribution.—Canadian and Hudsonian zones of Newfoundland.

As is the case with so many Newfoundland or Labrador races of birds, this hairy woodpecker is really much more like some of the western forms than it is like either *Dryobates villosus villosus*, or *Dryobates villosus septentrionalis*, the subspecies which lie geographically nearest. It is closest to *Dryobates villosus leucothorectis*¹ from New Mexico and Arizona, but differs in slightly larger size, particularly of the tail and middle toe; in having white spots on the wing-coverts, and often black spots or bars on the white dorsal stripe. It may readily be distinguished from *Dryobates villosus villosus* by its larger size, much less conspicuously white spotted lesser and middle wing-coverts, and the often black spotted or barred white dorsal stripe; and from *Dryobates v. septentrionalis* by the same color characters, as well as by shorter wing and bill.

The mixture of black in the white dorsal stripe, a character shared by only *Dryobates villosus piceoides*, although not constant, appears in many specimens. In some examples of *D. v. terraenovae*, black spots on the tail-feathers may be noticed.

We have seen 11 examples of this form, from the following localities: *Newfoundland.*—Codroy; Locke's Cove; Humber River; Canada Bay.

DRYOBATES VILLOSUS LEUCOTHORECTIS, new subspecies.

Chars. subsp.—Much like *Dryobates villosus monticola*, but decidedly smaller; wing coverts practically always without white spots.

Description.—Type, adult male, No. 196291, U.S.N.M., Biological Survey collection; Burley, New Mexico, September 19, 1905; N. Hollister. Upper parts generally, sides of head and neck, a broad malar stripe, wings, and middle tail-feathers, black; occipital band scarlet; nasal tufts grayish white; a broad superciliary stripe, a broad rictal stripe produced to the side of the nape, a broad dorsal stripe, spots on both webs of all the remiges except the tertials, small spots on a few of the upper wing-coverts, all of the two outer rectrices (including the dwarfed outermost one), most of the third, and terminal portion of the fourth, and entire under surface of body, pure white.

Measurements.—Male:² Wing, 123.5–131 (average, 126.8) mm.; tail, 75.5–86.5 (79.4); exposed culmen, 28.5–33 (30.8); tarsus, 20–22.5 (21.5); middle toe, 12.5–15.5 (13.8).

Female:³ Wing, 120.5–128 (123.6); tail, 73–83 (77.8); exposed culmen, 24–27.5 (25.9); tarsus, 20–22 (20.8); middle toe, 13–14.5 (13.5).

¹ See p. 608.

² Sixteen specimens, from Utah, Arizona, and New Mexico.

³ Ten specimens, from Arizona, New Mexico, and western Texas.

Type-locality.—Burley, New Mexico.

Geographical distribution.—Canadian and Transition zones in the mountains of the interior southwestern United States: north to the Beaver Mountains, south central Utah; Shiprock, northwestern New Mexico; and San Pedro, north central New Mexico; east to the Capitan Mountains, east central New Mexico; and the Guadalupe Mountains, central western Texas; south to the San Andres Mountains and Silver City, southern New Mexico; and Weber Creek (Tonto Basin), central Arizona; west to the Hualapai Mountains, western Arizona; and Pine Valley, southwestern Utah.

The present form differs from *Dryobates villosus hyloscopus*, of northern Lower California and southern California, in longer wing and tail, and in pure white lower parts. There is practically no difference in size between specimens from Arizona and those from most of New Mexico. Those, however, from southwestern New Mexico (Kingston, Cliff, Gila, and Mimbres to Rio Grande) are smaller, and thus intermediate in dimensions between *D. v. leucothorectis* and *Dryobates villosus icastus*,¹ but are pure white below like the former.

Specimens to the number of 68 have been handled, by which the subjoined localities are represented:

Arizona.—San Francisco Mountain; Trumbull Spring, Trumbull Mountain; northwest of Fort Defiance; Fort Whipple; near Flagstaff; Fort Verde; Pine Springs, Colorado Forest; Supai Village, Cataract Creek; Oak Creek (Yavapai County); Baker's Butte; Prescott; Weber Creek, Tonto Basin; Little Colorado River, near mouth of Rio Puerco.

New Mexico.—Fort Wingate; Mimbres to Rio Grande; Silver City; Los Pinos; G. O. S. Ranch, Sapello Creek, Gila National Forest (Grant County); Manzano Mountains; Glenwood; Burley; Bear Spring Mountains; San Mateo Mountains; Summit of western end of Capitan Mountains; southwestern slope of Capitan Mountains; southeastern slope of Capitan Mountains; Mount Capitan; Datil Mountains; Cloudcroft; Copperton; Cliff; Salinas Peak San Andres Mountains; San Pedro; Kingston; Gila; Burro Mountains; Shiprock; Fruitland; Zuñi Mountains.

Texas.—Guadalupe Mountains.

Utah.—Pine Valley; Riverview (San Juan County).

DRYOBATES VILLOSUS ORIUS, new subspecies.

Chars. subsp.—Resembling *Dryobates villosus leucothorectis*, but larger; lower parts usually brownish white, instead of pure white.

Description.—Type, adult male, No. 161978, U.S.N.M.; Quincy, California, February 10, 1892; E. Garner. Upper parts generally,

¹ See p. 612.

sides of head and neck, a broad malar stripe, wings, and middle tail-feathers, black; occipital band scarlet; nasal tufts, a broad superciliary stripe, a broad rictal stripe produced to the side of the cervix, all of the two outer rectrices (including the dwarfed outermost one), most of the third, and terminal portion of the fourth, with entire lower parts of body, brownish white; a broad dorsal stripe, spots on both webs of all the remiges except the tertials, and small spots on a few of the upper wing-coverts, creamy white.

Measurements.—Male:¹ Wing, 125.5–132.5 (average, 129.1) mm.; tail, 69.5–83.5 (77); exposed culmen, 30–34.5 (31.9); tarsus, 21–24 (22.9); middle toe, 14–15.5 (15).

Female:² Wing, 125–128.5 (126.3); tail, 78.5–83 (80.1); exposed culmen, 27–27.5 (27.1); tarsus, 21–22 (21.5); middle toe, 14–15 (14.4).

Type-locality.—Quincy, California.

Geographical distribution.—Canadian and Transition zones in the mountains of the Great Basin, western United States: north to south central Washington; east to Camp Harney, eastern Oregon; and the Ruby Mountains, eastern Nevada; south to Arc Dome (Toyabe Mountains), central Nevada; and Placerville, central California; west to the western slopes of the Sierra Nevada in Butte and Tehama counties, and to Canyon Creek (Trinity County), middle northern California; and Fort Klamath, Diamond Lake, and Mount Hood, central Oregon. In winter it wanders casually westward as far as Puyallup, western Washington.

This new race may be readily distinguished from *Dryobates villosus monticola* by shorter wing and tail, brownish-tinged lower parts, and the even less white-marked, nearly always unspotted, wing-coverts; from *Dryobates v. harrisi*, of the northwestern coast region, by the very much more whitish, less smoky brownish color of the under surface and all the other light portions of the plumage. Some individuals of this form have pure white lower parts, and thus in color resemble *Dryobates villosus leucothoractis*, but their greater size will usually serve to distinguish them.

Of this race, 99 examples, from the subjoined localities, have been seen:

California.—Canyon Creek (Trinity County); Baird; Weber Lake; Weaverville; Mount Lassen; Carberry's Ranch (east central Shasta County); Mount Shasta; Lyonsville; Carbondale; Payne P. O. (Tehama County); Warmcastle Soda Springs, Squaw Creek Valley (near Mount Shasta); Enterprise (Butte County); Blue Canyon, Sierra Nevada; Echo (Eldorado County); Quincy; Placerville; Fyffe; Mount Tallac; Glen Alpine; Fort Crook; Lumpkin Mills (Butte

¹ Thirteen specimens, from California, Oregon, and Nevada.

² Four specimens, from the same States.

County); Silver Creek; mountains near Camp Bidwell; Slippery Ford (Eldorado County).

Nevada.—Truckee River; Glenbrook; Carson City; Arc Dome, Toyabe Mountains.

Oregon.—Fort Klamath; Camp Harney; Diamond Lake; Paulina Lake; Tule Lake; Mount Hood; Whiskey Creek (Klamath County).

Washington.—Puyallup.¹

DRYOBATES VILLOSUS HYLOSCOPUS Cabanis and Heine

Dryobates hyloscopus CABANIS and HEINE, Mus. Hein., vol. 4, pl. 2, 1863, p. 69 (note).

Chars. subsp.—Like *Dryobates villosus orius*, but decidedly smaller.

Measurements.—Male:² Wing, 118.5–125.5 (average, 121.7) mm.; tail, 70–76.5 (73.2); exposed culmen, 28.5–32.5 (30.6); tarsus, 21–22 (21.6); middle toe, 13–14.5 (13.8).

Female:³ Wing, 114.5–122 (117.8); tail, 67–77 (73.7); exposed culmen, 26.5–28 (27.2); tarsus, 19.5–21 (20.4); middle toe, 12.5–13.5 (13).

Type-locality.—San José, California.

Geographical distribution.—Canadian and Transition zones in the mountains of southern California and northern Lower California: south to the San Pedro Martir Mountains, northern Lower California; east to the Cuyamaca Mountains and the San Bernardino Mountains, central southern California; and the Grapevine Mountains, middle eastern California; north, in the Sierra Nevada, to the White Mountains; and through the coast ranges to Cahto and to Snow Mountain (Colusa County), in northwestern California.

The subspecies *Dryobates villosus hyloscopus*, as here restricted, differs from *Dryobates villosus harrisi* in decidedly smaller size, and very much less deeply smoky brownish lower parts and other light areas.

Unfortunately the type of *D. v. hyloscopus* came from San José, California, in an area intermediate between the very small birds of northern Lower California and the large representatives of *Dryobates villosus orius* from northeastern California. In such a case it seems proper to consider, as we do here, the extreme development of the race as really typical, to which the type, like other intermediate specimens, is referable. Examples from southern and central western California (San Diego County to Cahto) are, like the type, somewhat larger than those from northern Lower California (length of wing in the male averaging about 123.5 mm.), and verge toward *Dryobates villosus orius*. Birds from the Piute Mountains, southern California, are white below, and incline somewhat toward the Arizona *Dryobates villosus leucothorectis*.

¹ Not breeding at this locality.

² Ten specimens, from Lower California.

³ Six specimens, from the same locality.

Ninety-two specimens of this form have been seen, by which the following localities are represented:

California.—San Bernardino Mountains; San Jacinto Mountains; Pine Flats, on North Fork of San Gabriel River (Los Angeles County); Volcan; Santa Barbara; Santa Ysabel; southern Sierra Nevada; Pine Valley (San Diego County); Strain's camp, San Gabriel Mountains; Sierra Madre Mountains (Los Angeles County); Piute Mountains (Kern County); Monterey; Pacific Grove; Santa Cruz; Nicasio; Cahto; Tejon Mountains; Fort Tejon; Tejon Valley; Paicines (San Benito County); Bear Valley (San Benito County); Snow Mountain (Colusa County); Mount Sanhedrin; Berryessa; Mount Whitney; Sargent; Preston Peak; White Mountains; Isabella, South Fork of Kern River; Kern River, 25 miles above Kernville; Walker Pass, western slope; Cuyamaca Mountain.

Lower California.—Piñon, western slope of San Pedro Martir Mountains; La Grulla, San Pedro Martir Mountains; Hanson Laguna, Hanson Laguna Mountains; 60 miles south of Campo; Santa Ulalia.

DRYOBATES VILLOSUS ICASTUS, new subspecies.

Chars. subsp.—Similar to *Dryobates villosus hyloscopus*, but bill much smaller, and wing slightly longer.

Description.—Type, adult male, No. 163914, U.S.N.M., Biological Survey Collection; El Salto, Durango, Mexico, July 21, 1898; E. W. Nelson and E. A. Goldman. Upper parts generally, sides of head and neck, a broad malar stripe, wings, and middle tail-feathers, black; occipital band scarlet; nasal tufts, superciliary stripe, a broad rictal stripe produced to the side of the cervix, throat, breast, and upper abdomen, brownish white; a broad dorsal stripe, spots on both webs of primaries, and on inner webs of secondaries, with all of the two exterior rectrices (including the dwarfed outermost one), most of the third, and terminal portion of the fourth, lower abdomen, and crissum, creamy white.

Measurements.—Male:¹ Wing, 117–128 (average, 123.5) mm.; tail, 67.5–76 (71.6); exposed culmen, 25.5–30.5 (28.1); tarsus, 20–22.5 (20.8); middle toe, 12.5–15 (13.6).

Female:² Wing, 119–128.5 (123.6); tail, 70–82.5 (74.9); exposed culmen, 23–28 (25.3); tarsus, 18–21 (20); middle toe, 11.5–14 (12.9).

Type-locality.—El Salto, Durango, Mexico.

Geographical distribution.—Transition and Canadian zones in the mountains of northwestern Mexico and contiguous portions of the southwestern United States: north to Pinal County, southeastern Arizona; and Animas Peak (Animas Range), southwestern New Mexico; west to El Puerto, eastern Sonora; Sierra Madre near Guadalupe y Calvo, southwestern Chihuahua; El Salto, southwestern

¹ Seventeen specimens, from Arizona, Sonora, Chihuahua, Coahuila, Durango, and Zacatecas.

² Ten specimens, from Chihuahua, Coahuila, Jalisco, and Durango.

Durango; and Sierra de Nayarit, eastern Tepic; south to Huajinic, southeastern Tepic; Bolaños, northern Jalisco; and Plateado, southwestern Zacatecas; east to Carneros, southeastern Coahuila; Bustillos, west central Chihuahua; and Pacheco, northwestern Chihuahua.

