SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 59

WASHINGTON
GOVERNMENT PRINTING OFFICE

ADVERTISEMENT.

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

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original papers based on the collections of the National Museum, setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually or oftener for distribution to libraries and scientific establishments, and, in view of the importance of the more prominent disseminations of new facts, a limited edition of each paper is printed in pamphlet form in advance. The dates at which these separate papers are published are recorded in the table of contents of the volume.

The present volume is the fifty-ninth of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

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

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as Bulletins.

William deC. Ravenel,

January 27, 1922 *Administrative Assistant to the Secretary, in charge of the United States National Museum.*

TABLE OF CONTENTS.

[1] Date of publication.

[1] Date of publication.

[1] Date of publication.

[1] Date of publication.

[1] Date of publication.

LIST OF ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

NEW SPECIES AND A NEW GENUS OF PARASITIC COPEPODS.

By Charles Branch Wilson,

Department of Biology, State Normal School, Westfield, Massachusetts.

The material for the present paper has been derived from a variety of sources, which have been duly acknowledged under the separate species.

It includes not only true parasites, but also commensals or semiparasites, whose relation to the animals with which they are associated is not even yet fully understood. Five of the species are North American, one was obtained in Japan, one in the Hawaiian Islands, and one in Jamaica. The types of the new species as well as all the specimens herein mentioned are deposited in the National Museum.

LEPEOPHTHEIRUS LONGIPES Wilson.

Plate 1, figs. 1–5.

Host and record of specimens.—Four adult females, five males, and two immature females were obtained from the rock bass, *Paralabrax clathratus*, at Crescent Bay, Catalina Island, California, by Dr. A. B. Ulrey, of the University of Southern California. They have been given Cat. No. 49779, U.S.N.M. The males and development stages are new for this species and are here described for the first time.

Characters of immature female.—Carapace relatively enormous, three times as long and four times as wide as the rest of the body; free thorax (fourth) segment wider than the genital segment and two-thirds as long; genital segment almost twice as wide as long, with a pair of one-jointed legs at the posterior corners, which are distinctly visible in dorsal view.

Abdomen one-jointed, the same length as the genital segment and half as wide; anal laminae relatively large; fourth legs, if straightened backward, reaching beyond the center of the abdomen, but not to its posterior margin. The chief points of difference between this development stage and the mature adult are the size of the carapace compared with the rest of the body, the relative length and width of

27177—21—Proc.N.M.vol.59——1

the genital segment, the presence of legs at its posterior corners, and the one-jointed abdomen.

Specific characters of male.—Carapace similar to that of mature female, about the same length and width, nearly twice the length of the rest of the body; free thorax (fourth) segment the same width as the genital segment ond one-third as long; genital segment obovate, three-fourths as wide as long, with a pair of fifth legs on its lateral margins, a little behind the center, and a pair of sixth legs at the posterior corners.

Abdomen a little more than half the width of the genital segment, two-jointed, the terminal joint twice the length of the basal; anal laminae large, curved inward at the tips, and armed with long plumose setae.

Appendages in general like those of the female, but the second antennae are stouter, as is usual in the male, and are armed with several accessory knobs and adhesion pads. The first maxillae are rather short, stout, and almost perfectly straight; the outer branch at the tip is twice the length of the inner, and the latter has a wide flange along its inner margin.

Color (preserved material) dark yellowish gray.

Total length, 3.75 mm. Length of carapace, 2.35 mm.; width, 2.25 mm. Genital segment, 0.65 mm. long, 0.50 mm. wide.

Remarks.—When the species was originally established in 1905[1] no males had been discovered, and there were no data as to locality and host. Afterwards 20 females were obtained from the jewfish (*Stereolepis gigas*) by Dr. J. C. McClendon at La Jolla, California. These were recorded[2] and bear Cat. No. 38567, U.S.N.M. The present specimens are from the same general locality, but from another host. They furnish additional evidence that the species belongs to the Pacific coast, and they supplement the original description by adding the male sex and a development stage.

ALEBION FUSCUS, new species.

Plate 1, figs. 6–11; plate 2, fig. 12.

Host and record of specimens.—Five females were obtained from the outer surface of a dusky shark, *Carcharhinus obscurus*, at Woods Hole in 1891 by Vinal Edwards. The specimens are somewhat curled and shriveled, as though they had suffered at some time from the drying up of the alcohol; but the best has been selected as the species type with Cat. No. 43559, U.S.N.M.

The other four become paratypes with Cat. No. 43560, U.S.N.M.

Specific characters of female.—Carapace ellipsoidal, one-fifth longer than wide and evenly rounded. Posterior sinuses narrow and

[1] Proc. U. S. Nat. Mus., vol. 28, p. 618. [2] Idem, vol. 35, p. 440.

pointed at the base, the median lobe considerably wider than the lateral lobes and armed at each posterior corner with three large spines.

The transverse groove in the lateral area is situated far forward, leaving the posterior portion of the area nearly twice as long as the anterior. Eyes distinctly visible, rather far forward, small, and fused on the midline. Free thorax segment as wide as the genital segment, but only a fourth as long, covered with a pair of dorsal plates, which overlap considerably the base of the genital segment. The two plates are fused across the midline for the entire length of the free segment, and then separated by a narrow sinus. Each is semielliptical in shape, one-half longer than wide, with a strongly convex lateral margin and a bluntly rounded posterior lobe, which covers the basal third of the genital segment, and is entirely without spines or armature of any sort.

Genital segment half the width of the carapace, with strongly convex lateral margins and long, flattened posterior processes. Each lateral margin is armed with a set of stout spines which begin at the center and extend backward nearly to the base of the posterior process. The latter is narrowed posteriorly and is armed along its inner margin with a row of small spines and three larger ones at the tip.

Abdomen two-jointed, the basal joint considerably larger than the terminal and extending backward on either side of the latter in a bluntly-rounded flattened process, similar to those on the genital segment.

Terminal segment with straight sides and carrying a pair of anal laminae, each of which is long and narrow and tipped with four plumose setae.

The tips of the anal laminae do not quite reach the level of the tips of the posterior processes of the genital segment.

The second antennae have a stout basal joint with a slender terminal claw, which is turned backward. The second maxillae have a long and slender terminal claw, with an accessory claw at its base on the outer side. The maxillipeds are short and stout with a blunt claw.

The swimming legs are similar to those of other species, the exopods of the first three pairs being armed with the long curved processes peculiar to this genus, one on the first pair, two on the second pair, and three on the third pair. The fourth legs are reduced to papillate, one-jointed stumps.

Color (preserved material) dusky brown, deepening into black in the thicker parts of the body.

Total length, 10 mm. Carapace, 5.40 mm. long, 4 mm. wide. Free segment, 2.15 mm. wide. Genital segment, 4 mm. long, 2.25 mm. wide. Egg strings 5 mm. long.

(*fuscus*, black in allusion to the color.)

Remarks.—This species may be distinguished from the others belonging to the genus by its darker color, by the presence of visible eyes, and by the large dorsal plates on the fourth segment. The posterior processes of the genital segment are also strongly flattened dorso-ventrally, and the inner margins are curled over dorsally. The lateral areas of the fused second and third segments are separated from those of the cephalothorax and project backward as far as the fourth segment.

ELYTROPHORA HEMIPTERA, new species.

Plate 2, figs. 13–19.

Host and record of specimens.—A single female without egg strings was found in a jar with *Temnopleurus pneumaticus*, a new Echinoid from Nagasaki, Japan, by the Bureau of Fisheries steamer *Albatross.* The nature of this parasite is such that its association with the Echnoid is in all probability accidental.

The specimen has been given Cat. No. 53556, U.S.N.M.

Specific characters of female.—Carapace only moderately convex, a trifle wider than long, evenly rounded except posteriorly, where it is rather squarely truncated. Its upper surface is divided by two longitudinal furrows, curved like parenthesis marks, into three areas. The central area extends from the frontal plates to a transverse groove between the first and second thorax segments. At its anterior end the cephalic area is indicated by a semicircular groove, with the two small eyes just visible near the posterior margin. Each lateral area is divided by a transverse groove into a longer anterior and a shorter posterior portion. The former is a part of the head, the latter of the first thorax segment. The grooves across the lateral areas are considerably in front of the one across the central area.

The second and third thorax segments are fused and lie between the posterior portions of the lateral areas. The second segment has a pair of short curved lateral wings or areas, which lie just inside those belonging to the first segment; the third segment has none.

The fourth or free thorax segment has a pair of dorsal wings, which are fused on the midline at their bases, while the tips are free Furthermore, the basal half of each wing is thickened and opaque, while the terminal half is thinner and semitransparent. They thus resemble closely the wings of many of the Hemiptera, and this has suggested the specific name.

The genital segment is barrel shaped, slightly widened posteriorly, with a broad dorsal lobe at each posterior corner. These lobes or wings are attached to the segment diagonally, are more fully chitinized than the segment itself, and are darker in color.

The abdomen is two-jointed; the joints about the same length and half as wide as the genital segment. The basal joint has lobes at its posterior corners similar to those on the genital segment but smaller. The anal laminae are broad and oval, as long as the last abdomen segment, and nearly half as wide; each is armed with four non-plumose setae.

The frontal plates are wide and project anteriorly, with a shallow median sinus. The first antennae are of the usual pattern, but the second pair are stronger and have a large terminal claw. The first maxillae are close to the base of the mouth tube; each consists of a single spine, long, slender, and strongly curved. The second maxillae are also long and slender, with a single terminal claw. The maxillipeds are stout and their terminal claw is abruptly curved near its tip.

The furca is narrow and slender, the base a little longer than the branches, which are cylindrical, straight, and not very divergent.

All four pairs of legs are biramose. The endopods of the first pair are very short and two-jointed, the exopods much longer and stouter; the basal joint carries a spine at the center of the anterior margin and another similarly located on the posterior margin. The second and third legs are similar to those of other Caligids. The endopod of the fourth legs is much shorter than the exopod and has but two joints, while the exopod has three. The basal joint is somewhat triangular, with a slight projection at the inner posterior corner.

Remarks.—In 1853 Gerstaecker published[3] the description and figures of a new genus and species of parasitic copepods, to which he gave the name *Elytrophora brachyptera*. In his diagnosis of the genus he wrote (p. 58):

Corporis pars thoracica cephalothorace tribusque annulis thoracicis satis distinctis composita, abdomen annulis duobus, appendicibusque duabus terminalibus, setiferis. Dorsum appendicibus foliaceis in mare duabus, quattuor in femina ornatum. . . . Pedum branchialium paria quattuor, quorum tria annulo thoracico primo, altero quartum affixum.