This bird is decidedly smaller than *Dryobates villosus leucothoracis*, as well as noticeably smoky-tinged on the under surface, instead of pure white; and it is in size so very much inferior to *Dryobates villosus orius*, that it is readily distinguishable.

Birds from Zacatecas, northern Jalisco, and eastern Sonora are identical in size with those from the type-locality in Durango. Specimens from Coahuila (Carneros and Sierra Guadalupe) are somewhat smaller—about the size of *Dryobates villosus intermedius*—(wing of male averaging about 118.5 mm.), but are so much paler below that they are best referred to the present race. Examples at hand from southeastern Arizona (north to Pinal County) and extreme southwestern New Mexico (Animas and San Luis ranges) are somewhat less smoky brownish below, but average fully as small as those from Durango, and also belong here. The birds from Chihuahua, to judge from the six of each sex examined, are larger than those from any other part of the range of this subspecies and average as follows:

Male.—Wing, 126.1 mm.; tail, 73; exposed culmen, 29; tarsus, 20.8; middle toe, 14.2.

Female.—Wing, 124.8; tail, 75.6; exposed culmen, 25.9; tarsus, 20.1; middle toe, 12.6.

Specimens examined, 48, from localities as below:

Arizona.—Santa Catalina Mountains; Pima County; Pinal County; Huachuca Mountains.

New Mexico.—Animas Peak, Animas Mountains (Grant County); western side of San Luis Mountains, near the United States and Mexican boundary line.

Chihuahua.—Sierra Madre, near Guadalupe y Calvo; Colonia Garcia; Pacheco; Rancheria de los Apaches; Mound Valley; Piños Altos; 30 miles west of Miñaca; Bustillos; San Luis Mountains.

Coahuila.—Sierra Guadalupe; Carneros.

Durango.—El Salto; Arroyo del Buey.

Jalisco.—Bolaños.

Sonora.—El Puerto.

Zacatecas.—Valparaiso Mountains; Plateado; Sierra Madre.

DRYOBATES VILLOSUS INTERMEDIUS Nelson.

Dryobates villosus intermedius NELSON, Auk, vol. 17, 1900, p. 259.

Chars. subsp.—Resembling *Dryobates villosus icastus*, but smaller, and much darker below.

Measurements.—Male: ¹ Wing, 119–122.5 (average, 120.7) mm.; tail, 70.5–74 (71.8); exposed culmen, 28–28.5 (28.3); tarsus, 20–21.5 (20.8); middle toe, 13.5–14 (13.7).

Female: ² Wing, 116–120.5 (118.2); tail, 74; exposed culmen, 25–25.5 (25.2); tarsus, 20.5; middle toe, 13–13.5 (13.2).

Type-locality.—Villar, San Luis Potosi, Mexico.

Geographical distribution.—Upper Austral Zone in the mountains of Tamaulipas and San Luis Potosi: northeast to Victoria, Montelunga, Galindo, and Miquihuana, southwestern Tamaulipas; and southwest to near Jesus Maria, southwestern San Luis Potosi.

Like the races of some other species that inhabit the region occupied by *Dryobates villosus intermedius*, this form has a rather limited distribution. Subsequent investigation may, however, somewhat extend its range.

Six examples have been seen, from the localities that follow:

San Luis Potosi.—Villar; mountains near Jesus Maria.

Tamaulipas.—Miquihuana; Victoria.

DRYOBATES VILLOSUS ENISSOMENUS, new subspecies.

Chars. subsp.—Similar to *Dryobates villosus intermedius*, but smaller, and ventral surface darker.

Description.—Type, adult male, No. 185785, U.S.N.M., Biological Survey Collection; Omilteme, Guerrero, Mexico, May 25, 1903; E. W. Nelson and E. A. Goldman. Upper parts generally, sides of head and neck, a broad malar stripe, wings, and middle tail-feathers, black; occipital band scarlet; nasal tufts, a broad rictal stripe prolonged to the side of the cervix, all of the two outer rectrices (including the dwarfed outermost one) except a small basal spot, most of the third, and terminal portion of the fourth, throat, breast, and upper abdomen, light smoky brown, the tail rather paler; superciliary stripe, a broad dorsal stripe, spots on the interior webs of primaries and secondaries, and small spots on outer webs of same (except innermost secondaries), lower abdomen, and crissum, brownish white.

Measurements.—Male: ³ Wing, 111–121 (average, 116.7) mm.; tail, 64.5–77 (70.1); exposed culmen, 25–28.5 (26.4); tarsus, 20–21.5 (20.6); middle toe, 13.5–14.5 (14).

Female: ⁴ Wing, 111–116 (113.2); tail, 65–71.5 (69.1); exposed culmen, 20–24 (21.7); tarsus, 18.5–20 (19.2); middle toe, 12–13.5 (12.7).

Type-locality.—Omilteme, Guerrero, Mexico.

Geographical distribution.—Transition Zone in the mountains of southwestern Mexico, in the States of Guerrero, Michoacan, and

¹ Three specimens, from the Mexican States of Tamaulipas and San Luis Potosi.

² Two specimens, from the same States.

³ Six specimens, from the Mexican States of Michoacan, Guerrero, and Jalisco.

⁴ Eight specimens, from the same States.

southern Jalisco: southeast to Amula and the vicinity of Chilpancingo, central Guerrero; north to Nahuatzin and Patzcuaro, northwest central Michoacan; and west to the Sierra Nevada de Colima, southern Jalisco.

The present race is most closely allied to *Dryobates villosus jardinii*, from Vera Cruz, with which it practically agrees in size, but it is nearly always much paler on the sides of head and neck, on the dorsal stripe, and under surface. There are, however, occasional specimens which, at first sight, appear to be like *D. v. jardinii*, but these are never as deeply colored as the darkest examples of that form, or of *Dryobates villosus hylobatus*,¹ particularly on the posterior lower parts, throat, and light dorsal stripe. In having such a wide range of individual color variation this race resembles *Dryobates villosus extimus*. Four birds from the Sierra Nevada de Colima, southern Jalisco, are larger than the others examined (wing of two males averaging 119.5 mm.), and verge somewhat toward *Dryobates villosus icastus*.

Of this form 14 specimens have been examined, from localities as follows:

Guerrero.—Omiteme; mountains near Chilpancingo.

Jalisco.—Sierra Nevada de Colima.

Michoacan.—Nahuatzin; Patzcuaro; Mount Tancitaro.

DRYOBATES VILLOSUS HARRISI (Audubon).

Picus harrisi AUDUBON, Birds Amer. (folio), vol. 4, 1838, pl. 417, figs. 8, 9.

Chars. subsp.—Resembling *Dryobates villosus cnissomcnus*, but very much larger; lower surface more deeply colored.

Measurements.—Male:² Wing, 124–136 (average, 127.8) mm.; tail, 73.5–84 (78.3); exposed culmen, 29–35 (31.7); tarsus, 22.5–25 (23.4); middle toe, 15–16 (15.4).

Female:³ Wing, 120–128 (124); tail, 74–82.5 (76.9); exposed culmen, 26–31 (28.2); tarsus, 21–23.5 (22.1); middle toe, 14–15.5 (14.8).

Type-locality.—Near Fort Vancouver, State of Washington.

Geographical distribution.—Canadian and Transition zones in the Pacific coast region of Alaska, British Columbia, and the northern United States: north to Chichagof Island and Chilcoot, southeastern Alaska; east to Boca de Quadra, coast of extreme southeastern Alaska; Hoop and Agassiz, southwestern British Columbia; Keechelus Lake and Fort Vancouver, western Washington; Portland and Crater Lake, western Oregon; and south (excepting Prince of Wales Island, Alaska, and the Queen Charlotte Islands, British Columbia) to Humboldt Bay, northwestern California. In winter it wanders as far south as Monterey, central California.

¹ See p. 617

² Fourteen specimens, from Alaska, British Columbia, Washington, Oregon, and California.

³ Twelve specimens, from the same localities.

This subspecies is remarkably uniform over its entire range, there being practically no difference in either size or color between birds from Alaska and those from northern California. Neither is individual variation as great as in most of the dark forms of the species.

I have examined 120 examples of this race from the subjoined localities:

Alaska.—Loring; near Killisnoo, Admiralty Island; Sitka; Howkan.

British Columbia.—Agassiz; Goldstream; Port Moody; Comox; Lund; Huntington; Victoria; Departure Bay, Vancouver Island; Union Bay, Vancouver Island; Mount Lehman; New Westminster; Saturna Island; Roab's ranch, Hope.

California.—Carson's camp, Mad River, Humboldt Bay; Crescent City; Nicasio;¹ St. Helena.¹

Oregon.—Portland; Tillamook; Crater Lake; Sumner; Beaverton; Columbia River; St. Helen; Logan; Seaside; Newport.

Washington.—Suez; Tenino; Tacoma; Lapush; Neah Bay; Keeche-lus Lake; Mount Vernon; Kalama; Whidbys Island; Seattle; Hump-tulips; Fort Steilacoom; Nisqually Flats; South Park (King County); Shoalwater Bay; Ilwaco; Fort Vancouver; Ocosta.

DRYOBATES VILLOSUS PICOIDEUS Osgood.

Dryobates picoideus OSGOOD, North Amer. Fauna, No. 21, 1901, p. 44.

Chars. subsp.—Much like *Dryobates villosus harrisi*, but wing and bill shorter; white dorsal stripe more or less barred or spotted with black; white outer pairs of tail-feathers nearly always with black subterminal spots, occasionally even bars.

Measurements.—Male:² Wing, 122.5–125 (average, 123.8) mm.; tail, 77.5–82.5 (80); exposed culmen, 26–27 (26.5); tarsus, 23–23.5 (23.3); middle toe, 15.5–16 (15.8).

Female:³ Wing, 121–127 (124); tail, 76–81 (79.2); exposed culmen, 25.5–27.5 (26.4); tarsus, 22–24 (22.6); middle toe, 14.5–15.5 (14.8).

Type-locality.—Cumshewa Inlet, Moresby Island, Queen Charlotte Islands, British Columbia.

Geographical distribution.—Canadian Zone in the Queen Charlotte Islands, British Columbia; and Prince of Wales Island, extreme southeastern Alaska.

The birds from Prince of Wales Island, Alaska, are not typical of *Dryobates villosus picoideus*, but in color characters, chiefly those of the back, are somewhat intermediate between this form and *Dryobates villosus harrisi*. The black spots on the inner webs of the white rectrices are a character that appears in only two other races—*Dryobates villosus piger*, and occasionally *Dryobates villosus terraenovae*.

¹ Not breeding at this locality.

² Two specimens, from British Columbia.

³ Five specimens, from British Columbia and southern Alaska.

One specimen from the Queen Charlotte Islands, British Columbia, has black bars on the white outer tail-feathers, as well marked as in *Dryobates pubescens*. In its black barred or spotted dorsal stripe, *Dryobates villosus picoideus* resembles no other form of the species, excepting, curiously enough, *Dryobates villosus terranovae*, from Newfoundland, and shows an interesting resemblance to some races of *Picoides americanus*.

Eight specimens have been available, representing the following localities:

Alaska.—Kasaan Bay, Prince of Wales Island.

British Columbia.—Cumshewa Inlet, Moresby Island, Queen Charlotte Islands; Skidegate, Graham Island, Queen Charlotte Islands.

DRYOBATES VILLOSUS HYLOBATUS, new subspecies.

Chars. subsp.—Similar to *Dryobates villosus enissomenus*, but decidedly larger, and darker on lower parts.

Description.—Type, adult female, No. 154895, U.S.N.M., Biological Survey Collection; Huitzilac, Morelos, Mexico, January 1, 1893; E. W. Nelson. Upper parts generally, sides of head and neck, a broad malar stripe, wings, and middle tail-feathers, black; superciliary stripe, connected occipital band, small spots on both webs of primaries and most of secondaries, and on interior webs of innermost secondaries, creamy white; two outer rectrices (including the dwarfed outermost one) excepting a small basal spot, with most of the third, and the terminal portion of the fourth, light smoky brown; nasal tufts, a broad rictal stripe prolonged to the side of the cervix, a broad dorsal stripe, and the entire lower surface of the body, deep smoky brown.

Measurements.—Male:¹ Wing, 123.5 mm.; tail, 75–77 (average, 76); exposed culmen, 26–27.5 (26.8); tarsus, 19.5–20 (19.8); middle toe, 13–14 (13.5).

Female:² Wing, 116.5–121.5 (118.8); tail, 71.5–75.5 (73.3); exposed culmen, 23–25 (24); tarsus, 20–20.5 (20.3); middle toe, 12.5–14.5 (13.6).

Type-locality.—Huitzilac, Morelos, Mexico.

Geographical distribution.—Canadian and Transition zones in the mountains of central Mexico, in the States of Mexico, Morelos, and western Puebla: north to the City of Mexico, central Mexico (State); west to the Volcan de Toluca, west central Mexico (State); south to Huitzilac, northwestern Morelos; and east to near Huejotzingo, central western Puebla.

From *Dryobates villosus intermedius* this new subspecies may be distinguished by its somewhat longer wing and tail, shorter bill, and

¹ Two specimens, from the Mexican States of Mexico and Morelos.

² Four specimens, from the same States.

very much more deeply smoky brown lower parts, dorsal stripe, and sides of head and neck.

Adults of *Dryobates villosus hylobatus* examined are all very deeply colored, excepting one male from Ajuseco, State of Mexico, which is indistinguishable in color from *Dryobates villosus intermedius*, but its large size indicates that it is properly referable to *D. v. hylobatus* as an example of extreme individual variation.

Nine specimens examined, from the localities given below:

Mexico.—Northern slope of Volcan de Toluca; Ajuseco; City of Mexico.