It is difficult to understand how the thoracic segments could be "satis distinctis" if three pairs of swimming legs were attached to the first segment.

In 1863 Krøyer described and figured[4] a new parasitic copepod from the Vienna Museum under the name *Arneus thynni* Kollar, saying that Kollar had given it a museum label as *Dinematura thynni*. Krøyer gave no diagnosis of the genus, but the description and figures leave no doubt that his parasite was the same as the one previously described by Gerstaecker. In addition the name

[3] Troschel's Archiv für Naturgeschichte, vol. 19, pt. 1, p. 58, pl. 3.

[4] Naturhistorisk Tidsskrift, vol. 3, pt. 2, p. 157, pl. 8, fig. 5.

Arneus had been preoccupied by Gistler for a genus of Coleoptera in 1848.

In 1865 Heller, in dealing with the Crustacea of the Novara expedition,[5] showed that both Kollar's museum label and Krøyer's published species were synonyms of Gerstacker's species. He gave a much better and more detailed description, and illustrated it with excellent figures, but did not change the original genus diagnosis.

This was left for T. and A. Scott, who in their excellent work[6] gave the following genus diagnosis:

> First three thoracic segments fused with the head; fourth segment with two dorsal plates. Genital segment lobed posteriorly.

This is the only correct diagnosis hitherto published, and it further stated that all four pairs of legs were biramose; both rami of the first pair two-jointed, of the second and third pairs three-jointed; exopod of the fourth pair three jointed; endopod two jointed.

Although there is only a single female, without egg strings and from a practically unknown host, upon which to found the present species, it substantiates T. and A. Scott's diagnosis in every particular, and adds to the validity of the genus by furnishing a second species.

ACHTHEINUS DENTATUS Wilson.

Plate 3, figs. 20–27.

Host and record of specimens.—Seven adult females were taken by Dr. A. B. Ulrey from the outside surface of a thresher shark, *Atopius vulpes*, in an aquarium at the marine station of the University of Southern California, Venice, California, July 14, 1919. They have been given Cat. No. 53555, U.S.N.M. Another lot consisting of six adult females, two young females, and a male was obtained by J. R. Beck from the outside surface of *Mustelus lunulatus*, 3 miles off Venice, California, July 28, 1913. The male has been isolated with Cat. No. 53558, U.S.N.M.; the females, old and young, have been given Cat. No. 53554, U.S.N.M.

Specific characters of adult female.—In addition to the description given,[7] the following may be added. On the ventral surface of each posterior lobe of the genital segment is a rudimentary fifth leg, consisting of a large papilla tipped with two small spines. A sixth segment is partially separated from the ventral surface of the genital segment at about the beginning of its posterior third. It takes the form of a large lobe on either side, between which and the genital segment opens the vulva. The egg sacks run back dorsal to the abdomen and ventral to the posterior lobes of the genital segment, in a manner similar to that found in the genus *Dinematura*. There

[5] Reise der *Novara*, p. 189.
[6] British Parasite Copepoda 1913, p. 82.
[7] Proc. U. S. Nat. Mus., vol. 39, 1911, p. 630.

is also a pair of very rudimentary legs connected with this sixth segment, which appear as small bifid papillae, one on the outer margin of each lobe at its base. There are no dorsal plates on this segment.

The claw at the tip of the second antennæ is evidently designed to hold securely when it has once been fastened to any part of the host. In two of the specimens from *Mustelus lunulatus* it was barbed as well as toothed, as shown in figure 20.

Internal characters.—The esophagus is short and enters the stomach at its anterior end on the ventral surface. The stomach-intestine starts in the head immediately beneath the mouth and widens gradually backward to the genital segment, then narrows until it reaches the level of the vulvae, where it is suddenly contracted into a short rectum. There is no demarcation between the stomach and intestine.

The ovaries are situated just beneath the dorsal surface of the head, above the anterior end of the stomach; each oviduct starts from the anterior end of the ovary and runs backward along the dorsal surface of the stomach to the genital segment, where it turns sidewise away from the midline and forms an S-loop before reaching the vulva. The cement glands are ventral to the oviduct, their anterior ends curved outward, their posterior ends slightly enlarged; they show distinct segmentation. Their inner surface is attached to the sides of the stomach intestine in two places. The semen receptacles are just inside of the vulvae and are connected across the midline.

Specific characters of young female.—Carapace like that of the adult; lateral portions of the dorsal plates belonging to the second segment visible behind the carapace. These and the dorsal plates of the fourth segment, reduced to tiny semicircles, are confined to the lateral margins of the segments and do not reach the midline. Fifth legs at the posterior corners of the genital segments and visible dorsally, each with a tiny plate inside of it on the dorsal surface of the posterior margin of the segment. No traces of a sixth segment. Abdomen and anal laminae like those of the adult, but entirely free and not covered at all by the genital segment. Anal setae relatively long and strongly curved.

Of the appendages the second antennae are large and stronger than in the adult, and the forceps peg of the maxillipeds is much more complicated, being composed of raised laminae, parallel with one another and having toothed edges (fig. 23). Inside the forceps peg, between it and the base of the claw on the anterior margin, is an accessory peg, also covered with raised laminae. The basipods of the third and fourth legs are smaller than in the adult, but otherwise the legs are the same.

Total length, 3.50 mm. Carapace, 1.80 mm. long, 2 mm. wide; genital segment, 1 mm. wide.

Specific characters of male.—This is the first male of the species to be recorded and may be compared with the male of *Achtheinus pinguis* described on page 236 of volume 42 of these Proceedings.

Carapace horseshoe-shaped, three-sevenths of the entire length and as wide as long, not including the posterior lobes. Frontal plates well defined, narrowed to a point on the median line, but wide at the lateral margins, where each projects in a rounded lobe over the basal joint of the antenna. Lateral areas narrow, with the transverse groove about in the center. Posterior lobes narrow but long, almost reaching the posterior margin of the third segment. Eyes fused on the median line.

Second and third segments fused, the narrow lobes at the posterior corners of the second segment reaching back nearly to the fourth segment. The latter segment is about half the width of the carapace and is much narrowed anteriorly where it joins the third segment, with a slight notch on the posterior margin on either side of the midline and some distance from it. Genital segment barrel-shaped, the posterior corners prominent, and each armed with a single large spine. Abdomen short, triangular, and one-jointed; anal laminae scarcely projecting beyond the tip of the abdomen, each armed with four long plumose setae and a short basal spine on the outer margin.

Of the appendages the second antennae are slender and strongly curved, and lack the row of teeth found in the female. The mouth tube is very long and narrow; the maxillae at its base are slender and each is tipped with a long spine. Each maxilliped has but a single claw, much longer than in the female, but shutting down similarly against a pad.

Color (preserved material) a uniform cinnamon brown, lighter and yellowish in the thinner portions of the carapace.

Total length, 3 mm. Carapace, including the posterior lobes, 2 mm. long., 1.40 mm. wide; genital segment, 0.55 mm. long, and the same width.

Remarks.—This male shows a marked similarity to that of *pinguis* described in the reference given above. It may be distinguished by the fused eyes, the long spines at the posterior corners of the genital segment, the long and narrow mouth tube, and the presence of but a single claw on each maxilliped. This last character shows that the presence of two claws on the maxillipeds, shutting past each other like the blades of a pair of scissors, must be regarded as a specific character of *pinguis* and not as a character common to the genus.

The two hosts here recorded are new for the genus, as well as the species, and it may be added that a single female specimen of the present species was obtained from another new host, the cow shark, *Notorhynchus maculatus* on the California coast in 1911, and has been given Cat. No. 42274, U.S.N.M.

TREBIUS LATIFURCATUS, new species.

Plate 4, figs. 28-34.

Host and record of specimens.—About 25 females were taken by Dr. A. B. Ulrey from the outside surface of four different kinds of fish in the aquarium of the marine station of the University of Southern California at Venice, California, August 4, 1919. The fish which served as hosts were the small sting ray, *Urolophus halleri*, the California sting ray, *Myliobatis californicus*, the marbled ray, *Pteroplatea marmorata*, and the bastard halibut, *Paralichthys californicus.*

One of the females with fully developed egg strings has been selected as the type of the species and has been given Cat. No. 53551, U.S.N.M.

The remaining specimens become paratypes, with Cat. No. 53552, U.S.N.M.

Specific characters of female.—Carapace suborbicular, wider than long, evenly rounded anteriorly, but quite squarely truncated posteriorly. Frontal plates broad and well rounded, their combined length about three-sevenths of the width of the carapace. Transverse grooves dividing the lateral areas placed farther back than in any other species. Eyes fused on the midline and very distinct. Third thorax segment nearly one-half wider than the fourth, but not as long. Fourth segment barrel-shaped, wider than long. Genital segment half the width and two-thirds the length of the carapace, flask-shaped, narrowed into a short neck anteriorly as it joins the fourth segment and posteriorly as it joins the abdomen.

The posterior corners are rounded and armed with spines. The egg strings are about the same width as the abdomen and do not quite reach the tip of the latter; eggs small, 25 to 30 in each string.

Abdomen one-half longer than the genital segment and less than one-third as wide, three-jointed, the terminal joint indistinctly separated from the subterminal. The entire surface of all three joints is sparsely covered with tiny spines. Anal laminae long and narrow, armed with short spines on the outer margin and at the end, but with long capillary setae on the inner margin.

First antennae long and narrow and projecting prominently. Terminal claw of the second antennae as thick as the basal joint and abruptly curved near the tip. Maxillary palp S shaped, with the basal portion slightly enlarged and the tip bluntly rounded. Basal joint of the first maxillae fused with the ventral surface of the head and furnished with a rudimentary exopod in the form of two long spines; endopod broad at the base and then abruptly narrowed to a bifurcate tip, the branches of which are slender and of the same length. Furca small, the rami longer than the basal portion, flattened and considerably enlarged at the tip. All the swimming legs biramose; rami of the first pair two-jointed, the endopod very much reduced; rami of the other pairs three-jointed, the endopod a trifle longer than the exopod. Fifth legs reduced to spines just in front of the base of the egg strings.

Color (preserved material) reddish yellow, deepening into a brown at the centers of the various segments on the dorsal surface.

Total length, 5.25 mm. Carapace, including third thorax segment, 2 mm. long, 2 mm. wide. Genital segment, 1.10 mm. long, 1 mm. wide. Abdomen 1.90 mm. long, 0.30 mm. wide. Egg strings, 1.60 mm. long.

(*latifurcatus*, *latus*, wide and *furcatus*, furnished with a furca.)

Remarks.—On comparing this species with others that have been described it shows most resemblance to Krøyer's species, *caudatus*, but differs from it in the presence of visible eyes, in the shape and relative proportions of the carapace, fourth and genital segments, in the spiny covering of the abdomen, and in the shape and armature of the anal laminae. The species *exilis* has a one-jointed abdomen, while the species *tenuifurcatus* has a two-jointed abdomen, relatively very much narrower. In addition the furca of the present species is radically different from that of any others yet described.

In the letter accompanying these parasites it was stated, "They have become rather serious pests in our aquaria at the marine station." Breeding in the restricted areas of aquaria, where every nauplius is protected from its natural enemies, and is insured a suitable host upon reaching the proper stage in its development, a copepod parasite that ordinarily would remain rare may easily develop into a serious menace. And once established they prove very difficult to exterminate, and furnish another illustration of the old adage, "An ounce of prevention is worth a pound of cure."

BLAKEANUS, new genus.

Generic characters of female.—Head and anterior thorax fused and greatly inflated dorsally after the manner of *Doropygus* and *Buprorus*. Antennae, mouth parts, and four pairs of swimming legs packed closely together in a furrow along the ventral midline. A pair of curved horns at the posterior ventral corners of the inflated portion. Fifth segment abruptly narrowed to normal size. Abdomen distinctly segmented. A pair of external egg strings attached close together on the dorsal surface of the genital segment. Basal joint of first antennae enlarged into a broad setose hand. Second antennae nonprehensile. Maxillipeds with a stout terminal claw. Male unknown.

Type of genus.—*Blakeanus corniger*, monotypic.

(*Blakeanus*, to J. H. Blake, one of the pioneers in the United States Bureau of Fisheries, who made many excellent drawings of parasitic copepods, which have been published in previous papers of this series.)

BLAKEANUS CORNIGER, new species.

Plate 5, figs. 39–43.

Host and record of specimens.—A single adult female with mutilated egg strings was taken from the Ascidian, "*Cynthia carnea*," in Long Island Sound by the United States Bureau of Fisheries in 1874. It is made the type of the new genus and species with Cat. No. 53569, U.S.N.M.

Specific characters of female.—Anterior body wide and very strongly inflated dorsally; posterior body much narrower and tapered. Head and first four thorax segments fused, with only a partial furrow on the dorsal surface between the head and the first segment. Dorsal inflation greatest in the fourth segment, where the height or thickness is about equal to the length and breadth of the entire inflation.

Along the midline of the ventral surface of this cephalothorax is a shallow longitudinal groove, bordered on either side by a low ridge. This ridge is curved around the anterior end of the groove, where it projects obliquely downward and forward. In the groove are arranged in order the antennae, mouth parts, and four pairs of swimming legs, packed closely together. At the posterior ventral corners of the inflated portion are attached a pair of horns, which extend out obliquely sidewise and backward. Each horn is curved into the shape of the letter S and tapers from the base to the tip, which is bluntly rounded.

The fifth thorax segment is abruptly depressed to the level of the genital segment on the dorsal surface, but is considerably extended laterally to the bases of the horns. The groove of demarcation between the fourth and fifth segments is not carried far enough laterally to determine whether the horns belong exclusively to the fifth segment or not, but the indications are that they do.

The genital segment is cylindrical, two-fifths wider than long, with a pair of small rounded projections close together on the midline of the dorsal surface near the anterior margin. Through the tips of these projections the oviducts open into the external egg sacks. The latter are club shaped and considerably swollen posteriorly, and they project a quarter of their length beyond the tip of the abdomen. The eggs are comparatively large and are not arranged regularly in rows. There are about 75 or 80 in each sack.

The abdomen is four jointed, the joints distinctly separated and diminishing slightly in width backward; the first, third, and fourth joints are about the same length, the second is somewhat longer. At the tip of the terminal joint are the anal laminae, which are flattened laterally and curved up dorsally; they are entirely destitute of setae.

The first antennae are peculiar in the enlargement of the basal joint into a wide hand with seven divisions or fingers each tipped with a long and stout seta. The remainder of the antenna is attached like a thumb on the outer margin of the hand instead of the inner. It is not as long as the finger setae and is indistinctly three jointed, each joint armed with short spines. The second antennae are slender, cylindrical, and three jointed, the basal joint very short, the other two much longer and about equal. The terminal joint carries a short claw-like spine at its tip and three small setae on its outer margin.

Since there is but the single specimen it has not been considered advisable to dissect out the mouth parts; but a profile view shows distinctly a short and rather blunt mouth tube, with two pairs of jointed maxillae, tipped with spines. The maxillipeds are large and strong, three jointed; the terminal joint armed with a powerful claw as long as the joint itself and but slightly curved.

There are four pairs of biramose swimming legs, crowded closely together. The rami of the first three pairs are three-jointed, but the endopod of the fourth pair has only two joints.

Color (preserved material), a uniform brownish yellow.

Total length, 4 mm. Inflated cephalothorax, 2.20 mm. long, 2.25 mm. wide, 2.35 mm. thick. Length of egg strings, 2.40 mm.; width, 1 mm.

Remarks.—It is to be regretted that there is but a single specimen of this remarkable copepod. It presents, however, even in a cursory examination so many points of divergence from other genera as to leave no doubt of its validity.

The inflated thorax suggests relationship to *Notodelphys* and *Doropygus*, but the external egg cases offer an effective barrier against even including it in the same family with those genera. The enlarged basal joint of the first antenna finds a counterpart in the genus *Bomolochus*, but is unknown amongst the semiparasites. The maxillipeds are fully as well developed as in any of the fish parasites and must function as powerful organs of prehension.

So far as known no other copepod possesses anything that corresponds to the curved horns found at the posterior corners of the inflated cephalothorax. They are very different in structure and hence probably in function from the processes found in the Chondracanthidae and some of the Lernaeopodidae. Their only counterpart seems to be the horns developed on the cephalothorax of the Lernaeidae, but they can not be intended for the same purpose, since they are not buried in the tissues of the host. And, finally, the anal laminae are peculiar in being naked, laterally flattened and dorsally curved, as in some of the Lernaeopodidae.

We conclude, therefore, that this parasite belongs to the group of Notodelphyoida, but that it can not be located in any of the existing families of that group.

PSEUDOMOLGUS HAWAIIENSIS, new species.

Plate 4, figs. 35–38; plate 5, figs. 44–48; plate 6, figs. 49–57.

Host and record of specimens.—Eight females and three males were obtained by the Bureau of Fisheries steamer *Albatross* at station 3853 during the Hawaiian explorations of 1902. They were ectoparasitic upon a large Tectibranch mollusk belonging to the genus *Pleurobranchus*.

One of the females has been selected as the species type and has been given Cat. No. 53564, U.S.N.M. The other females and the males become paratypes with Cat. No. 53565, U.S.N.M.

Specific characters of female.—Body rather slender, the cephalothorax much wider than the genital segment and abdomen, and oval in outline. The first thorax segment is the widest part of the body and is distinctly separated from the head both by a dorsal groove and by marginal notches. The second segment is nearly as wide as the first; the third and fourth segments are considerably narrower, while the fifth segment is abruptly reduced to less than two-fifths the width of the fourth segment.

Genital segment barrel-shaped, the same length and width, with the vulvae near the center of each lateral margin. Abdomen a little more than half the width and about the same length as the genital segment, three-jointed; joints the same width and length. Anal laminae oblong, each tipped with four setae, two long ones in the center and a short one on either corner. The egg strings are a little less than half the length of the body, are narrowed anteriorly and rather bluntly rounded posteriorly; eggs minute, about 400 in each string.

First antennae slender, a little longer than the cephalon and containing seven distinct joints, the second much longer than any of the others, and all except the basal joint moderately armed with setae. Second antennae much shorter and stouter, four-jointed, the last two joints fused and tipped with three claws of unequal length, jointed near their tip. First maxillae with the mosticatory part bifid, the two lappets long, lashlike, and incurved. These lappets are also denticulate along their outer margin, the two proximal denticles on the principal lappet being much larger than the others. The palp is an irregular short lamella, armed with two tiny setae.

Second maxillae with the terminal process armed with nine stout spines of about equal length along the outer margin. Maxillipeds indistinctly three-jointed, somewhat lamellar, and terminating in a minute sharp point.

First four pairs of legs biramose, each ramus three-jointed; basal joint of the exopods denticulate on the outer margin; terminal joint of the first endopod with one, of the second endopod with three, and of the third and fourth endopods with four spines. All the spines on both endpods and exopods are dagger-shaped.

Color (preserved material), a uniform cinnamon brown.

Total length, 4 mm., exclusive of anal setae. Width of first thorax segment, 2 mm.; length of egg strings, 2 mm.

Specific characters of male.—Body smaller and narrower than in the female; abdomen relatively longer and wider and four-jointed, the penultimate joint the shortest. Anal laminae each terminated by three unequal setae, the inner one the longest and the outer one the shortest, the relative lengths being, respectively, 14, 9, 3. The genital segment is considerably enlarged, and shows on the ventral surface at the posterior corners the rudiments of a sixth pair of legs.

The fifth legs are much wider than in the female, and each carries a large seta near the distal end of the outer margin, in addition to the three terminal ones, all four about the same length.

The first antennae are narrower than those of the female and more abundantly supplied with setae. The maxillipeds are very strong; the second joint is coarsely toothed along the distal half of the inner margin; the terminal claw is longer than the second joint and strongly curved.

Color (preserved material), a uniform cinnamon brown.

Total length, 2.85 mm., exclusive of anal setae. Greatest width, 1.25 mm.

(*hawaiiensis*, a native of the Hawaiian Islands.)

Remarks.—This species agrees so fully with the two described by Sars [8] that it must be referred to the same genus.

The distinguishing specific characters are the large size, the position of the articulation in the terminal claws of the second antennae. the heavier armature of the second maxillae, and the relatively shorter and thicker anal laminae. Neither of Sars' species was positively parasitic, although *leptostylis* might well have been so. The young females and adult male, which he recorded as "picked up from the bottom residue of a large collecting bottle containing various animals," could easily have been ectoparasites on one of those animals and have been washed off into the bottle. The present species is definitely known to be parasitic since all the specimens were taken directly from its host.

[8] Copepoda of Norway, vol. 6, Copepoda Cyclopoida, pt. 13, 1918, pp. 182 and 184.

PSEUDOMOLGUS, species.

Host and record of specimens.—A single badly mutilated specimen of an adult *Pseudomolgus* female with egg strings was obtained from a Tectibranch mollusk at Laguna Beach, California, August 8, 1918, has been given Cat. No. 53566, U.S.N.M. In all probability this represents a new species of the genus, but owing to the condition of the specimen it does not seem advisable to attempt establishing the species.