Morelos.—Huitzilac.

DRYOBATES VILLOSUS JARDINII (Malherbe).

Picus (Leuconotipicus) jardinii MALHERBE, Rev. Zool., Oct., 1845, p. 374.

Chars. subspecies.—Like *Dryobates villosus hylobatus* in color, but decidedly smaller.

Measurements.—Male:¹ Wing, 114–118 (average, 116.2) mm.; tail, 67–74 (69.7); exposed culmen, 24–27 (25.6); tarsus, 20–21.5 (20.7); middle toe, 13.5–14 (13.9).

Female:² Wing, 110; tail, 62; exposed culmen, 23.5; tarsus, 19; middle toe, 13.

Type-locality.—"Mexico," i. e., central Vera Cruz.

Geographical distribution.—Canadian and Transition Zones in the mountains of eastern Mexico in the States of Vera Cruz, Puebla, and Oaxaca: north to Las Vigas, central Vera Cruz; west to Mount Orizaba, eastern Puebla; and south to the city of Oaxaca, central Oaxaca.

A single adult male from Mount Orizaba, Puebla, is very much paler below than other examples, and is practically identical in color with *Dryobates villosus intermedius*, yet it is much too small for that race, and is doubtless merely another instance of the great range of individual variation to which the dark races of *Dryobates villosus* are subject. The writer has seen no specimens from the State of Oaxaca, but records of the species from Tonaguia, central northern Oaxaca,³ and the city of Oaxaca,⁴ belong probably under the present subspecies.

The type of Malherbe's *Picus jardinii*⁵ was an immature bird, as its abnormally small measurements clearly indicate, and came from "Mexico." When this author subsequently more fully described the form,⁶ he had other specimens whose measurements proclaim them

¹ Four specimens, from the Mexican State of Vera Cruz.

² One specimen, from the same State.

³ Hargitt, Cat. Birds Brit. Mus., vol. 18, 1890, p. 238.

⁴ Boucard, Proc. Zool. Soc. Lond., 1859, p. 388.

⁵ Rev. Zool., 1845, p. 374.

⁶ Mon. Piciées, vol. 1, 1861, p. 103, pl. 25, figs. 4, 5.

to belong to birds from Vera Cruz rather than from the State of Mexico. It seems best, therefore, to restrict the name *jardinii* to the bird from central Vera Cruz.

Five examples have been seen, from the subjoined localities:

Puebla.—Mount Orizaba.

Vera Cruz.—Mirador; Jalapa; Las Vigas.

DRYOBATES VILLOSUS SANCTORUM Nelson.

Dryobates sanctorum NELSON, Auk, vol. 14, 1897, p. 50.

Chars. subsp.—Resembling *Dryobates villosus jardinii*, but much smaller; ventral surface decidedly darker.

Measurements.—Male:¹ Wing, 107–111.5 (average, 109.4) mm.; tail, 63–65 (63.9); exposed culmen, 23–25.5 (24.2); tarsus, 17–20 (19.2); middle toe, 13–14.5 (13.7).

Female:² Wing, 99.5–108.5 (104.6); tail, 57.5–65 (60.9); exposed culmen, 20–23 (21.1); tarsus, 17.5–19 (18.3); middle toe, 12.5–13.5 (13.1).

Type-locality.—Todos Santos, Guatemala.

Geographical distribution.—Transition Zone in the mountains of Chiapas, Mexico, and of Guatemala: west to Pinabete, southern Chiapas; north to San Cristobal, central Chiapas; and Vera Paz, Guatemala; and east to the Volcan de Fuego, southeastern Guatemala.

This race is apparently little subject to individual variation. Specimens from the State of Chiapas, Mexico, are identical in size with those from Guatemala. Although first described as a full species, *Dryobates sanctorum* is clearly but a subspecies of *Dryobates villosus*, since all characters, by reason of the individual variation of contiguous races, ultimately fail to prove trenchant.

Sixteen specimens have been examined, from the following localities:

Chiapas, Mexico.—Pinabete; Juncaná; San Cristobal; Canjob.

Guatemala.—Volcan Santa Maria; Hacienda Chancol; Calderas, Volcan de Fuego; near Teepam.

DRYOBATES VILLOSUS FUMEUS, new subspecies.

Chars. subsp.—Similar to *Dryobates villosus sanctorum*, but very much paler below and on rectrices; dorsal stripe very decidedly more whitish—in fact, barely smoky except posteriorly.

Description.—Type, adult male, No. 101240, American Museum of Natural History; San Rafael del Norte, Nicaragua, April 6, 1907; William B. Richardson. Upper parts generally, sides of head and neck, a broad malar stripe, wings and middle tail-feathers, black; broad occipital band scarlet; nasal tufts, a broad rictal stripe produced to the side of the cervix, all of the two outer rectrices (including the

¹ Seven specimens, from Guatemala and the Mexican State of Chiapas.

² Seven specimens, from the same localities.

dwarfed outermost one) except a small basal spot, with most of the third, and terminal portion of the fourth, and the entire lower surface of body, somewhat rufescent smoky brown; superciliary stripe, broad dorsal stripe, spots on both webs of remiges (except outer webs of tertials and innermost secondaries), brownish white.

Measurements.—Male:¹ Wing, 106–109.5 (average, 108.1) mm.; tail, 60–63 (61.6); exposed culmen, 24.5–26 (25.1); tarsus, 18.5–19.5 (19.1); middle toe, 12–14 (13.1).

Female:² Wing, 101–108.5 (105.3); tail, 55.5–64 (59.8); exposed culmen, 21.5–24 (22.9); tarsus, 18–19 (18.7); middle toe, 13–13.5 (13.3).

Type-locality.—San Rafael del Norte, Nicaragua.

Geographical distribution.—Upper Tropical Zone in the mountains of central northern Nicaragua.

As at present known, this new race has a very limited range in northern Nicaragua, but it probably extends over much, if not all, of the mountain region of this country, and for at least a considerable distance into the mountains of western Honduras. The record of *Picus jadinii* from Siquatepeque, Honduras, southeast of Lake Yojoa,³ may belong to either *Dryobates villosus sanctorum* or *Dryobates villosus fumeus*.

Of this form, twelve examples have been available, representing the localities below:

Nicaragua.—San Rafael del Norte; Ocotal; Jinotega.

DRYOBATES VILLOSUS EXTIMUS (Bangs).

Dendrocopus villosus extimus BANGS, Proc. New Engl. Zool. Club, vol. 3, 1902, Jan. 30, 1902, p. 33.

Chars. subsp.—Resembling *Dryobates villosus fumeus*, but much smaller, and lower parts darker.

Measurements.—Male:⁴ Wing, 97.5–106.5 (average, 102.8) mm.; tail, 54.5–63 (58.6); exposed culmen, 22–26.5 (24.9); tarsus, 19–21 (19.8); middle toe, 12–15 (13.8).

Female:⁵ Wing, 98–105 (102.1); tail, 49–64 (58.4); exposed culmen, 20–23.5 (21.9); tarsus, 18–19.5 (18.7); middle toe, 12–14 (13.1).

Type-locality.—Boquete, Chiriqui, Panama.

Geographical distribution.—Upper Tropical Zone in the mountains of Costa Rica and western Panama: east to Chiriqui, western Panama; and northwest to the Volcan de Irazu, central Costa Rica.

There is great individual variation in the shade of the lower surface in this race, from a very deep smoky brown to a color almost whitish;

¹ Seven specimens, from Nicaragua.

² Five specimens, from the same country.

³ Taylor, Ibis, 1860, p. 119.

⁴ Nineteen specimens, from Panama and Costa Rica.

⁵ Eighteen specimens, from the same countries.

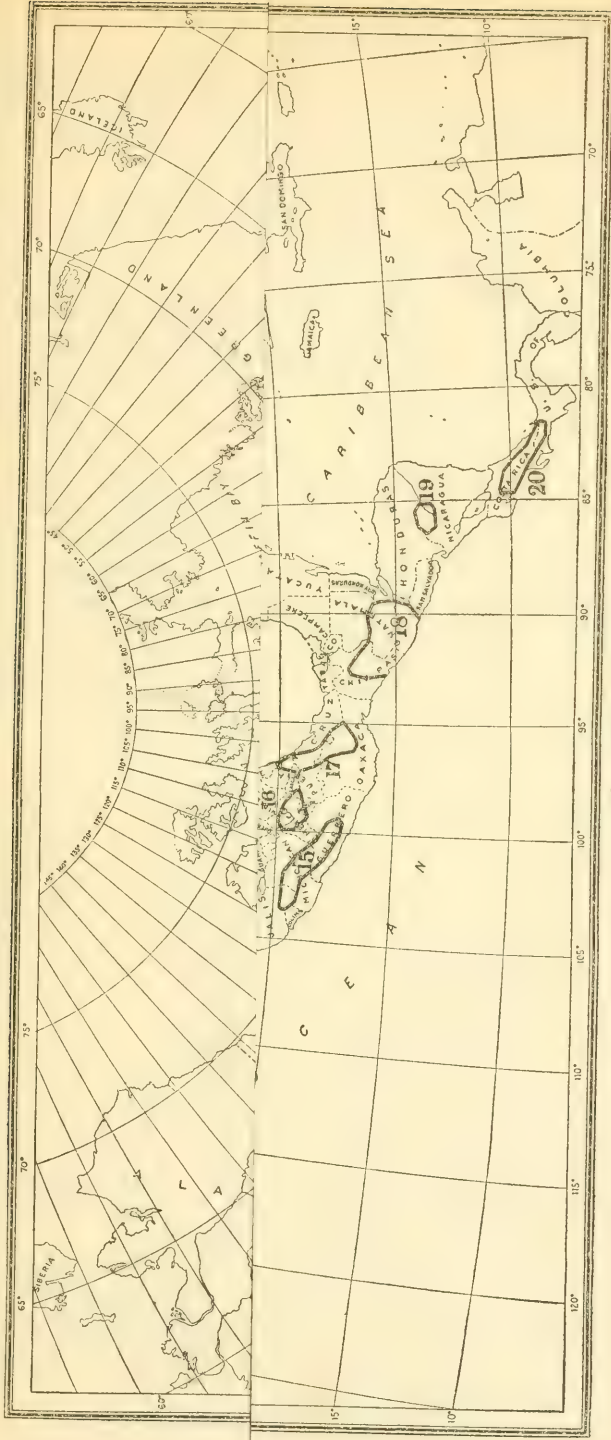
but both these extremes are exceptional. Birds from Panama average very slightly paler below, and, in the male, slightly smaller, but these differences are too insignificant and too inconstant to warrant the recognition of another subspecies. The comparison of size can be easily made by means of the following average measurements:

| | Wing. | Tail. | Exposed culmen. | Tarsus. | Middle toe. |
|----------------------------------|-------|-------|-----------------|---------|-------------|
| Nine males from Panama..... | 101.7 | 57.3 | 25.3 | 20.0 | 14.1 |
| Ten males from Costa Rica..... | 103.7 | 58.5 | 24.6 | 19.7 | 13.5 |
| Eight females from Panama..... | 102.3 | 59.3 | 22.3 | 19.0 | 13.3 |
| Ten females from Costa Rica..... | 102 | 57.8 | 21.7 | 18.5 | 13.1 |

I have seen 95 specimens of this race, from the following localities:

Costa Rica.—Santa Maria de Dota; Volcan de Irazu; Rancho de Rio Jimenez, Volcan de Irazu; Burgos, Volcan de Irazu; Coliblanco, Volcan de Turrialba; La Estrella de Cartago; Las Vueltas de Dota; Lagunaria de Dota; Azahar de Cartago; El Copey de Dota; La Palma de San José; Cervantes; Escazú; La Hondura; Ojuras de Terraba.

Panama.—Chiriqui; Boquete.



BREEDING RANGES OF THE SUBSPECIES OF DRYOBATES VILLOSUS.

- | | | | |
|--|---|---|---|
| <ol style="list-style-type: none"> 1. <i>Dryobates villosus septentrionalis</i>. 2. <i>Dryobates villosus tetraenovae</i>. 3. <i>Dryobates villosus villosus</i>. 4. <i>Dryobates villosus audubonii</i>. 5. <i>Dryobates villosus piger</i>. | <ol style="list-style-type: none"> 6. <i>Dryobates villosus maynardi</i>. 7. <i>Dryobates villosus harrisi</i>. 8. <i>Dryobates villosus picoides</i>. 9. <i>Dryobates villosus hylaeus</i>. 10. <i>Dryobates villosus oris</i>. | <ol style="list-style-type: none"> 11. <i>Dryobates villosus monticola</i>. 12. <i>Dryobates villosus leucothoracis</i>. 13. <i>Dryobates villosus ianthis</i>. 14. <i>Dryobates villosus intermedius</i>. 15. <i>Dryobates villosus chissemensis</i>. | <ol style="list-style-type: none"> 16. <i>Dryobates villosus hylobatus</i>. 17. <i>Dryobates villosus jardini</i>. 18. <i>Dryobates villosus sanctorum</i>. 19. <i>Dryobates villosus fumens</i>. 20. <i>Dryobates villosus extimus</i>. |
|--|---|---|---|



1. *Dryogates villosus* *monticola*.
 2. *Dryogates villosus* *elaeagnifolia*.
 3. *Dryogates villosus* *californicus*.
 4. *Dryogates villosus* *californicus*.
 5. *Dryogates villosus* *californicus*.

BREEDING RANGES OF THE SUBSPECIES OF *DRYOGATES VILLOSUS*.

6. *Dryogates villosus* *monticola*.
 7. *Dryogates villosus* *californicus*.
 8. *Dryogates villosus* *californicus*.
 9. *Dryogates villosus* *californicus*.
 10. *Dryogates villosus* *californicus*.

11. *Dryogates villosus* *californicus*.
 12. *Dryogates villosus* *californicus*.
 13. *Dryogates villosus* *californicus*.
 14. *Dryogates villosus* *californicus*.

SCALE OF STATUTE MILES

DESCRIPTION OF A NEW SPECIES OF *ÆGA* FROM THE ATLANTIC COAST OF THE UNITED STATES.

By HARRIET RICHARDSON,

Collaborator, Division of Marine Invertebrates, U. S. National Museum.

A new species of *Æga* was collected by the U. S. Bureau of Fisheries steamer *Albatross* in 1885 off the Atlantic coast of the United States. Only one specimen was obtained, the description of which follows:

ÆGA ORNATA, new species.

Body oblong ovate, twice as long as wide, 8 mm.:4 mm.

Head large, subtriangular, with apex obtuse, about twice as wide as long, a little more than 1 mm. long and a little more than 2 mm. wide. Eyes large, composite, composed of six rows of ocelli on the dorsal side and separated at their anterior extremities by a distance of 0.5 mm. The eyes are also conspicuous on the ventral side of the head, showing several rows of ocelli. The first pair of antennæ have the first two articles of the peduncle short and subequal; the third article is three times as long as the second; the flagellum is composed of 11 articles and extends to the post-lateral angle of

the first thoracic segment and a little beyond the peduncle of the second antennæ. The second antennæ have the first two articles of the peduncle short and subequal; the third is as long as the first two taken together; the fourth is twice as long as the third; the fifth is one and one-half times as long as the fourth; the flagellum is composed of 16 articles and extends to the post-lateral angle of the third thoracic segment.

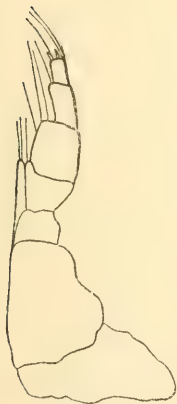


FIG. 2.—*ÆGA ORNATA*.
MAXILLIPED. $\times 65\frac{2}{3}$.

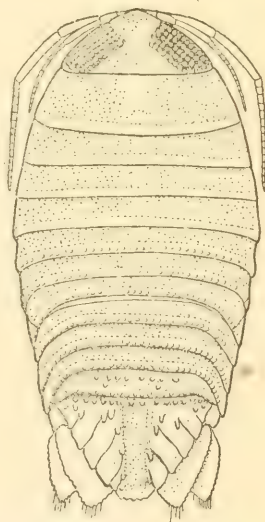


FIG. 1.—*ÆGA ORNATA*. $\times 8$.

of the first thoracic segment and a little beyond the peduncle of the second antennæ. The second antennæ have the first two articles of the peduncle short and subequal; the third is as long as the first two taken together; the fourth is twice as long as the third; the fifth is one and one-half times as long as the fourth; the flagellum is composed of 16 articles and extends to the post-lateral angle of the third thoracic segment.

The first segment of the thorax is the longest and is a little more than twice as long as the second; the second, third, and fourth are subequal, each being 0.5 mm. in length; the fifth and sixth are subequal and each is a little shorter than the preceding segment; the seventh segment is the shortest. The last three segments have a row of small tubercles, set close together, on the posterior margin. All the segments except the first are furnished with epimera; those of the second and third segments do not reach beyond the posterior margins of their respective segments and are rounded posteriorly; the last four have the outer post-lateral angle produced, gradually increasing in length to the last, and all extending beyond the posterior margins of their segments; the last three have small tubercles on the posterior margins. All are furnished with a carina.



FIG. 3.—*ZEGA ORNATA*. FIRST MAXILLA. $\times 65\frac{1}{2}$.

The first segment of the abdomen is almost entirely concealed; the following three segments are subequal and each has the posterior margin furnished with a row of small tubercles, set close together; the fifth segment is a little longer than any of the preceding segments and in addition to the row of tubercles on the posterior margin has a few on the dorsal surface about the middle. The sixth or terminal segment is triangulate in shape with the apex truncate and furnished with five small teeth, one in the median line and two on either side. The lateral margins of the segment are incised, the two anterior incisions extending only a short distance from the lateral margin, but the three posterior ones extend to the sides of the median furrow. The upper end of each incision is marked by a tubercle on the posterior side; there is also one on the anterior side of the first and third incisions at the upper end. A row of small tubercles is also placed at the base of the segment, extending from one side to the other. The inner branch of the uropoda is a little longer and wider than the outer branch and extends a little beyond the extremity of the abdomen. Both branches are rounded posteriorly and crenulate. The first three pairs of legs are prehensile, the last four pairs ambulatory.

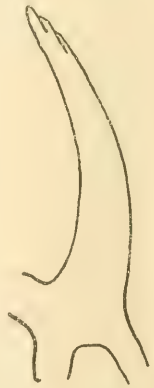


FIG. 4.—*ZEGA ORNATA*. SECOND MAXILLA. $\times 124$.

Only one specimen was obtained by the *Albatross* in 1885 from the Atlantic Ocean off the southern coast of the United States. It was found parasitic on the Red Porgy (*Pagrus pagrus*).

The type is Cat. No. 42377, U.S.N.M.

THE HOthouse MILLIPED AS A NEW GENUS.

By O. F. COOK,

Custodian of Myriapoda, U. S. National Museum.

NOTES ON THE HABITS OF MILLIPEDS.

Most of the species of millipeds are localized in definite areas, often of very limited extent. A few species have attained a cosmopolitan distribution in the tropics, and one of these has established itself in many hothouses in Europe and America. The hothouse conditions are evidently quite congenial for this species, to judge from the abundance of individuals. They are sometimes accused of attacking the plants, though seldom convicted of any serious damage. They often feed upon tissues killed by fungi or insect pests and are likely to be looked upon as the cause of injury, instead of being recognized as harmless scavengers.

The mouthparts of millipeds are not adapted for biting or chewing, but are equipped with minute scrapers and combs for collecting soft, decaying materials. Dead or dying tissues are preferred. The only living plants that are regularly eaten by millipeds are the fleshy fungi. Some of the native millipeds in the vicinity of Washington, District of Columbia, feed to a considerable extent upon the local species of *Amanita*, *Russula*, and *Lactarius*. Damage is sometimes done to other plants when millipeds gain access to wounded surfaces of roots or cuttings. Healing may be prevented or cuttings may be kept from rooting by continual scraping of the exposed surfaces.

In nature at large the millipeds have a share in the beneficial work of reducing dead plant material to humus. Prussic acid and other corrosive secretions may aid in the precipitation of colloidal substances in the humus, in addition to the protection that they give by rendering the millipeds distasteful to birds and other animals that might otherwise feed upon them. The precipitation of the colloids enables the millipeds to keep their bodies clean and protects them against the clogging of their spiracles.

In relation to the soil there is a notable contrast between the habits of millipeds in the Central American region and in West Africa. Owing, perhaps, to the great abundance of termites, the African forests have very slight superficial accumulations of dead leaves and humus. The soil remains relatively open and noncolloidal, and is inhabited by numerous species of millipeds. In the forests of tropical America the termites effect no such complete destruction of the dead leaves and other vegetable débris, which accumulate and decay on the surface. The underlying soils are generally much more colloidal than in Africa and the milliped population is generally sparse, or often lacking altogether, especially after the land has been under cultivation for a few years.

SYSTEMATIC POSITION OF THE HOthouse MILLIPED.

The hothouse milliped was first described in 1847 by C. L. Koch as *Fontaria gracilis*, but has still to find a satisfactory place in generic classification. In addition to the original reference to *Fontaria*, the species figures in literature under two other generic names, *Paradesmus* and *Orthomorpha*, but none of these names seems to find a correct application to the animal in question.

In 1872 Humbert and Saussure referred Koch's species to the old genus *Polydesmus*, as a member of a subgenus *Paradesmus*, that had been established by Saussure for other species in 1859. In Latzel's monograph of the Austro-Hungarian myriapoda, published in 1884, the same course was followed, except that *Paradesmus* was recognized as an independent genus.

The next change was made in 1893 when Bollman discovered the preoccupation of the name *Paradesmus* and proposed *Orthomorpha* as a substitute. Hence the species has been called, by all recent writers, *Orthomorpha gracilis*. The unfortunate necessity of a further change arises from the fact that Bollman's new name was proposed as a direct substitute for *Paradesmus*, and is therefore limited in its application to the genus to which the original type of *Paradesmus* belongs.

DESIGNATION OF THE TYPE OF *PARADESMUS*.

The determination of the type of *Paradesmus* carries us back to the original treatment of the subgenus by Saussure. Several species were included, though none that recent authors have treated as congeneric with the hothouse milliped. Pocock has recently proposed, in the *Biologia Centrali-Americana*, to designate as the type of *Paradesmus* (and *Orthomorpha*), an East Indian species, *O. blainvillei*. This designation can hardly be accepted, in view of the fact that *blainvillei* was placed by Saussure in one of the two divisions of *Paradesmus* that were indicated as forming transitions to other sub-

genera, and are therefore not to be reckoned as typical members of the subgenus *Paradesmus*. The remaining division, containing the genuine examples of *Paradesmus*, consisted of three species, *klugii* Brandt, *erichsoni* Brandt, and *picteti* Saussure. The first of these should be considered as the true type of *Paradesmus*, and hence of *Orthomorpha* as well.

The propriety of this treatment is not affected by the fact that Humbert and Saussure used the typical species of *Paradesmus*, ten years later, as the basis of a new subgenus, *Pachyurus*. Bollman found that this name also was preoccupied, and proposed to replace it by *Polylepis*. In reality *Orthomorpha* was a sufficient substitute for both *Paradesmus* and *Pachyurus*, since both these names were proposed originally for the same species.

APPLICATION OF THE NAME *ORTHOMORPHA*.

In view of the preceding facts, it appears that the name *Orthomorpha* is applicable to a Central American genus of millipeds, with *O. klugii* (Brandt) as the typical species, replacing *Amplinus* Attems, at least for the Central American species. Attems proposed this name for a subgenus of *Pachyurus*, with a Peruvian species, *P. kalonotus*, as the type. Pocock has adopted *Amplinus* as the generic name of the Central American group to which *Orthomorpha klugii* belongs.

ORTHOMORPHA POCOCKI, new species.

Amplinus klugi Pocock, Biol. Centr.-Amer., Diploda, p. 152, pl. 2, figs. 5c-5e, 1910.
Not *Polydesmus klugii* BRANDT, Recueil Mem. Myriop., p. 133, 1841.

The species described and illustrated as *Amplinus klugi* in the *Biologia* is not to be considered as the type of the genus *Orthomorpha*. The figures of the gonopods evidently do not represent the same species as Brandt's type of *klugii* in the Berlin Museum. The drawings show that the gonopods are relatively short and robust, with the two terminal prongs also rather short, nearly equal, and strongly incurved or connivent. In the true *Orthomorpha klugii* the gonopods are much longer and more tapering, with longer, more unequal, and only slightly curved prongs. Tracings of the gonopods of the type specimen of *klugii* at Berlin are much more similar to Pocock's figures representing *Orthomorpha areata* and *O. flavicornis* than to those of *O. pococki*. The drawings of this species in the *Biologia* represent a specimen from Jalapa, Mexico, in the British Museum, which may be considered as the type of the new species.

The type-specimen of *O. klugii* is supposed to have been collected by Deppe at Alvarado, in the State of Vera Cruz. Four other species of *Orthomorpha* are known from Mexico, *O. palicaudatus* (Attems), *O. erichsonii* (Brandt), *O. armatus* (Pocock), and *O. tiramus* (Pocock). Three species are credited to Guatemala, *O. nitidus* (Broelemann),

O. palicaudatus (Attems), and *O. areatus* (Pocock). Other Central American countries are not yet represented in the genus *Orthomorpha*, except Costa Rica, with a single species, *O. convexus* (Carl).

Pocock's suggestion that *O. erichsonii* is probably a synonym of *O. klugii* is unfortunate. A comparison of the types of the two species at Berlin showed that the gonopods were very different, those of *O. erichsonii* having three prongs, somewhat as in *O. triramus*, but considerably longer and more nearly equal and parallel.

Saussure's *Polydesmus picteti*, the third of the species originally referred by that author to the typical section of his subgenus *Paradesmus*, is also placed by Pocock as a synonym of *klugii*, but may prove to be a distinct species.

A NEW GENERIC NAME FOR THE HOTHOUSE MILLIPED.

The complications that attend the application of the generic name *Orthomorpha* to Central American species should not affect the status of the hothouse milliped. None of the previously applied generic names being available, this species remains to be treated as the type of a new genus, for which the name *Oxidus* is proposed, in allusion to the repugnatorial secretion of prussic acid. This milliped served as the basis of the first chemical investigation of the nature of the secretion.

Although the animal is perhaps the most common and widely distributed representative of the whole class Diplopoda, several characters available for generic diagnosis seem to have been overlooked.

OXIDUS, new genus.

Genotype.—*Fontaria gracilis* C. L. Koch, a species widely distributed in the tropics and in hothouses. First described from a hothouse in Austria. Original habitat unknown, but supposed to be in the East Indies. Present description based on specimens collected in greenhouses of the Bureau of Plant Industry, U. S. Department of Agriculture, Cat. No. 810, U.S.N.M.

Diagnosis.—Antennæ inserted low down and close together; first segment enlarged, second and third segments reduced; posterior subsegments crossed by a deep transverse impression; constriction between the subsegments deep and strongly beaded; lateral carina strongly margined with a prominent setiferous tubercle near the anterior corner; repugnatorial pores distinctly lateral, behind the middle of the segments, with distinct raised rims; posterior segments scarcely shortened; last segment with two transverse rows of setiferous tubercles, the apex with two large rounded, nonsetiferous tubercles; sterna with median and transverse impressions and a broadly conic tubercle at the base of each leg; spiracles with expanded

auriculate rims; legs of males tuberculate on the lower surfaces of the last two joints; gonopods with second joint robust, ending in four strongly curved simple prongs.