It is included here to show that the Tectibranchs of the California coast are infested as well as those of the Hawaiian Islands, and search would probably reveal copepods enough to establish this species and perhaps others.

MODIOLICOLA JAMAICENCIS, new species.

Plate 7, figs. 58–65.

Host and record of specimens.—Five females, three of which carried egg strings, were obtained from black ascidians common upon the mangrove roots on the Bogue Islands, Montego Bay, Jamaica. A single specimen has been selected as the type female and has been given Cat. No. 53567, U.S.N.M. The others become paratypes with Cat. No. 53568, U.S.N.M.

Specific characters of female.—Body elliptical, strongly narrowed anteriorly and posteriorly, nearly as wide as long. Cephalon not very distinctly separated from the first thorax segment; the latter the widest part of the body. Second, third, and fourth segments diminishing rapidly in width; fifth segment abruptly narrowed to half the width of the fourth. Genital segment considerably wider and longer than the fifth segment; the openings of the oviducts near its posterior margin and widely separated. Abdomen four-jointed, the joints diminishing slightly in size from in front backward. Anal laminae as wide as long, each armed with five plumose setae; numbering the setæ from within outward their lengths come in the following order, beginning with the longest, 2, 3, 1, 4, 5.

The first antennae are seven-jointed, the second joint the longest, and all the joints heavily armed with setae; those of the second, fourth, and seventh joints are especially long and numerous. The second antennae are three jointed, the three joints about the same length. The third or terminal joint is tipped with two stout curved claws, with two setæ on the outer and two on the inner margin. The basal and second joint each carry a short seta on their inner margin. The masticatory lappet of the maxillae is elongate and densely hairy, and its base is armed with two setae. The maxilliped is without any armature except a minute spine on the inner margin near the tip. The terminal joint is short, narrowed beyond the center, and bluntly rounded at the tip. There are four pairs of biramose swimming legs, each ramus three-jointed, the endopod of the fourth legs being shorter and narrower. The spines on the legs are flattened dorso-ventrally and are shaped like broad daggers. The egg strings are a little more than half the total length of the body, narrowed anteriorly and bluntly rounded posteriorly. The eggs are large and are not arranged in definite rows, with 75 to 80 in each string.

Color (preserved material), a uniform grayish brown.

Total length, exclusive of anal setae, 1 mm. Width of first thorax segment, 0.55 mm. Length of egg strings, 0.55 mm. Length of anal setae, 0.21 mm.

(*jamaicensis*, a native of Jamaica).

Remarks.—The genus *Modiolicola* was established by Aurivillius for a copepod which he had found inside the common European mussel, *Modiolus vulgaris*, and occasionally in the oyster, *Mytilus edulis*. Canu afterwards recorded another species under the name *Modiolicola inermis*.

T. Scott and Sars have both given supplementary descriptions and figures of the original type species. The present specimens agree so well with those descriptions as to leave no doubt that they belong to the same genus. The endopod of the fourth legs is distinctly three-jointed; the terminal joint long and narrow and tipped with two flattened spines. The second antennae are tipped with two curved claws, with two long setae outside of them; and the last joint of the maxilliped in the female is small, unarmed, and very bluntly rounded. These are the type characters of the genus and yet there are enough differences in the present species to distinguish them from those thus far described.

The most noticeable characters are the short and stout anal laminae, with their long setae and the flattened daggerlike spines on the swimming legs. Both of the previous species of the genus were found in mollusks, while the present specimens came from an ascidian. But it is worthy of note that there are numerous mussels on the mangrove roots, interspersed among the ascidians, and it would be quite possible for free-swimming copepods to pass from one to the other. It is to be regretted that the mussels were not also examined for copepods.

EXPLANATION OF PLATES.

PLATE 1.

Lepeophtheirus longipes and *Alebion fuscus*.—Fig. 1. Dorsal view of immature female of *L. longipes*. Fig. 2. Dorsal view of male. Fig. 3. Second antenna of male. Fig. 4. First maxilla. Fig. 5. Maxillary palp. Fig. 6. Second antenna of *Alebion fuscus* female. Fig. 7. Second maxilla. Fig. 8. Maxilliped. Figs. 9 to 11. First, second, and third swimming legs.

PLATE 2.

Alebion fuscus and *Elytrophora hemiptera*.—Fig. 12. Dorsal view of *Alebion fuscus* female. Fig. 13. Dorsal view of *Elytrophora hemiptera* female. Fig. 14. Second antenna. Fig. 15. First maxilla. Fig. 16. Furca. Figs. 17 to 19. First, second, and fourth swimming legs.

PLATE 3.

Achtheinus dentatus.—Fig. 20. Second antenna of adult female. Fig. 21. Ventral surface of genital, showing partial separation of sixth, segment (*sg*), sixth legs (*sp*), abdomen (*a*), fifth legs (*lm*), cement glands (*cg*), and oviducts (*od*). Fig. 22. Dorsal view of immature female, showing reproductive system. Fig. 23. Maxilliped. Fig. 24. Accessory laminae on maxilliped. Fig. 25. Dorsal view of male. Fig. 26. Mouth tube and maxillae. Fig. 27. Second antenna.

PLATE 4.

Trebius latifurcatus and *Pseudomolgus hawaiiensis*.—Fig. 28. Dorsal view of *Trebius latifurcatus* female. Figs. 29 to 32. First, second, third, and fourth legs. Fig. 33. Second antenna, maxilla, and maxillary palp. Fig. 34. Furca. Figs. 35 to 38. First, second, third, and fourth swimming legs of *Pseudomolgus hawaiiensis* female.

PLATE 5.

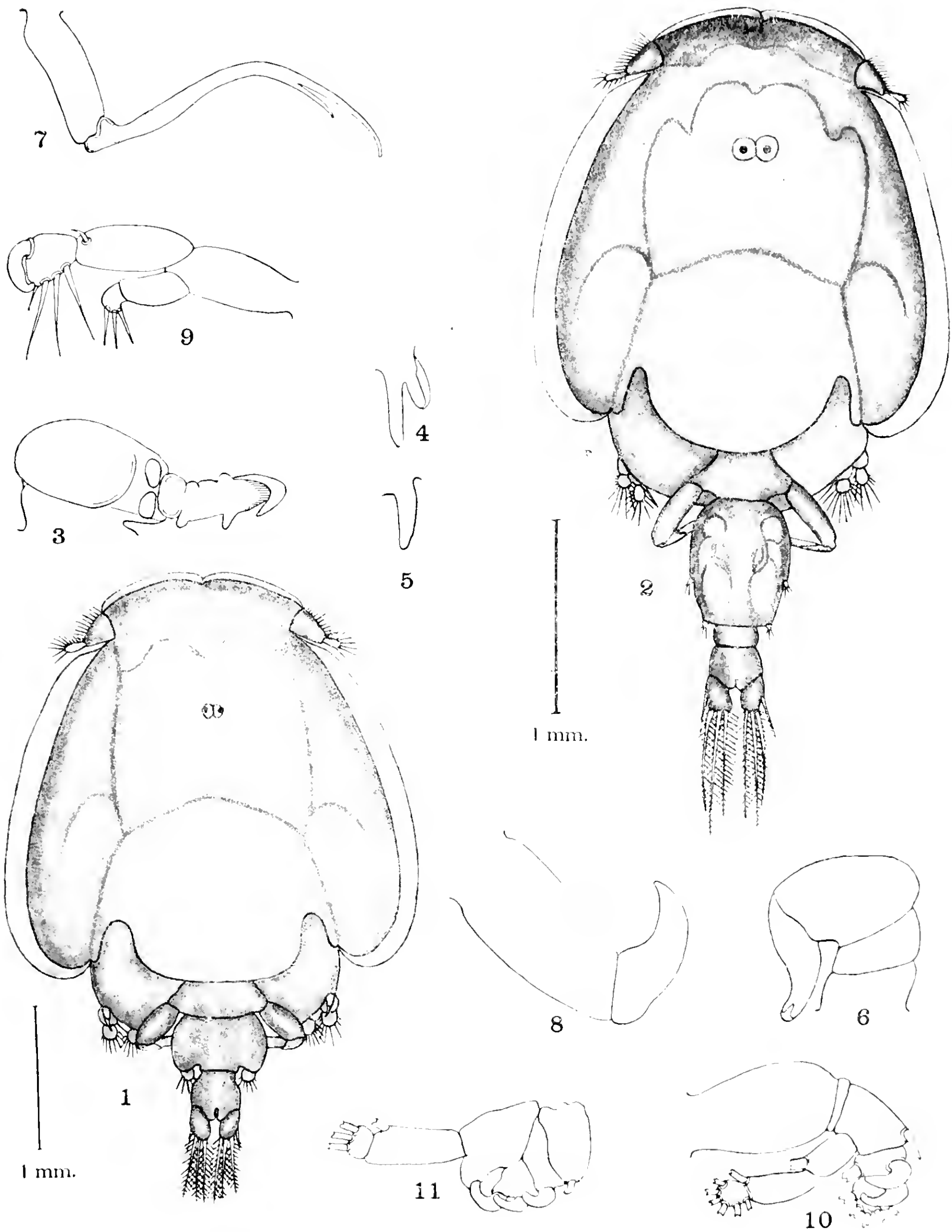
Blakeanus corniger and *Pseudomolgus hawaiiensis*.—Fig. 39. Side view of *Blakeanus corniger* female. Fig. 40. First antenna. Fig. 41. Second antenna. Fig. 42. Maxilliped. Fig. 43. Fourth swimming legs. Fig. 44. First antenna of *Pseudomolgus hawaiiensis* male. Fig. 45. First antenna of female. Fig. 46. Second antenna of female. Figs. 47 and 48. Third and fourth swimming legs of male.

PLATE 6.

Pseudomolgus hawaiiensis.—Fig. 49. Dorsal view of female. Fig. 50. Dorsal view of male. Fig. 51. Second antenna of male. Fig. 52. First maxilla. Fig. 53. second maxilla. Fig. 54. Maxilliped of male. Fig. 55. Ventral surface of genital segment of male. Fig. 56. Fifth leg of male. Fig. 57. Fifth leg of female.

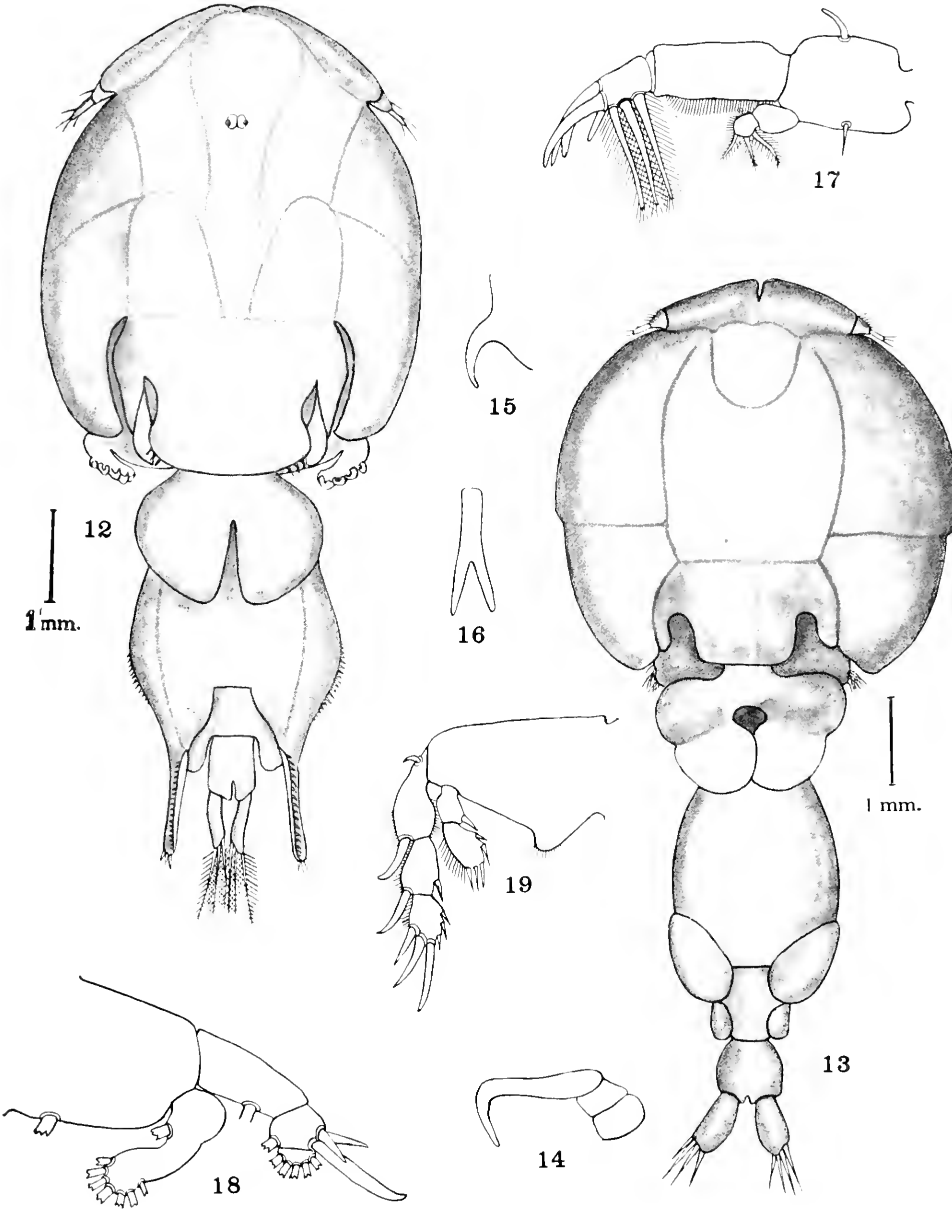
PLATE 7.

Modiolicola jamaicensis.—Fig. 58. Dorsal view of female. Fig. 59. First antenna. Fig. 60. Second antenna. Fig. 61. Second maxilla. Fig. 62. Maxilliped. Figs. 63 to 65. Third, fourth, and fifth swimming legs.



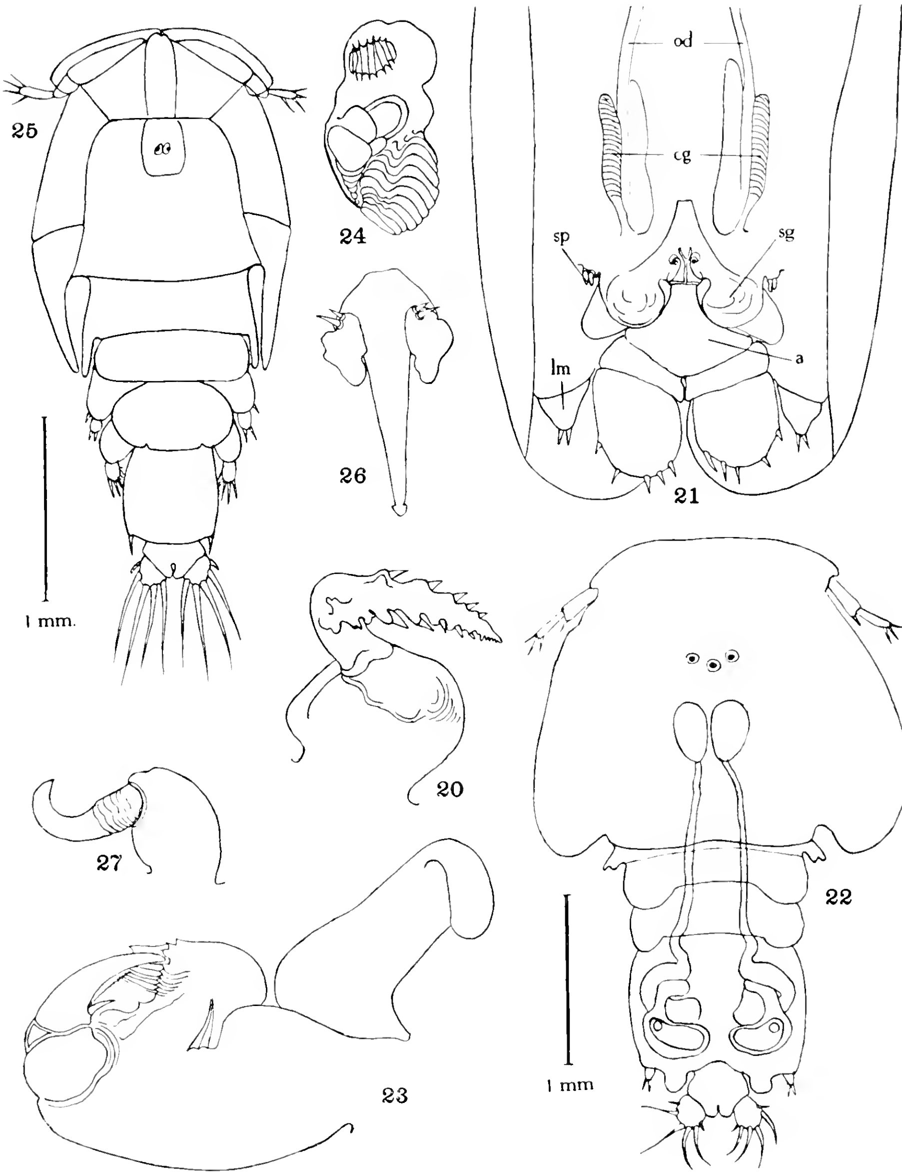
LEPEOPHTHEIRUS LONGIPES AND ALEBION FUSCUS.

FOR EXPLANATION OF PLATE SEE PAGE 17.



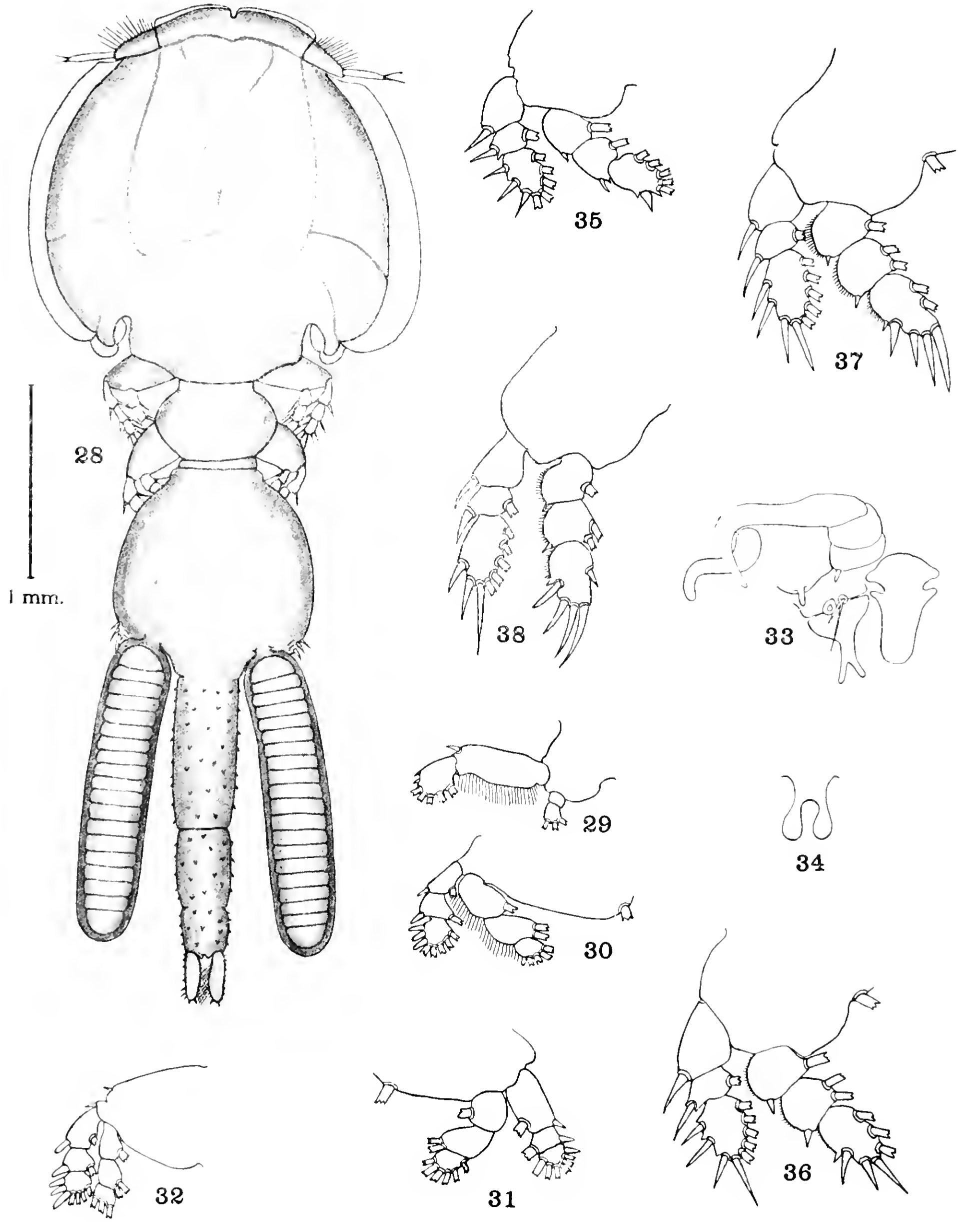
ALEBION FUSCUS AND ELYTROPHORA HEMIPTERA.