Description.—Body small and depressed, oblong, slender, over eight times as long as wide.

Head strongly convex, prominent; vertex evenly rounded, smooth, with a deep median furrow to near the level of the antennæ; a few setiferous punctations on each side of the furrow; hirsute between and below the antennæ, also punctate and transversely rugulose; labrum with three distinct teeth in a shallow emargination, bordered by two regular rows of setiferous punctations.

Antennæ inserted low down, separated by only about the width of one of the sockets; rather slender filiform, or the terminal joints slightly thicker, joints 2–6 nearly equal in length.

First segment somewhat wider than the head, transversely oblong, over twice as broad as long, anterior and posterior corners rounded, especially the former; anterior margin with a fine raised rim, broader and more prominent on the sides; surface evenly convex, with a transverse row of ten setiferous punctations near the anterior margin and a second row of two punctations a little behind the middle. Lateral punctations of anterior row mounted on the raised margin.

Segments 2 and 3 much shorter than the others, only about half as long as segment 1; lateral carinæ of segment 2 depressed below the level of the others and prolonged in front under the posterior corners of segment 1. Segment 4 intermediate in length between 3 and 5 and with a transverse dorsal impression wanting on segments 2 and 3.

Subsequent segments with dorsal surface nearly smooth, somewhat rugulose and very minutely striolate longitudinally, under sufficient magnification; marked with a slight median impression and a deep transverse furrow across the middle of the posterior subsegments. Each segment with a transverse row of six bristles near the anterior margin, the lateral pair of bristles on the raised rims of the carinæ.

Lateral carinæ nearly horizontal, rather narrow, less than one-fourth as wide as the body cavity, with distinct raised margins; anterior corners rounded, the posterior nearly a right angle on anterior segments, becoming more produced and somewhat spiniform on posterior segments; lateral edge of carinæ nearly straight, but abruptly narrowed behind a setiferous tubercle near the anterior corner.

Repugnatorial pores inserted in small lateral excavations of segments, 5, 7, 9, 10, 12, 13, 15–19; margins of poriferous carinæ somewhat thickened, especially underneath the pores, but the pores not indicated from above, except that the lateral margin is usually distinctly sinuate above the pore.

Anterior subsegments covered with a rather regular minute reticulation of raised lines; separated from the posterior subsegment by a very deep, abrupt, and distinctly beaded transverse constriction. Reticulation interrupted a little in front of the constriction by a delicate transverse impressed line.

Pleuræ roughened with scattered granules, thickened below into an oblique ridge, sharply angled behind, especially on anterior segments.

Penultimate segment scarcely shortened, but the carinæ distinctly smaller and less acutely produced; not transversely impressed like the preceding segments, but with a pair of bristles on the posterior part of the segment in addition to the six anterior bristles.

Last segment nearly twice as long as the exposed part of the penultimate, the projecting apex rather large, about as long as broad, ending in a pair of prominent rounded, nonsetiferous tubercles separated by a distinct notch with two pairs of setiferous punctations. A transverse row of four bristles in front of the apex, one pair dorsal, the other lateral, another transverse row of eight bristles near the middle of the segment, two pairs dorsal and two pairs lateral, near the upper corners of the anal valves.

Anal valves rather flat, but distinctly convex in the middle, with distinctly compressed raised margins; two setiferous tubercles distinct from the margins. Preanal scale nearly as long as broad, convex, distinctly angled by the prominent setiferous tubercles that equal or exceed the scarcely produced apex.

Sterna smooth, rather sparsely hirsute, with a distinct but gradually sloping cruciform impression; a small broadly conic tubercle or spine at the base of each leg, directed caudad. Spiracles with large ear-like expanded rims on the outer side, especially the anterior pair of each segment. Coalesced pleuræ of second segment of male with a median process in front and behind; those of the third segment of the female with a median process in front.

Legs of moderate length, rather robust; joints 3 and 6 the longest, subequal, all the joints moderately hirsute, at least on the ventral surface; joints 5 and 6 also tuberculate on the ventral surface in the male, but not provided with cushions of dense hairs. Seminal ducts opening in small pores on the rounded mesial corners of the basal joints of the second pair of legs.

Gonopods rather short, accommodated by a slight excavation between the bases of the seventh pair of legs; aperture without a raised rim; basal joint prominent; apical joint with a very short, cushion-like hirsute base, a robust, obconic slightly curved shaft, and four terminal curved prongs, a short one projecting mesad, and two much larger projecting distad, but strongly incurved and decurved; the shorter of the two rises from a slender base and expands into a thin oblique, triangular decurved blade; the longer prong rises from a rather broad,

tapering base, curves around the more slender prong and ends in two diverging plates. The fourth prong, carrying the seminal duct, is simple and very slender. It rises from the anterior or dorsal face of the shaft, curves abruptly forward, enters the base of the third prong, and remains inclosed for nearly its entire length, only the tip emerging at the side of the proximal plate of the third prong.

The general form of the gonopods is fairly well shown in Latzel's figure, though somewhat conventionalized, except for the treatment of the third prong that sheaths the seminal duct. The sheath is formed by infolding of the edges along the convex outer margin, which appears completely closed in Latzel's figure.

OXIDUS GRACILIS (C. L. Koch).

Fontaria gracilis C. L. Koch, System der Myriopoden, p. 142, 1847; Die Myriopoden, vol. 2, p. 51, pl. 85, fig. 173, 1863.

Paradesmus gracilis LATZEL, Myr. der Oest.-Ung. Mon., vol. 2, p. 162, pl. 6, fig. 70, 1884.

Paradesmus dasys BOLLMANN, Proc. U. S. Nat. Mus., vol. 10, p. 619, 1887.

Orthomorpha gracilis BOLLMANN, Bull. 46, U. S. Nat. Mus., p. 197, 1893.—Pocock, Ann. Mag. Nat. Hist., ser. 6, vol. 15, p. 354, 1895.—ATREMS, Denkschr. kais. Acad. Wiss., Wien, vol. 47, p. 337, 1898.—Pocock, Biol. Centr.-Amer., Diplopoda, p. 160, 1909.

Length of males 19.21 mm., width 2.2 mm.; females 20–22 mm. by 2.5 mm.

Living colors of adult: Dorsum deep chestnut brown or black, the carinae bordered with lemon yellow, the sides chestnut brown, sterna and basal joints of legs pallid; distal joints of legs and apex of last segment of body rather pale, but distinctly tinged with brown; antennae and vertex dark brown, darker than other parts of the head. Young individuals are paler brown and lack the yellow color of the carinae. The yellow also disappears in alcohol, leaving the carinae pale like the ventral surfaces. In some specimens the carinae of the second segment are much darker than the others.

The three characters used by Bollman in the diagnosis of *Paradesmus dasys*, the tubercles of the legs of males, the hairs of the vertex, and the two rows of bristles on the first and penultimate segments, are present, apparently, in all specimens of *gracilis*. The fact that they had been overlooked by previous writers seems to have been the occasion of the naming of the new species.

DESCRIPTIONS OF A NEW GENUS AND SPECIES OF JANIRIDÆ FROM THE NORTHWEST PACIFIC.

By HARRIET RICHARDSON,

Collaborator, Division of Marine Invertebrates, U. S. National Museum.

In the material collected by the U. S. Bureau of Fisheries steamer *Albatross* in the Northwest Pacific in 1906 there was a single specimen representing a new genus and species of Janiridæ. This specimen has only recently turned up, so was not included in my earlier report¹ on the isopoda of that collection.

JÆRELLA, new genus.

Head produced in the middle of the front in an extremely long rostrum. Antero-lateral angles also produced in an extremely long process on either side. Lateral margins of head produced on either side in an elongate process. Eyes large, conspicuous and situated some distance from the lateral margin.

First segment of the thorax produced on either side in a single long triangular process, similar to the lateral process of the head. The following six segments have the lateral margins produced on either side in two narrow elongate processes, equal in length to the lateral process of the first segment.

Abdomen consisting of a single large segment, the posterior margin of which is produced in two long processes, posteriorly directed, and the lateral margins of which are furnished on either side with a single long triangular process. Uropoda, with a short peduncle and two slightly unequal branches, are placed between the two posterior processes of the abdomen.

Head, first three and last three segments of the thorax ornamented with two sharp spines, one on either side of the median line. Fourth segment of thorax furnished with four spines, two on either side of the median line, in longitudinal series. There is one spine on the anterior portion of the abdomen in the median line.

¹ Proc. U. S. Nat. Mus., vol. 37, 1909, pp. 75-129.

The legs of the first pair are prehensile, of the following six pairs ambulatory.

The type of the genus is *Jærella armata*, new species.

This genus is closer to *Iolella* (as represented especially by *I. spinosa* (Harger), *I. speciosa* (Bovallius), and *I. glabra* Richardson) than to any other genus of the family, but differs from it in having the antero-lateral angles of the head as well as the lateral margins produced in triangular processes; in having the last three segments of the thorax produced in two elongate processes instead of one; in having the abdomen produced in two posterior triangular processes and two lateral triangular processes instead of the two posterior triangular expansions found in that genus; and in having four spines on the fourth segment of the thorax. This genus may also be compared with *Rhacura* Richardson,¹ *Acanthaspida* Stebbing,² *Iolanthe* Beddard,³ and *Ianthopsis* Beddard.⁴

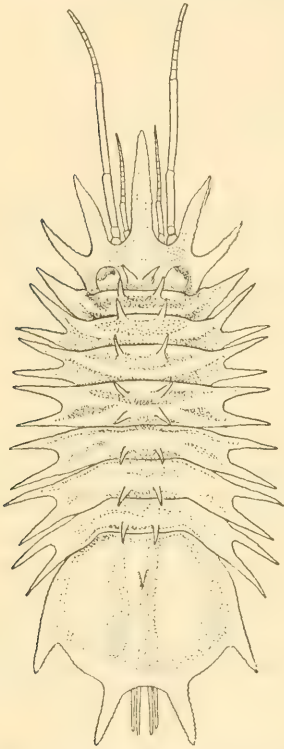


FIG. 1.—*JÆRELLA ARMATA*. $\times 11$.
(Drawn by Miss V. Dandridge.)

JÆRELLA ARMATA, new species.

Body oblong-ovate.

Head with anterior margin produced in the middle in an extremely long rostrum, ending acutely. Antero-lateral angles also produced forward in extremely long processes, one on either side, almost as long as the rostrum. Below these the lateral margin is produced on either side in a long process, extending almost as far as the antero-lateral process. Eyes large, rounded, and situated some distance from the lateral margin, on the posterior half of the head.

Between the eyes on the dorsal surface are two long sharp spines, one on either side of the median line. The first pair of antennæ extend to the middle of the last peduncular article of the second pair of antennæ. The second pair of antennæ have the first four articles short and about equal in length; the fifth is a little longer than the first four taken together; the sixth is a little longer than the fifth; the flagellum is broken in the only specimen.

¹ Proc. U. S. Nat. Mus., vol. 35, 1908, pp. 72-74.

² Norwegian North-Atlantic Expedition, XIV, Zoology, Crust., vol. 1, 1885, pp. 119-121, pl. 10, figs. 27-30.

³ Challenger Report, Zool., vol. 17, pt. 48, 1886, pp. 15-18, pl. 4, figs. 9-14; pl. 5, figs. 1-4.

⁴ *Idem*, p. 15, pl. 5, fig. 5. Also Studer, Abh. k. Akad. Wiss. Berlin, 1883, pp. 10-12, pl. 1, fig. 2.

The first segment of the thorax has the lateral margins produced on either side in one extremely long process, which is as long as the lateral process of the head. The following six segments each have the lateral margins produced on either side in two extremely long processes, as long as those of the first segment. The first three segments and the last three segments each have two sharp spines on the dorsal surface, one on either side of the median line. The fourth segment has four spines, two on either side of the median line in longitudinal series.

The abdomen is composed of a single large segment. Its posterior margin is produced in two long processes, one on either side of the median line, and its lateral margins are produced in a single long process on either side, posteriorly directed and situated about half the distance from the base to the extremity of the segment. On its dorsal surface is a single median sharp spine on the anterior portion of the segment. The uropoda are composed of a short peduncle, and two branches, not reaching quite to the extremity of the posterior processes of the abdomen, and between which they are situated. The outer is slightly shorter than the inner branch. In a dorsal view the peduncle does not show.

The first pair of legs are prehensile, the following pairs ambulatory.

Only one specimen, a male, was taken in the Northwest Pacific, June 7, 1906, at station 4781, lat. $52^{\circ} 14' 30''$ N.; long. $174^{\circ} 13'$ E., by the U. S. Bureau of Fisheries steamer *Albatross*, at a depth of 300 fathoms, in fine gray sand and pebbles.

The type, a dried specimen, is Cat. No. 42162, U.S.N.M.

This species comes from the same locality and depth as *Microprotus cæcus* Richardson,¹ and certainly bears a curious superficial resemblance to that form in the shape of the abdomen, which, however, has only four elongate processes instead of six. In other respects it is closer to *Iolella*, as previously stated.

¹ Proc. U. S. Nat. Mus., vol. 37, 1909, pp. 116-118.

A NEW CESTODE FROM AN AFRICAN BUSTARD.