FOR EXPLANATION OF PLATE SEE PAGE 17.



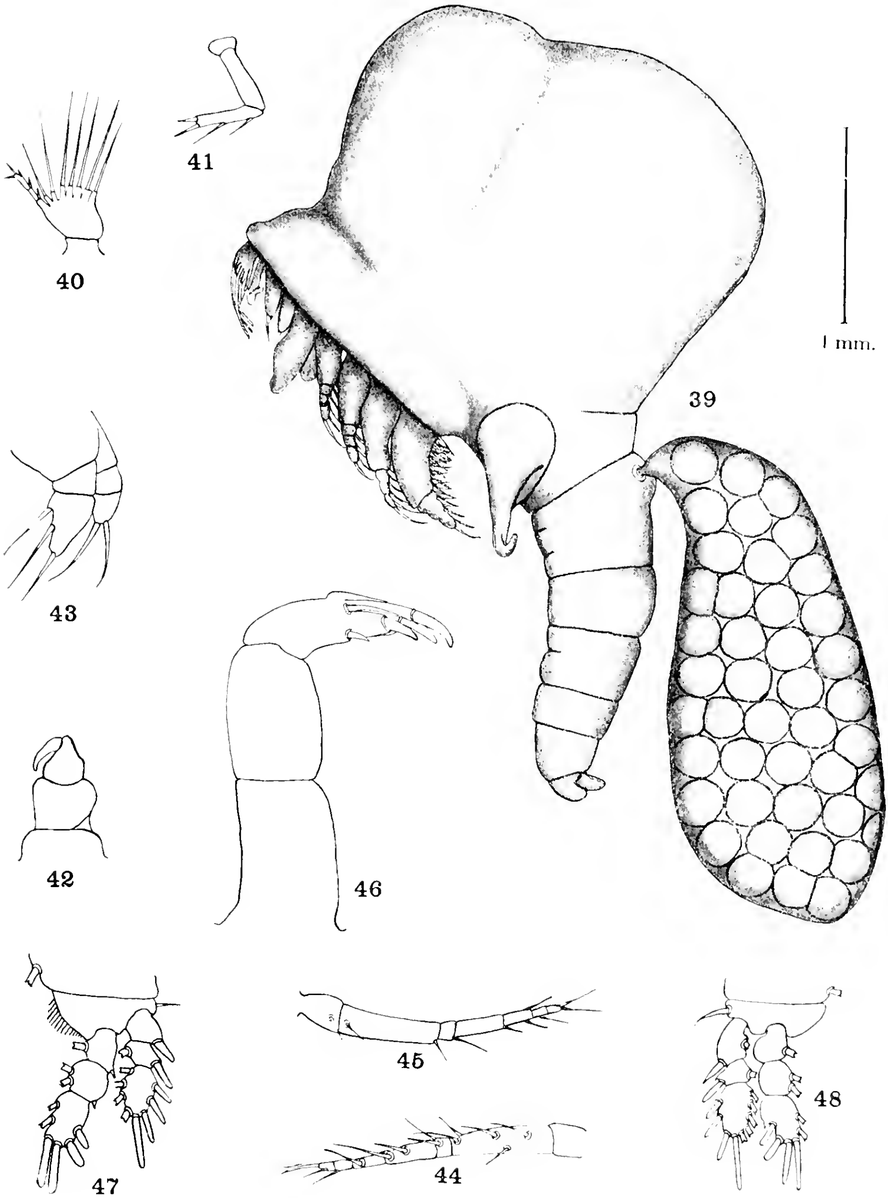
MALE AND FEMALE OF ACHTHEINUS DENTATUS.

FOR EXPLANATION OF PLATE SEE PAGE 17.



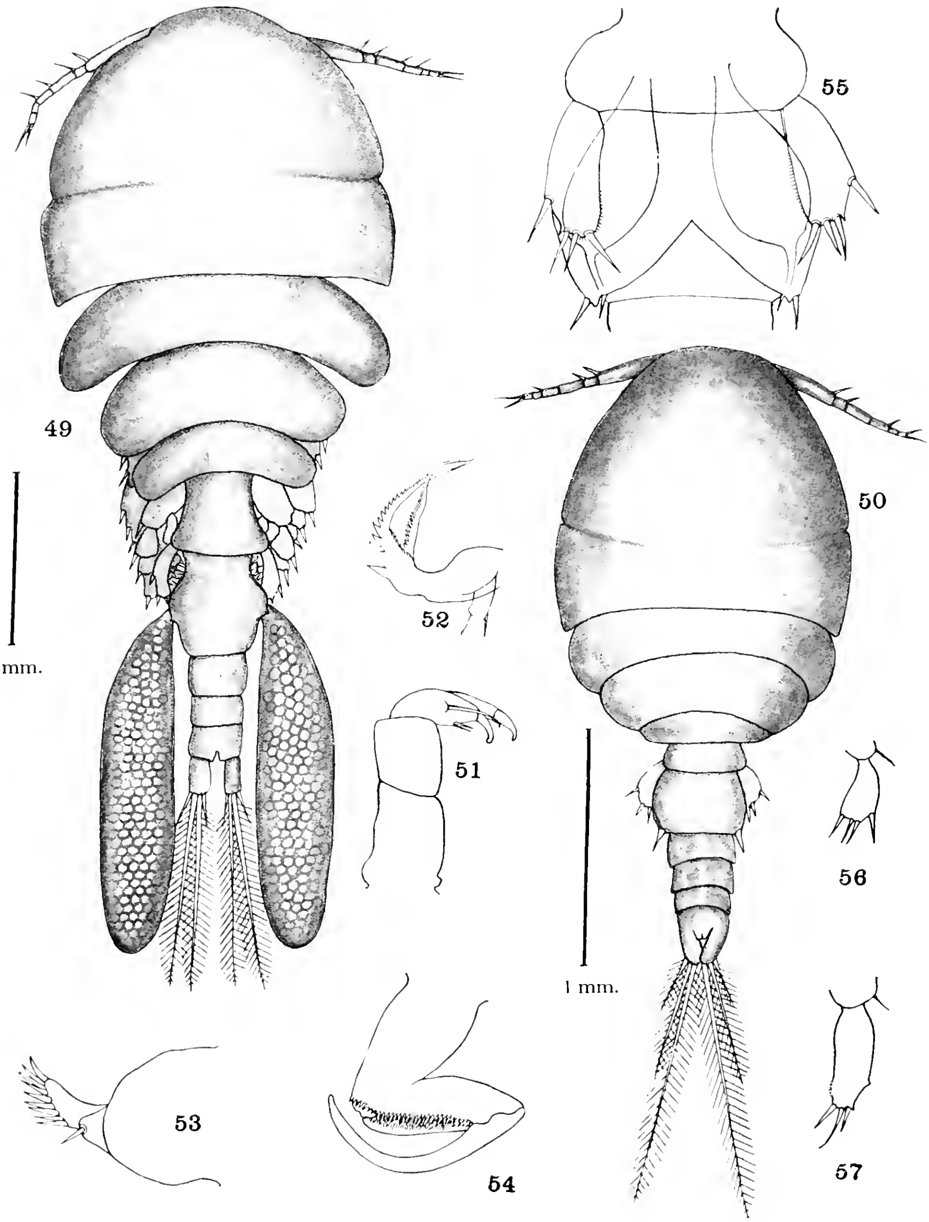
TREBIUS LATIFURCATUS AND PSEUDOMOLGUS HAWAIIENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 17.



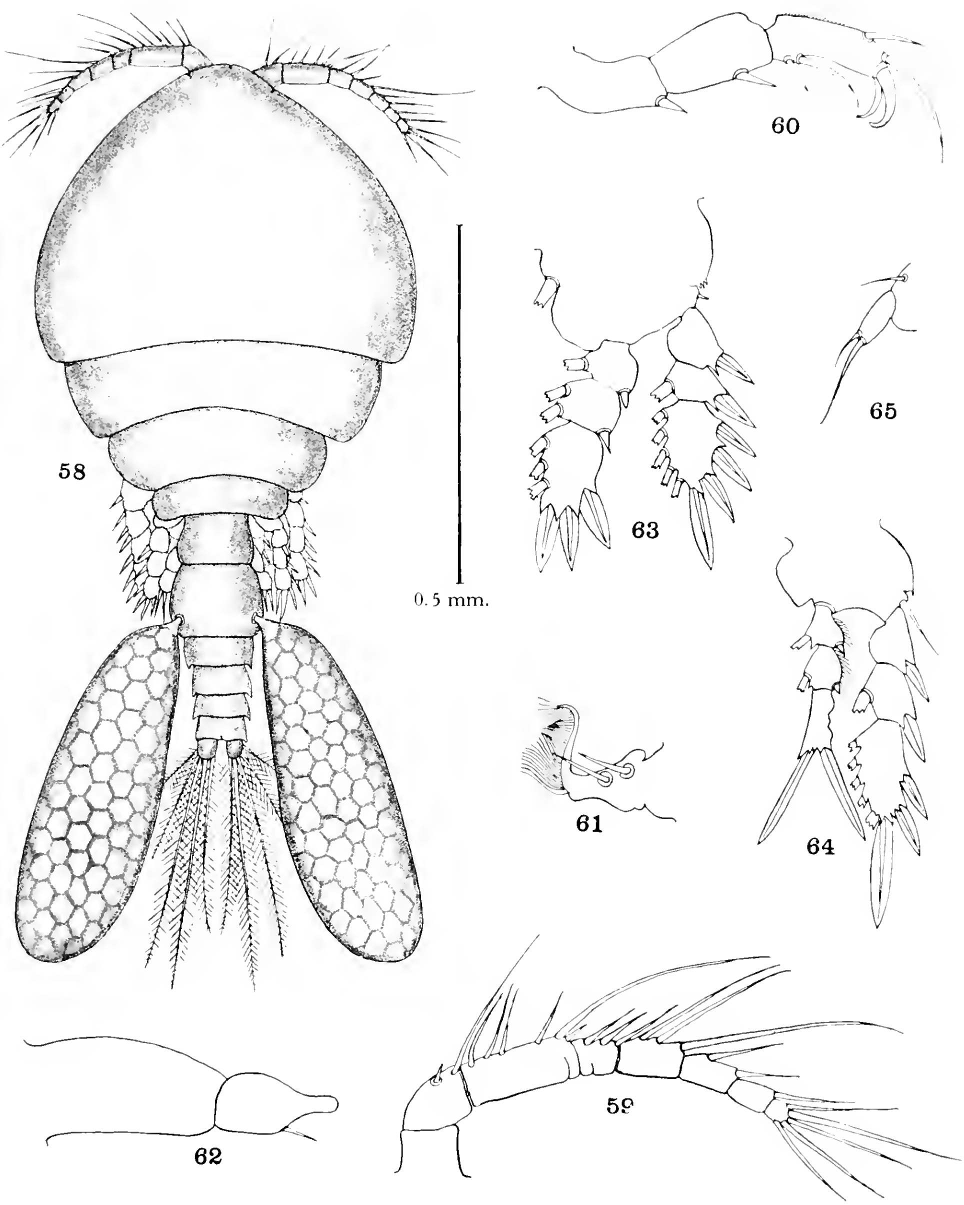
BLAKEANUS CORNIGER AND PSEUDOMOLGUS HAWAIIENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 17.