By BRAYTON HOWARD RANSOM,

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Among the collections of the Smithsonian African expedition, 1909-10, there are some specimens of tapeworms collected July 4, 1909, from the lower intestine of a bustard, *Neotis capfra* (Lichtenstein), by Mr. J. Alden Loring, at N'garri, Narok River, British East Africa (original number 233). These specimens, about a dozen in number, are in a poor state of preservation. Notwithstanding their poor condition it has been possible to establish certain facts relative to their morphology which show that they belong to a species of the family Davaineidæ hitherto undescribed. Furthermore, the worms are not only of a new species but on account of several characteristics not in accord with any genus heretofore recognized, they also represent a new genus, for which the name *Sphyroncotænia* (σφύρα, a hammer; ὄγκος, a hook) is proposed. To the species is given the name *Sphyroncotænia uncinata*.

Genus SPHYRONCOTÆNIA Ransom, 1911.

GENERIC DIAGNOSIS.—Superfamily Tænioidea, family Davaineidæ, subfamily Idiogeninæ: Rostellum armed with numerous hammer-shaped hooks arranged in 10 to 12 rows. Suckers unarmed. Cortical parenchyma and longitudinal musculature greatly developed, with numerous muscle bundles. Genital pores unilateral. Genital canals pass ventral of the longitudinal excretory vessel and nerve. Testicles numerous. Female glands on the pore side of the median line. Eggs in uterus become more or less isolated by ingrowths of the uterine wall. A para-uterine organ is present in gravid segments in front of the uterus. Adults in birds.

Type-species.—*Sphyroncotænia uncinata* Ransom, 1911.

SPHYRONCOTÆNIA UNCINATA Ransom, 1911.

SPECIFIC DIAGNOSIS.—*Sphyroncotænia* (type): Length, 22 to 37 cm.; breadth at middle of strobila, 1 to 2 mm.; breadth at posterior end, 2 to 3 mm.; maximum breadth, 3.5 to 4 mm. at a point 1 to 4



FIG. 1.—SPHYRONCOLENIA UNCINATA. ENTIRE WORM.
NATURAL SIZE.

cm. from the posterior end (alcoholic material). Segments several hundred in number, broader than long except at the posterior end of the strobila where they may be slightly longer than broad. (Fig. 4.) Head (fig. 2), 400 to 450 μ broad by 280 to 300 μ long. Suckers unarmed, 175 to 200 μ in diameter. Rostellum simple, truncate conical in shape, 150 to 175 μ long by 190 to 200 μ broad at its base, armed with numerous hammer-shaped hooks (fig. 3), 25 to 30 μ long, arranged in 10 to 12 rows. Retracted rostellum lies within a cavity whose inner surface is lined with an armature of very numerous short spines, which evidently form a spiny zone back of the rostellum when the latter is protracted. Unsegmented neck region practically nil. Just back of the head the breadth of the strobila is slightly less than that of the head, varying with the state of contraction. Posterior borders of each segment, except in the posterior region of the strobila, overlap the succeeding segment nearly half way. Genital pores unilateral. (Fig. 4, *g. p.*) The genital pore in younger segments is located in the lateral margin just posterior of the edge of the posterior border of the preceding segment. In gravid segments (fig. 4) the posterior borders overlap the succeeding segments but slightly, and the genital pore is located a short

distance posterior of the middle of the lateral margin of the segment. (Fig. 4, *g. p.*) The cortical parenchyma and longitudinal musculature are well developed, in sexually mature segments comprising two-thirds of the thickness of the strobila. (Fig. 5.) Transverse musculature well developed (fig. 5, *t. m.*) Lateral longitudinal nerves prominent. (Figs. 5, 6, *l. n.*) Ventral excretory vessels (figs. 4, 5, *ex.*) large, located a considerable distance from the edge of the strobila, and connected by a transverse commissure in the posterior portion of each segment. Dorsal excretory vessels absent or so much reduced in size as to be no longer apparent in sexually mature segments. Genital canals (fig. 5) pass ventral of the excretory vessel and nerve.

Male reproductive organs.—Testicles (fig. 5, *t.*) numerous (over 80), confined to the median portion of the medullary parenchyma; the mass of testicles, extending from the transverse excretory vessel forward nearly to the anterior limits of the segment, is dorsal in portion except posteriorly where it occupies the ventral as well as the dorsal portion of the medullary parenchyma. Vas deferens (fig. 5, *v. d.*) forms a mass of coils on the median side of the ventral longitudinal excretory vessel a short distance in front of the plane of the genital pore, then passes outward and backward on the ventral side of the excretory vessel and enters the base of the cirrus pouch. (Figs. 5, 6, *c. p.*) Cirrus pouch elongated, pyriform, about 250 μ long. Cirrus when evaginated measures about 50 μ in diameter, armed with numerous curved spines 10 to 12 μ long. Cirrus pouch opens into the bottom of a deep genital cloaca which measures 150 μ or more in depth.

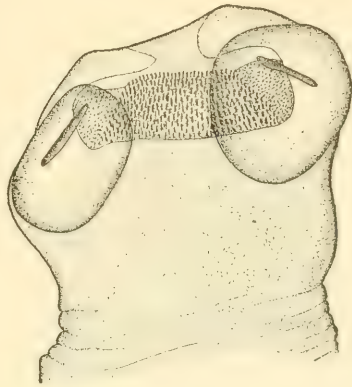


FIG. 2.—SPHYRNCOTENIA UNCINATA. HEAD, CONSIDERABLY FLATTENED BY PRESSURE. ENLARGED.



50 μ

FIG. 3.—SPHYRNCOTENIA UNCINATA. HOOK FROM ROSTELLUM. ENLARGED.

Female reproductive organs.—Vagina (figs. 5, 6, *vag.*) opens into the bottom of the genital cloaca ventral and posterior of the cirrus pouch, passing in a nearly straight course on the ventral side of the ventral longitudinal excretory vessel and on the posterior side of the mass of coils of the vas deferens. Near its inner end, the vagina is enlarged to form the seminal receptacle (fig. 5, *sem. rec.*), oval in shape, situated originally on the median side of the mass of coils of the vas deferens,

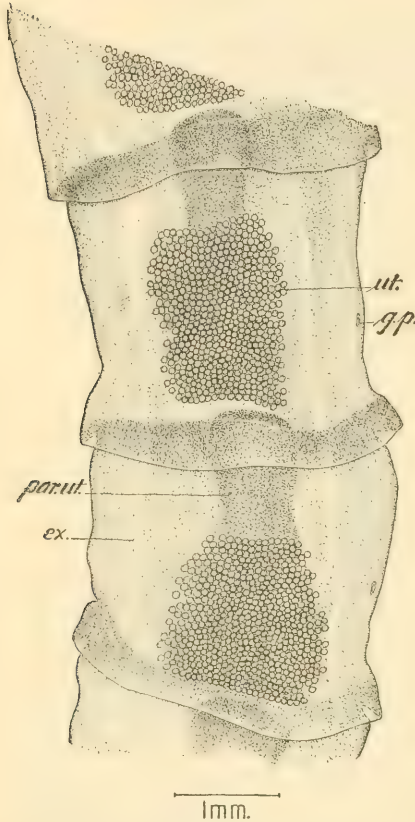


FIG. 4.—SPHYRONCOTENIA UNCINATA. GRAVID SEGMENTS FROM POSTERIOR PORTION OF STROBILA. *ex.*, EXCRETORY VESSEL; *g. p.*, GENITAL PORE; *par. ut.*, PARA-UTERINE ORGAN; *ut.*, UTERUS. ENLARGED.

about midway between the dorsal and ventral surfaces of the segment. At the height of its development the seminal receptacle measures $125\ \mu$ or more in length. In gravid segments it is pushed dorsalward by the uterus against the ventral surface of the dorsal layer of transverse muscles. Medial from the seminal receptacle the vagina is prolonged for a distance of 40 or $50\ \mu$, and at its termination joins the oviduct. The ovary (fig. 5, *ov.*) is located ventrally in the medullary portion of the segment on the median side of the coils of the vas deferens, and extends a variable distance toward or beyond the median line of the segment. The oviduct passes from the ovary in a diagonal direction laterally (i. e., toward the pore side of the segment) and dorsally and after joining the inner end of the vagina, continues in an inward (i. e. toward the median line of the segment) and dorsal direction. Curving around the ventral surface of the shell gland (fig. 5, *s. g.*) it enters the latter on its median side. The shell gland measures about $150\ \mu$ in diameter and is situated in the dorsal portion of the medullary parenchyma, near the seminal receptacle, dorsal of the latter and nearer the median line of the segment. Shortly before or after entering the shell gland the oviduct is joined by the yolk duct. After passing through the shell gland the oviduct runs in the ventral direction and presumably joins the uterus. The yolk gland (fig. 5, *y. g.*) is a rounded body about $100\ \mu$ in diameter situated in

about the same frontal and horizontal planes as the seminal receptacle, and about half way between the latter and the median line. The uterus (fig. 5, *ut.*) develops on the dorsal side of the ovary. When fully developed the uterus (fig. 4, *ut.*) occupies most of the medullary portion of the segment in the posterior half, extending laterally almost to the longitudinal excretory vessels. Numerous infoldings or proliferations from the wall of the uterus penetrate among and surround the eggs in such a manner that they appear in some cases to be inclosed in separate chambers. In the anterior portion of the segment the medullary parenchyma becomes modified to form a para-uterine organ (fig. 4, *par. ut.*), which laterally extends a variable distance on each side toward the longitudinal excretory

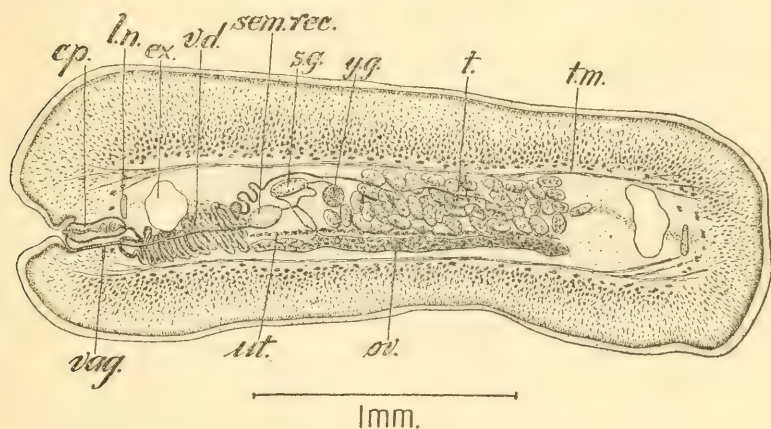


FIG. 5.—SPHYRNOCOLENIA UNCINATA. TRANSVERSE SECTION OF SEXUALLY MATURE SEGMENT. *c. p.*, CIRRUS POUCH; *ex.*, EXCRETORY VESSEL; *l. n.*, LATERAL LONGITUDINAL NERVE; *ov.*, OVARY; *sem. rec.*, SEMINAL RECEPTACLE; *s. g.*, SHELL GLAND; *t.*, TESTICLES; *t. m.*, TRANSVERSE MUSCLES; *ut.*, PRIMORDIUM OF UTERUS; *vag.*, VAGINA; *v. d.*, VAS DEFERENS; *y. g.*, YOLK GLAND. ENLARGED.

vessels and antero-posteriorly from the anterior limits of the uterus to the anterior end of the segment. The tissue of the para-uterine organ contains numerous calcareous corpuscles. Whether the para-uterine organ is functional to the extent that the eggs are finally pressed into it from the uterus and become encapsuled by it, is uncertain, as this condition does not obtain in any of the specimens examined. The eggs (fig. 7) are round or oval with thin shells, at least two in number, an outer shell measuring 70 by 40 μ to 80 by 55 μ in diameter, and an inner shell, measuring 45 by 35 μ to 64 by 40 μ in diameter, thinner than the outer shell, and closely investing the oncosphere. The hooks of the oncosphere measure 25 to 30 μ in length.

Host.—*Neotis caffra* (Lichtenstein).

Location.—Lower intestine.

Locality collected.—British East Africa.

Type-specimens.—United States National Museum, Helminthological collections, No. 7319, collected by Mr. J. Alden Loring, July 4, 1909, at N'garri, Narok River.

As to the taxonomic position of *Sphyrnocoetænia uncinata*, the presence of hammer-shaped hooks on the rostellum is a character which by itself may be considered sufficient to establish the species in the family Davaineidæ, although heretofore no species of this family has been known which possesses more than three rows of hooks on the rostellum. Of the three subfamilies of the Davaineidæ, Ophryocotylinæ is excluded from consideration on account of differences in the

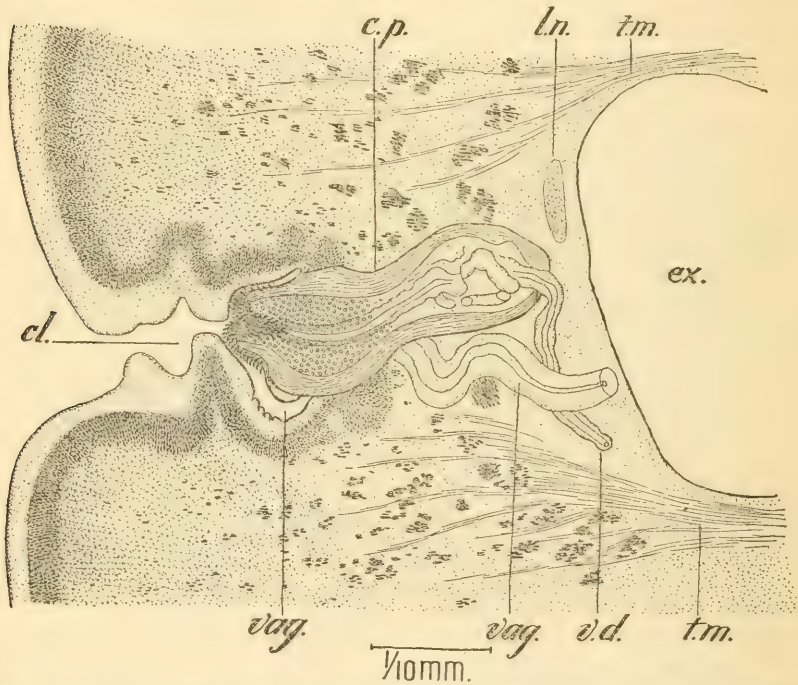


FIG. 6.—SPHYRNOCOTÆNIA UNGINATA. TRANSVERSE SECTION THROUGH GENITAL PORE, CIRRUS POUCH, AND NEIGHBORING STRUCTURES. *cl.*, GENITAL CLOACA; *c. p.*, CIRRUS POUCH; *ex.*, EXCRETORY VESSEL; *l. n.*, LATERAL LONGITUDINAL NERVE; *t. m.*, TRANSVERSE MUSCLES; *vag.*, VAGINA; *v. d.*, VAS DEFERENS. ENLARGED.

rostellum, and the absence of para-uterine organs. The subfamily Davaineinæ is also excluded on account of the absence of para-uterine organs. The third subfamily, Idiogeninæ, is characterized especially by the presence of a single set of reproductive organs in each segment, a sac-like uterus more or less lobed or much branched which is not persistent and from which the eggs finally pass into a para-uterine organ. *Sphyrnocoetænia uncinata* possesses all of these characters and may therefore be placed in the subfamily Idiogeninæ. Two genera have heretofore been recognized in this subfamily, namely the type genus, *Idiogenes* Krabbe, 1868, and *Chapmania* Monticelli, 1893.

In the former genus four species are known—*Idiogenes otidis*¹ Krabbe, 1868, which is the type of the genus, *Idiogenes flagellum*² (Goeze, 1782) Kholodkovski, 1905, *Idiogenes grandiporus* Kholodkovski, 1905, and *Idiogenes horridus* Fuhrmann, 1908.

In certain respects *Sphyrnocoetænia uncinata* resembles the genus *Idiogenes*. The hammer-shaped rostellar hooks, the unilaterality of the genital pores, and the presence of a para-uterine organ are characters common to both. Distinct differences, however, are seen in the arrangement of the hooks on the rostellum (10 or 12 rows in the one case and 2 rows in the other), in the comparatively large size of the strobila and the great development of the musculature of *Sphyrnocoetænia uncinata* and the small size of the strobila and weak development of the musculature of *Idiogenes*, in the small size of the cirrus pouch relative to the size of the segment and absence of retractor muscle in the former case and the relatively large size of the cirrus pouch and presence of retractor muscle in the latter, in the numerous testicles of the former and the few testicles of the latter, and in the distinct displacement of the female glands toward the pore side of the segment in *Sphyrnocoetænia uncinata* and their practically median position in *Idiogenes*. Although the resemblances between *Sphyrnocoetænia uncinata* and the genus *Idiogenes* indicate that they are somewhat closely related, they exhibit too many differences to be placed together generically.

In the other genus of Idiogeninæ mentioned above two species have been recognized, namely, *Chapmania tauricollis*³ (Chapman, 1876) Monticelli, 1893, which is the type species of *Chapmania* and *Chapmania tapika*⁴ Clerc, 1906.

Sphyrnocoetænia uncinata resembles the genus *Chapmania* in a number of characters, as follows: It is a comparatively large species, with well-developed cortical parenchyma and musculature. It has rostellar hooks of similar shape. The genital pores are unilateral, as in the type species of *Chapmania*. The cirrus pouch does not extend inward beyond the limits of the cortical parenchyma. The vas deferens is without seminal vesicle and is much convoluted. The



1/10mm.

FIG. 7.—SPHYRNOCOETÆNIA UNCINATA. EGG. ENLARGED.

¹ Kowalewski (1906, 683-686) and Fuhrmann (1908, 49) consider *Idiogenes otidis* and *I. grandiporus* to be identical but Kholodkovski (1905; 1906) and Clerc (1906, 724) hold to the view that two distinct species may be recognized. Under the circumstances it seems necessary to recognize both species until more certain evidence of their identity can be obtained, the evidence thus far available not being sufficient to prove that the two species are the same.

² Synonyms: *Tænia flagellum* Goeze, 1782; *Halysis flagellum* (Goeze) Zeder, 1803; *Tænia mastigophora* Krabbe, 1879; *Idiogenes mastigophora* (Krabbe) Kholodovskii, 1905; *Davainca* (*Chapmania*) *longicirrhosa* Fuhrmann, 1906.

³ Synonyms: *Tænia tauricollis* Chapman, 1876; *Tænia argentina* Zschokke, 1888; *Davainca tauricollis* (Chapman) Fuhrmann, 1896; *Capsodavainca tauricollis* (Chapman) Fuhrmann, 1901.

⁴ Synonym: *Idiogenes tapica* Clerc, 1906.

testicles are numerous. The eggs become more or less separated from one another by ingrowths from the wall of the uterus.¹ A para-uterine organ develops in front of the uterus and into this the eggs presumably pass and become inclosed in a single egg capsule.

At least one important difference from *Chapmania* is exhibited by *Sphyrnocoetænia uncinata*, namely, the arrangement of the hooks on the rostellum in ten to twelve rows. Less important is the lack of hooks on the suckers of *S. uncinata*, which, moreover, may be due simply to their loss in the specimens examined. The lack of a dorsal longitudinal excretory vessel may be only an apparent and not an actual condition. The location of the female glands toward the pore side of the medullary parenchyma though different from the condition in the type species of *Chapmania* is paralleled by the slight displacement in that direction in *C. tapika*. The eggs in *Sphyrnocoetænia uncinata* are apparently without parenchymatous or connective tissue envelopes outside the second shell, but it is possible that such envelopes are present, as in *C. tauricollis*, the condition of the material examined being such that this point could not be definitely determined.

As already noted, with regard to the uterus and para-uterine organ *Sphyrnocoetænia uncinata* and *Chapmania* are very similar, the resemblance of *S. uncinata* to *C. tapika* being closer than to *C. tauricollis* if Fuhrmann is correct in his statement that in the latter species the uterus breaks down and the eggs become enveloped by parenchymal tissue before they enter the para-uterine organ.

The similarities in the structure of *S. uncinata* and *Chapmania* indicate a relationship between them, but as the former is widely different from the latter in the arrangement of the rostellar hooks, the arrangement of these hooks being given great weight under the present system of classification in the separation of genera throughout the entire superfamily Tænioidea, the necessity of erecting a separate genus for *S. uncinata* is clearly apparent.

Sphyrnocoetænia uncinata is much like *Porogynia lata* (Fuhrmann, 1901), the type and only known species of *Porogynia* Railliet and Henry, 1909, though this species is at present classed in a different

¹ In *C. tapika* the cavity of the uterus becomes more or less separated into chambers, which, however, always remain in communication, and contain groups of two to six eggs (Clerc, 1906). According to Fuhrmann (1908) the uterus in the genus *Chapmania* breaks down and the eggs become surrounded by parenchymatous capsules, after which they are pressed into a para-uterine organ which develops in front of the uterus, and in gravid segments, after their release from the strobila, this para-uterine organ transforms into a single large egg capsule. It would seem, however, both from Clerc's (1906) description and Fuhrmann's (1909) description of *C. tapika* that in this species the eggs pass directly from the uterus into the para-uterine organ. It may perhaps be considered an open question whether in *C. tauricollis* the uterus actually breaks down, the eggs then becoming surrounded by envelopes of parenchymatous origin, or whether the uterus as a result of extensive proliferation from its wall becomes more or less divided up into little chambers, the outer envelopes of the eggs then being added as a secretion from or a direct transformation of the ingrowths of the wall of the uterus. If the latter supposition be true, the eggs might apparently be contained in individual capsules, yet all of them still be within the cavity of the uterus, and completely surrounded by its peripheral wall.

subfamily (Davaineinæ) from that in which *S. uncinata* evidently belongs. *Porogynia lata*, according to Fuhrmann (1902; 1908; 1909), is a rather large species, reaching a length of 24 to 40 cm. with a maximum breadth of 6 to 10 mm. The suckers apparently are unarmed. The cortical parenchyma of the strobila is very thick and the musculature greatly developed. Dorsal longitudinal excretory vessels are absent. The genital pores are unilateral. The cirrus pouch does not extend inward as far as the lateral nerve. The vas deferens is much coiled without seminal vesicle. The testicles are numerous. The female glands are not median but are located in the medullary parenchyma toward the pore side of the segment, the ovary near the longitudinal excretory vessel and the yolk gland between the ovary and the median line. In all these characters *Porogynia lata* closely resembles *S. uncinata*. If Fuhrmann be correct in his original opinion (1902) as to the orientation of the segment, there is another important character in which *P. lata* resembles *S. uncinata*, namely, the passing of the sexual canals on the ventral side of the longitudinal excretory vessel and nerve. More recently, however, Fuhrmann (1908, 47) has decided that he was mistaken in his first interpretation, and that the side of the strobila which he originally looked upon as ventral is really the dorsal side. *Porogynia lata* is furthermore somewhat like *S. uncinata* in the possession of more than two rows of hooks on the rostellum. These two species are the only ones in the entire family known to possess more than two rows of rostellar hooks, and might on this account be placed together generically, though *P. lata* possesses only three rows (Fuhrmann, 1908; 1909) whereas *S. uncinata* has 10 to 12 rows. With regard to the uterus *Porogynia lata* presents characters which preclude the generic association of this form with *S. uncinata*, unless the present system of classification is materially modified. The uterus of *Porogynia lata* is described (Fuhrmann, 1902) as having very thin walls which early disappear, the eggs becoming inclosed singly in parenchymatous capsules and occupying the entire medullary portion of the segment. No para-uterine organ is developed and on this account the genus *Porogynia* is excluded from the subfamily Idiogeninæ.

By means of the following key *Sphyrnocolænia uncinata* and the various species of tapeworms which it most closely resembles may be readily distinguished.

KEY TO THE FAMILY DAVAINIIDÆ.

1. Para-uterine organs present in gravid segments.....(Idiogeninæ) 4.
 Para-uterine organs absent.....2.
2. One to three rows of hooks on the rostellum; uterus not persistent, eggs becoming
 inclosed in numerous egg capsules.....(Davaineinæ) 3.
 Two rows of hooks on the rostellum; rostellum very broad; uterus persis-
 tent.....Ophryocotylinæ

DAVAINEINÆ.

3. One or two rows of hooks on the rostellum.....Genera *Davainea* and *Cotugnia*.
 Three rows of hooks on the rostellum; cortical parenchyma and musculature greatly developed; genital pores unilateral; dorsal excretory vessels absent; testicles numerous; cirrus pouch 450 μ long, not extending inward as far as the excretory vessels; female glands not median, displaced toward the pore side of the segment; eggs with two or three membranes in addition to an outer parenchymatous envelope; size of strobila 24 to 40 cm. in length by 6 to 10 mm. in maximum breadth; recorded as parasitic in *Numida ptilorhyncha*, Africa.....*Porogynia lata*.

IDIOGENINÆ.

4. Two rows of hooks on the rostellum.....5.
 Ten to twelve rows of hooks (25 to 30 μ long) on the rostellum; retracted rostellum in a cavity whose inner surface is thickly covered with spines; suckers unarmed; cortical parenchyma and musculature greatly developed; dorsal excretory vessels absent or very small; genital pores unilateral; sexual canals pass ventral of ventral excretory vessel and nerve; cirrus pouch about 250 μ long not extending inward as far as the excretory vessel; testicles numerous; female glands displaced laterally toward the pore side of the medullary parenchyma; eggs with two thin shells; para-uterine organ supplied with rather numerous calcareous corpuscles; strobila 20 to 37 cm. long with a maximum breadth of about 4 mm.; recorded as parasitic in *Neotis caffra*, Africa.....*Sphyronecotænia uncinata*.
5. Strobila not over 7 cm. long and not over 2 mm. in maximum breadth; not more than 200 hooks on rostellum; suckers unarmed; cortical parenchyma and musculature weakly developed; genital pores unilateral or arranged in alternate series of 8 to 10 on each side of the strobila; cirrus pouch relatively large, crossing the nerve and excretory vessels and extending far into the medullary portion of the segment, and supplied with a retractor muscle; testicles few (less than 20); female glands practically median; eggs pass from uterus into an anterior para-uterine organ.....(*Idiogenes*) 6.
 Strobila 20 cm. or more in length and over 3 mm. in maximum breadth; more than 300 hooks on rostellum; suckers armed; cortical parenchyma and musculature greatly developed; genital pores unilateral or alternating; cirrus pouch small, compared to the size of the segment, either not crossing the excretory vessels or extending beyond them only slightly; testicles numerous; female glands median or displaced slightly toward the genital pore; eggs pass anteriorly into a para-uterine organ from the uterus either directly or after the disappearance of the uterine wall and the envelopment of the eggs in individual parenchymatous capsules.....(*Chapmania*) 9.

Idiogenes.

6. Genital pores unilateral.....7.
 Genital pores arranged alternately in series of 8 to 10 on each side of the strobila; strobila 15 to 25 mm. long and 0.3 mm. in maximum breadth; genital cloaca small, funnel shaped; testicles 10 to 15 in number; eggs with three thin shells; recorded as parasitic in *Otis tarda*, *Tetrax tetrax*, and *Houbara undulata*.....*Idiogenes otidis*.
7. Rostellar hooks 150 or more in number, about 10 μ long; length of strobila not over 3 cm., maximum breadth not over 0.5 mm.....8.