MALE AND FEMALE OF PSEUDOMOLGUS HAWAIIENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 17.



FEMALE OF MODIOLICOLA JAMAICENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 17.

SOME FOSSIL FISH SCALES FROM PERU.

By T. D. A. Cockerell,
Of the University of Colorado, Boulder.

Some time ago Messrs. K. C. Heald and K. F. Mather collected some fossil fish scales at Huacho, Peru. The locality is on the coast, about 70 miles north of Callao. As it was desirable to determine the age of the rocks if possible, Dr. T. W. Stanton forwarded the material to me for identification.

The scales are well preserved and apparently represent a single species belonging to the family Characidae (or Characinidae). They do not agree with any modern genus known to me but are related in a general way to several. The deposit is doubtless fresh water and of Tertiary age, but beyond this it is unsafe to make any positive statement. The general similarity of the scales to those of modern genera and the high degree of specialization of structure would suggest rather late Tertiary, possibly Miocene. Berry [1] has described a series of Miocene plants from northern Peru.

CHARACILEPIS, new genus.

Scales small, subquadrate to transversely elongate; apical field broadly sculptureless, without radii, circuli, or ctenoid structures; basal field with broadly spaced transverse or arched circuli (sometimes angulate in middle), but no radii; between the basal and apical fields a variable area (sometimes only narrowly developed, and at sides) of transverse circuli set very close together, and quite independent of the other series. Lateral line very distinct.

Type of the genus.—Characilepis tripartitus, new species.

CHARACILEPIS TRIPARTITUS, new species.

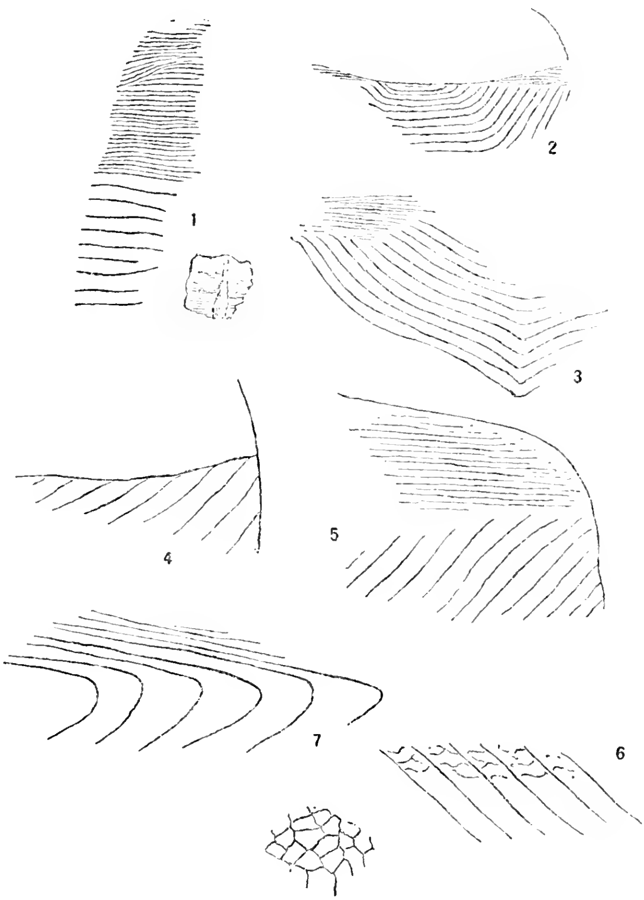
Scales, 3 to 4 mm. broad, polished.

Huacho, Peru.

A lateral line scale (fig. 1) may be considered the type. The scale shown in figure 2 illustrates the sharp limitation of the sculptured area, as in the modern *Bryconamericus*. In the marine genus *Hyporhamphus* (fig. 7) there are two sets of circuli, broadly and narrowly spaced, but one series is directly continuous into the other, as the

[1] Proc. U. S. Nat. Mus., vol. 55, 1919, p. 279.

figure shows. In the Characidae the two sets have become entirely distinct, as is shown in *Acanthocharax microlepis* (fig. 5) and in *Characilepis*. In *Bryconamericus* (fig. 4) the condition resembles that of the *Characilepis* scale in figure 2, except that the transverse closely placed circuli have disappeared. In *Charax gibbosus* (fig. 6)



FIGS. 1-7.—LATERAL LINE SCALE OF CHARACILEPIS TRIPARTITUS NEW SPECIES; TYPE. THE ENLARGED DRAWING SHOWS THE SCULPTURE. 2, SCALE OF CHARACILEPIS TRIPARTITUS, NEW SPECIES. 3, SCALE OF CHARACILEPIS TRIPARTITUS, NEW SPECIES. 4, PART OF SCALE OF BRYCONAMERICUS HYPHESSUS EIGENMANN. 5, PART OF SCALE OF ACANTHOCHARAX MICROLEPIS EIGENMANN. 6, DETAILS OF SCULPTURE IN SCALE OF CHARAX GIBBOSUS (LINNÆUS). 7, PART OF SCALE OF HYPORHAMPHUS UNIFASCIATUS (RANZANI).

there is a peculiar broken transverse sculpture along the line limiting the widely spaced circuli, and near the nucleus this sometimes takes the form of a network. It seems to be derived from the other set of circuli.

Holotype and paratypes.—Cat. Nos. 9615, 9616, 9617, U.S.N.M.

A PALM NUT FROM THE MIOCENE OF THE CANAL ZONE.

By Edward W. Berry,
Of the Johns Hopkins University, Baltimore, Maryland.

The fossil plants collected during the geological work by T. W. Vaughan and others in the Canal Zone have been described recently by M. A. Howe [1] and the writer.[2] Subsequently I have received from the United States National Museum several small and exceedingly fragmentary collections that contain nothing noteworthy except a new and fairly well characterized palm fruit. This comes from locality 5845, which is 1½ miles northeast of Gatun and overlooking the Gatun Locks, and seems worthy of special comment. The geological horizon is the Gatun formation, which comprises the latest pre-Pliocene sediments recognized in the Canal Zone, and in terms of the European section, as determined by Vaughan, is Burdigalian or Helvetian in age.[3]

It has been customary among paleobotanists to refer fossil palm fruits to the genus *Palmocarpon* Lesquereux unless they possessed very obvious relationships with existing genera as in the case of the Eocene forms referred to the genus *Nipadites*. In the case of the present form I am constrained to depart from this custom since the fossil greatly resembles the fruits of the tribe Iriarteae, and refer the new species to the genus *Iriartites* [4], the type of which is *Iriartites tumbezensis* Berry,[5] a feather palm described recently from the Miocene of the north Peruvian coast.

IRIARTITES VAUGHANI, new species.

Nut an unsymmetrical prolate spheroid in general form, rounded proximad and slightly narrowed distad, slightly over 4 cm. in length, 3.3 cm. in maximum width, and 2.8 cm. in maximum thickness. Hilum large, eccentric, about 5 mm. in diameter. Surface roughened by a covering of narrow flat elongated overlapping fibers exactly as

[1] Howe, M. A. On some fossil and recent Lithothamnieae of the Panama Canal Zone. Bull. U. S. Nat. Mus. 103, pp. 1–13, pls. 1–11. 1919.

[2] Berry, E. W. The fossil higher plants from the Canal Zone. Idem. pp. 15–44, pls. 12–18.

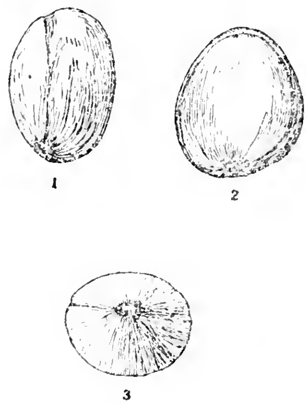
[3] See Vaughan, Idem. Table facing page 595.

[4] Berry, E. W. Proc. U. S. Nat. Mus., vol. 55, p. 285, 1919.

[5] Idem, pl. 14.

in the fruits of existing species of *Iriartea*, *Astrocaryum*, etc. Species named in honor of T. Wayland Vaughan as a slight tribute of appreciation of his work in the American tropics.

The present species was first compared with the nuts of *Astrocaryum* Meyer, a genus with numerous existing species ranging from Mexico to southern Brazil, but in this genus the nuts are more



FIGS. 1-3, IRIARTITES VAUGHANI BERRY. GATUN FORMATION, 1½ MILES NORTHEAST OF GATUN, CANAL ZONE. 1, 2, LATERAL VIEWS; 3, VIEW FROM BELOW, SHOWING LARGE HILUM. ½ NAT. SIZE.

symmetrical and the three perforations are usually obvious. The genus *Iriartea* of Ruiz and Pavon, whose fruits are very close to the fossil, contains over a dozen, perhaps more, not very well understood existing species, essentially South American but ranging from Costa Rica southeastward through Colombia and the basins of the Orinoco and Amazon and along the eastern lower slopes of the Andes to Bolivia.

Type.—Cat. No. 35621, U.S.N.M.

NOTES ON SOME WESTERN FLUVIAL FISHES DESCRIBED BY CHARLES GIRARD IN 1856.

By John Otterbein Snyder,

Of Stanford University, California.

In the course of a recent investigation of the fishes of the Bonneville drainage system of the Great Basin, pursued under the authority of the United States Bureau of Fisheries, it became necessary to attempt an identification of several species found there with those described by early writers on western ichthyology. The greatest difficulty was encountered in the descriptions and names published by Charles Girard. These were based on a small collection [1] made by the naturalists of an exploring party directed by Capt. J. W. Gunnison, United States Army.

An examination of available data associated with the collection has led to certain facts and inferences that appear to be worth recording at this time.