- Rostellar hooks about 100 in number, 22 to 30 μ long; strobila 6 to 7 cm. long with a maximum breadth of 1.2 mm; genital cloaca very large, spherical, its diameter equal to about one-third the length of the segment; testicles apparently 15 to 20 in number; eggs with three thin shells; recorded as parasitic in *Tetrax tetrax*.....*Idiogenes grandiporus*
8. Testicles 10 to 12 in number; yolk gland directly behind the middle of the ovary; recorded as parasitic in *Milvus milvus*, *Milvus korschun*, and *Milvus melanotis*.....*Idiogenes flagellum*.
- Testicles 7 to 9 in number; yolk gland behind the ovary but displaced toward the pore side of the segment; recorded as parasitic in *Cariama cristata*.
Idiogenes horridus.
- Chapmania*.
9. Rostellar hooks about 8 μ long; genital pores unilateral; cirrus pouch 0.5 mm. or more in length, supplied with a retractor muscle; testicles about 80 in number; eggs with two thin shells; recorded as parasitic in *Rhea americana*.
Chapmania tauricollis.
- Rostellar hooks 10 to 15 μ long; each sucker bears two conical processes, one on either side of the opening; genital pores irregularly alternating; cirrus pouch 240 to 280 μ long; testicles 200 or more in number; recorded as parasitic in *Tetrax tetrax*.....*Chapmania tapika*.

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THE SYSTEMATIC POSITION OF THE CRINOID GENUS MARSUPITES.

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Some time ago I suggested the division of the great group of free living crinoids known as the comatulids into three suborders, as follows:

INNATANTES: Families Marsupitidæ and Uintacrinidæ.

OLIGOPHREATA: Families Comasteridæ, Zygométridæ, Himerométridæ, Stephanométridæ, Pontiométridæ, Mariamétridæ, Colobométridæ, Thalassométridæ, Calométridæ, and Tropiométridæ.

MACROPHREATA: Families Antedonidæ, Atelecrinidæ, and Pentametrocrinidæ.

At that time I was concerned mainly with the recent forms, and so I did not wish to go into detail in regard to the processes of deduction by which I had arrived at the conclusion that *Marsupites* is closely allied to the comatulids, the predominant type in the recent seas.

I owe it to my collaborators, however, to define my position, and to state the reasons for my conclusion, so that they may judge for themselves whether I am right or wrong.

As I understand it, *Marsupites* is a pelagic comatulid, derived from the common comatulid stock and owing its aberrant calyx structure solely to its pelagic mode of life; the calyx is the most primitive type of comatulid calyx, serving the original purpose of protecting the viscera; what development there has been was exactly the opposite of that seen in all other comatulids, and resulted in enlarging the dorsalmost plates instead of reducing them, as has happened in all other forms. The arms alone have developed along the lines followed by the other comatulids; judging from the material which I have been able to examine, the arms are not only exactly like those of the recent comatulid or pentacrinite, but are comparable only to the arms of the more specialized types, in the latter only to those in the genus *Endoxocrinus*.

It is in the arms that we get the only direct clue to the systematic position of *Marsupites*; but this clue is positive and unmistakable;

and, once we grasp the idea that *Marsupites* may be a comatulid, it is readily seen that, with due regard for contingent circumstances consequent on a curiously specialized mode of existence, the remaining structures point to the same conclusion.

When any member of a group of animals adopts a mode of life entirely different from that of all the other members of the same group we must be prepared to encounter extraordinary and unexpected changes in its organization which are not connected with the more normal type of organization by any intermediates; and it must be remembered that such changes affect first of all the general body form. Among such animals we almost always find the group characters developed in a most erratic manner; some structures will be very highly specialized, sometimes specialized far beyond what is seen in any other members of the group, while others will be in a very rudimentary or primitive state of development, or even absent altogether.

As instances of adaptation to a peculiar and phylogenetically unnatural environment I may mention the flying mammals (bats); the pelagic mammals (cetaceans); the terrestrial birds (kiwi, ostrich, etc.); the pelagic birds (penguins); the flying reptiles (pterodactyls); the pelagic reptiles (sea snakes, plesiosaurs, ichthyosaurs, etc.); the purely aquatic amphibians (*Amphiuma*, *Siredon*, *Triton*, *Siren*, etc.); the purely terrestrial amphibians (*Hylodes*, etc.); the semiterrestrial fishes; the flying fishes; the parasitic or symbiotic fishes; the purely pelagic fishes; the deep-sea fishes; the parasitic insects; the aquatic insects; the aquatic arachnids; the parasitic arachnids; the mud-inhabiting holothurians; the deep-sea holothurians; the pelagic holothurians; the mud-living echinoids; the sessile gastropods; the parasitic gastropods; the parasitic "worms;" the sessile ctenophores; the parasitic barnacles; the free-living barnacles; the parasitic crustacea; the pelagic crustacea; the deep-sea crustacea. A large number of additional instances could be brought forward, but a study of the types mentioned is sufficient to show at once that when an animal acquires a phylogenetically new environment a readjustment of its structure is induced which often leads to very remarkable changes, so that the real affinities of the animal are rendered very difficult of appreciation.

Among the echinoderms a few cases seem worthy of special attention. The elaspod holothurians, which live in deep water, are bilaterally symmetrical, with tube feet on the ventral side only, and with papillæ on the back; there are no respiratory trees or Cuvierian organs. The apodal holothurians, which commonly live in mud, have no radial canals, tube feet, or respiratory trees. The free-swimming pelagic holothurians have no calcareous deposits whatever, no respiratory trees, no Cuvierian organs, no retractor muscles, and single lon-

gitudinal muscles. Only those echinoids which have flexible tests possess longitudinal muscles; many of the species never develop teeth, while some do not develop the lantern apparatus; several genera of the Arbaciidæ never develop spines upon the apical surface, this permanently remaining as in the very young of *Arbacia*.

We see, therefore, that it is a very common thing for a genus or other group living under special conditions to suffer an arrest in the development of some organ or set of organs, and in very many cases, best illustrated among the echinoderms, perhaps, by the well-known instances among the Arbaciidæ (*Arbaciella*, *Podocidaris*, *Dialithocidaris*, etc.), this arrest in development is chiefly evident in the very primitive condition of the general body form, as shown by a comparison of the adults of these genera with the very young of *Arbacia*.

In the very young of *Antedon*, as has been demonstrated by Bury and by Seeliger, there are:

(1) An apical system, consisting of a central plate, or dorsocentral, and a few columnars;

(2) A circle of underbasals surrounding this apical system;

(3) A circle of basals outside of and alternating with the underbasals;

(4) A circle of radials beyond and alternating with the basals.

(5) A circle of orals, each oral lying directly beyond a basal.

The differences between the calyx of the young *Antedon* and that of *Marsupites* are:

(1) In *Marsupites* the apical system is composed of a single plate instead of one large plate and a series of smaller ones;

(2) In *Marsupites* the underbasals are very large, as large as the basals, instead of being very small, as in *Antedon*.

This latter difference is easily shown to be of no especial significance by a study of the calyx development among the recent crinoids, and especially among the comatulids. Primarily the calyx is composed of four circlelets of plates, all the plates being approximately equal in size; these circlelets are (1) the underbasals, (2) the basals, (3) the radials, and (4) the orals. Phylogenetic development is in the direction of a reduction in the size of the calyx cavity and of a progressive extrusion of the visceral mass. The underbasals are first affected; instead of forming, as in the primitive condition, an important integral part of the body wall, they move inward, reducing their circlelet in size, so that their inner borders, instead of abutting on the sides of the topmost columnar, slip inward over it; at the same time they gradually become more and more recumbent, finally attaining a horizontal position and, instead of functioning as a part of the lateral calyx wall, become merely a sort of flooring upon which the contents of the calyx rest. The basals are next affected; they become reduced in size, and their lower edges slip inward over the inner side of the

horizontal underbasals, so that they eventually form a horizontal circlet of plates superimposed upon the similar circlet composed of underbasals; this condition is seen in *Antedon* just before the transformation of the basals into the rosette. A somewhat similar state of affairs is seen in the pentacrinites, though here the basals are not quite so reduced and, instead of covering the underbasals, as in *Antedon*, they imbricate over them. The radials travel the same path as did the basals and underbasals before them, and in most of the comatulids have become quite horizontal, serving merely as a platform upon which the visceral mass rests, and for the attachment of the arms.

This developmental path is very plain and easily demonstrated; but in *Antedon* the underbasals at their first appearance are very small and irregular in number, while in *Comactinia*, *Comanthus*, *Hathrometra*, and *Compsometra*, according to the investigations of Mortensen and myself, no underbasals ever appear. It seems clear that in the recent comatulids acceleration of development has operated to push the metamorphosis of the underbasal circlet so far forward in the ontogeny that it either only appears as a transient, usually imperfect, circlet or not at all; from what we know of the transformation of the basals and of the radials we must assume that the underbasals were of equal importance. This reasoning demonstrates that there is no tangible difference between the calyx of *Marsupites* and that of a comatulid in the younger stages, excepting only for the occurrence of a central plate, end to end with the underbasals, in the former.

The central plate in *Marsupites*, like the similar central plate in *Uintacrinus*, I believe to be the homologue of the dorso-central (terminal stem plate) plus all the columnars of the comatulid. In a previous paper I traced out the development of the crinoid stem from a hypothetical primitive central plate such as is seen in certain echinoids. I assumed that the central plate in *Marsupites* and in *Uintacrinus* was a primitive central plate, and in no way comparable to the comatulid centrodorsal (the topmost columnar of a subsequently discarded stem) for the following reasons: It lies in the body wall flush with the surrounding underbasals, and therefore can not be a columnar, for in all stalked crinoids the topmost columnar supports more or less of the lower margin of the basals or of the underbasals; this is a mechanical necessity, as otherwise the weight of all the calcareous structures would have to be taken up by the soft interior structures immediately above the stem and by the sutures between the topmost columnar and the underbasals. As the underbasals of the young *Antedon* surround its apical system in just the way that the underbasals of *Marsupites* and of *Uintacrinus* surround their central plates, I see no escape from the conclusion that these

central plates are the equivalents of the entire apical system (the dorsocentral plus the columnars) of the developing *Antedon*.

There is additional evidence that *Marsupites* never at any stage possessed a stalk, nor did *Uintacrinus*. This evidence is purely circumstantial, but appears to be none the less good. The enormous range of *Uintacrinus socialis* is well known, and recently *Marsupites* has been shown to have a range equally as extensive. Now we find among the jellyfishes forms which are purely pelagic and other forms which are fixed for varying periods. The extent of the distribution of these different types is very varied, the pelagic species having the greatest and the longest fixed the least range. When we compare the distribution of *Marsupites* and *Uintacrinus* with that of the recent jellyfish we find that the parallel is distinctly with those types which are exclusively pelagic and pass through no fixed stage, and we therefore appear to be justified in assuming that *Marsupites* and *Uintacrinus*, like them, were always, at all stages, free swimming.

Marsupites has large orals, and the arms are attached to a comparatively small portion of the distal border of the radials. Both these features are characteristic of the young *Antedon*, as well as of the young of all other genera in which the young have been observed. The orals undergo a metamorphosis just as do the underbasals, basals, and radials; but this metamorphosis merely takes the form of gradual resorption. In general, the resorption of the orals is correlated with the metamorphosis of the basals in the comatulids, as exemplified by *Antedon*. It would be presupposed, therefore, that, were we to discover a comatulid with persistent unmetamorphosed basals, it would also possess persistent unmetamorphosed orals.

Correlated with the presence of orals and unmetamorphosed basals in the young *Antedon*, we find the arms occupying only a small portion of the distal border of the radials; and therefore the same feature in *Marsupites* occasions no surprise.

Mr. Frank Springer first pointed out the correspondence between the structure of *Uintacrinus* and that of the comatulids, in particular to those belonging to the Comasteridæ. *Uintacrinus* has the same globular float-like body as *Marsupites*, but it is differently formed; *Uintacrinus* has progressed much farther along the phylogenetic comatulid path; both agree in having a centrale instead of a centrodorsal and in the possession of underbasals, though these are not always present in *Uintacrinus*. They should, therefore, be united in the same group, a group parallel to those which I have called Oligophreata and Macrophreata.

Uintacrinus has an eccentric mouth; if we can judge from the analogy with the eccentric mouth of most of the Comasteridæ, it also had a many-coiled digestive tube. The long digestive tube of

the comasterid species is necessary on account of the habits of those animals, for a large amount of inorganic matter is ingested with the food, necessitating a large absorption surface; the comasterids of deep water have short digestive tubes and central mouths, like the species of other families. *Uintacrinus*, being a pelagic form, probably lived at or near the surface, and therefore its food consisted largely of minute plants. This would be sufficient to induce a very considerable increase in the length of the digestive tract over that necessary for the assimilation of purely animal nutriment. *Marsupites* had a central mouth; we can not say that it did not have a long digestive tube; if it had a short one, it may have been strongly plicated like that of some of the recent endocyclic forms.

The position of the mouth is of no particular importance, systematically, in regard to the question of the relationships of these genera. Among the Comasteridæ most of the species have a marginal or a submarginal mouth, though a number have it perfectly central as in *Antedon*, as, for instance, *Comatilia*. Moreover, in those comasterids in which the mouth is marginal it is always central in the young, and does not begin to move from its central location until the orals have become entirely resorbed. Thus in *Marsupites*, with its large orals, we should not expect to find the mouth eccentric, no matter what might be its position in nearly related genera.

The crinoids are primarily fixed types inhabiting shallow water, derived, not remotely, from free living littoral bottom inhabiting animals. A pelagic crinoid, or a crinoid in the deep sea, is a crinoid living under conditions not normal for its class, and in such a crinoid we must always be prepared to find some structural inconformity which, unless we are careful, will prevent us from appreciating its true affinities.

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