Early in 1853 Capt. Gunnison organized an expedition the purpose of which was to explore certain parts of a proposed route for a railroad from the Mississippi River to the Pacific Ocean. The War Department directed a survey of the pass through the Rocky Mountains in the vicinity of the headwaters of the Rio del Norte, by way of the Huerfano River and Coochetopa, or some other eligible pass, into the region of Grand and Green Rivers and westerly to the Vegas de Santa Clara and Nicolette River of the Great Basin, and thence northward to the vicinity of Lake Utah on a return route. The party was a large one, including members competent to "make researches in those collateral branches of science which effect the solution of the question of location, construction, and support of a railway communication across the continent." Lieut. E. G. Beckwith was second in command, Mr. F. Creutzfeldt was the botanist, while Mr. J. A. Snyder, who is mentioned as a young assistant topographer, collected some specimens.

[1] What now remains of this collection is preserved in the United States National Museum, and the specimens that were collected west of the continental divide were examined by the writer in 1914.

A rendezvous was effected near Westport, Missouri, and a start made on June 23, 1853. An arduous, interesting, and at times exciting journey was accomplished, the expedition arriving at Salt Lake City on November 8 of the same year. Just after entering the valley of Great Salt Lake Capt. Gunnison, Mr. Creutzfeldt, and several other members of the party lost their lives at the hands of marauding Indians. Lieut. Beckwith then assumed command, and it was he who wrote the journal and prepared or directed the preparation of maps and reports that have since been published. After wintering at Salt Lake and making various observations in the region the party proceeded westward to the Pacific slope.

While the expedition may now be regarded as a mere incident in western exploration and travel, it accomplished something of scientific value, much of which was based upon the work of the naturalist. However, the published narrative shows almost no interest in his activities, while authors of papers relating to his collections accord him no recognition, one of them even being careless about the spelling of his name.

Fishes representing 19 species were collected. Eighteen of these received new names, many of which appeared in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1856. They were redescribed, with additional notes, in the tenth volume of the Pacific Railroad Surveys. For easy reference the more important data recorded by Girard, together with the generally accepted identifications of recent authors, are here tabulated. An examination of the table will serve to show something of the faulty condition of the records relating to the specimens.

Species.	Cat. No.	Locality.	Date.	Collector.	Synonymy (Jordan and Evermann).	Distribution (Jordan and Evermann).
Salar virginalis[1]	539	Utah Creek, tributary to Rio Grande del Norte.	1854	Mr. Creutzfeldt	*Salmo mykis virginalis* (Girard).	Utah Lake, Bonneville.
Siboma atraria[1]	236	Spring, Utah district near the desert.	1853	do	*Leuciscus lineatus* (Girard)	Bonneville and Snake River.
Acomus generosus[1]	256	Cottonwood Creek, Utah.	1854	Lieutenant Beckwith.	*Pantosteus generosus* (Girard)	Bonneville.
Argyreus dulcis[1]	53	do	1854	Mr. Creutzfeldt	*Rhinichthys cataractae dulcis* (Girard).	Mississippi and Rio Grande.
Cyprinella gunnisoni[1]	139	do	1854	do	*Notropis bubalinus* (Baird and Girard).	Mississippi.
Cyprinella lugubris[1]	141	do	1853	do	*Notropis macrostomus* (Girard)?	Mississippi and Rio Grande.
Cyprinella ludibunda[1]	132	do	1853	do	*Notropis ludibundus* (Girard)	Unknown; probably Indian Territory.
Bryttus humilis	429	do	1853	Lieutenant Beckwith.	*Lepomis humilis* (Girard)	Mississippi.
Pimephales maculosus[1]	153	Sluice of Arkansas River.	1853	do	*Pimephales promelas maculosus* (Girard).	Do.
Hybognathus placitus[1]	89	Sluice of Arkansas River near Fort Makee.	1853	do	*Hybognathus nuchalis* Agassiz	Do.
Cyprinella beckwithi[1]	135	do	1854	Mr. Creutzfeld	*Notropis bubalinus* (Baird and Girard).	Do.
Moniana tristis[1]	93	Unknown	1854	do	*Notropis proserpina* (Girard)?	Rio Grande.
Gila elegans	249	do	1853	do	*Gila elegans* (Baird and Girard).	Colorado.
Tigoma egregia[1]	226	do	1854	do	*Leuciscus egregius* (Girard)	Lahontan.
Tigoma lineata[1]	229	do	1854	do	*Leuciscus lineatus* (Girard)	Bonneville.
Tigoma gracilis[1]	230	do	1854	do	*Leuciscus aliciae* (Jouy)	Do.
Ptychocheilus vorax[1]	202	do	1854	do	*Gila robusta* (Baird and Girard).	Colorado.
Algansea obesa[1]	194	do	1853	do	*Rutilus symmetricus* (Baird and Girard).	Bonneville to Sacramento-San Joaquin.
Tigoma humboldti[1]	225	Humboldt River		Mr. Creutzfeld (orig. descr.).	*Leuciscus humboldti* (Girard)	Lahontan.

[1] Types.

In describing *Salmo virginalis* Girard [2] writes:

Specimens collected by the party under Lieut. Beckwith in Utah Creek, and at Sangre de Cristo Pass, upper waters of the Rio Grande del Norte (Rio Bravo).

According to the narrative the party reached Sangre de Cristo Creek, a tributary of the Rio Grande, August 13, 1853, and, passing down the stream, camped for 10 days on Utah Creek ("Ute Cr." of some maps), when trout and perhaps other fishes were collected. Through some oversight Jordan and Evermann [3] have used the name *S. virginalis* for the trout of Utah Lake and the Bonneville basin generally, and also Evermann and Kendall [4] have accepted *S. spilurus* for the Rio Grande trout, not following Cope,[5] however, for they regard *S. virginalis* as synonymous with *S. spilurus*. It now appears that the Rio Grande trout should be known as *S. virginalis* (ignoring Cope's contention that two species inhabit the Sangre de Cristo and Utah creeks), while Suckley's name, *S. utah*, is restored to the Bonneville form.

Siboma atraria is said to have been taken from a spring in the desert of Utah. The United States National Museum records the locality as "near 38° latitude." The type specimen, No. 236, is somewhat over 6 inches long, the caudal fin being broken. There are 8 dorsal and 8 anal rays, 56 scales in the lateral series, 30 between occiput and dorsal, 12 above the lateral line. The head measures 0.28 of the length; depth, 0.28; depth caudal peduncle, 0. 11; snout to occiput, 0.22; snout to dorsal, 0.54; snout to ventral, 0.56. The gillrakers, numbering 11, are short and pointed. The species represented by this specimen is widely distributed in the Bonneville basin, where it abounds in favorable places, frequently inhabiting springs and spring pools. It is very probable that the type came from Fish Springs in the southern part of Tooele County, Utah, as will appear.

The narrative and maps offer no evidence that Creutzfeldt collected the type of this species, but it seems that it was secured in 1854, when the party again faced the west after wintering at Salt Lake. On May 13 they reached an oasis where were "fine large springs of fresh water, sending out considerable streams on the plain. They were surrounded by large meadows of excellent grass. These springs are filled with small fish, and the Indians therefore give them the name of Pangwitch or Fish Springs." A stop of two or three days was made at this place, providing time for collecting and preserving specimens. These springs with their numerous fishes still remain—the center of an oasis in a forbidding desert—and they may without much doubt be regarded as the type locality of *S. atraria*.

The species has been regarded as synonymous with *Tigoma lineata* Girard, but the present writer finds no facts in support of that iden-

[2] Proc. Acad. Nat. Sci. Phila., 1856, p. 220.
[3] Fishes N. and M. America, p. 495.
[4] Bull. U. S. Fish Com., for 1892, p. 106.
[5] Hayden's Geological Survey Montana, 1871, p. 470.

tification. The type of *T. lineata* is lost and the locality in which it was found is unknown. One pharyngeal arch is preserved (Cat. No. 2783, U.S.N.M.). The teeth are in two rows, 2–4, and they closely resemble those of *R. hydrophlox*. Girard writes of *T. lineata:* "The general aspect is elongated, the body being subfusiform, anteriorly thickish, and quite tapering posteriorly." Also the same author remarks of his *T. egregia:* "By its general aspect this species resembles *T. lineata.*" It is quite clear, therefore, that *T. lineata* was a fish of slender, graceful form like *R. egregius* or *R. hydrophlox*, while *S. atraria* is a deep-bodied, thick-tailed form, with a comparatively arge head. The name *Richardsonius atrarius* should, therefore, stand for the common chub of the Bonneville basin, where it is very generally distributed, inhabiting both lakes and streams, and where it is the species which was apparently able to hold out longest in bodies of water which have dwindled during the slow desiccation which followed the Quaternary period.

Acomus generosus was said to have been taken in the Bonneville basin, and the writer of the present paper unwittingly accepted the statement in a recent brief review [6] of the genus to which it is supposed to belong. In the description of the species, Girard [6] gives the locality "Cottonwood Creek, an affluent of the Great Salt Lake of Utah." In the table presented on a previous page it will be noted that other species from the same locality have been identified with Mississippi basin forms, and no one would now presume to assign species of *Notropis* or *Lepomis* to the Great Basin. Clearly, then, in the case of at least four or possibly five nominal species a mistake was made in the locality. There is evidence that at four places in Beckwith's travels a Cottonwood Creek was approached. Two of these creeks are named and located in his maps of the route and two were apparently unknown by that name. The banks of the first one encountered furnished a camp site for two nights and a day early in July. This creek is a tributary of the Arkansas, and at the point crossed by the old Sante Fe trail is no doubt the type locality of *A. dulcis, C. gunnisoni, C. lugubris,* and *C. ludibunda.* At this place it would also be possible to collect specimens of *B. humilis* and *A. dulcis.* The second Cottonwood Creek noted by Beckwith was passed on the 8th of November, 1853, after camping there on the previous night. The party was then without a naturalist, and it was quite probable that no collecting was done. This stream is Girard's affluent of the Great Salt Lake of Utah, and, as is now evident, an impossible locality for the species which he assigned to it. Returning to *Acomus generosus,* the types are two specimens measuring about 3½ inches (Cat. No. 256, U.S.N.M.). The head is short, the body robust, the lips small and not very pendent. The skull is thick; the fontanelle completely obliterated. There are 79–81 scales in the

[6] Proc. U. S. Nat. Mus., vol. 49, 1915, p. 575.

lateral series, 16–17 above lateral line, 41–42 before the dorsal. On comparing the types of *A. generosus* and *C. plebeius* (Baird and Girard) it became evident to the writer that both belonged to a very closely related species, if indeed they were not identical. It now seems probable that the fishes called *A. generosus* were collected in the Rio Grande basin, perhaps in Utah Creek, along with the trout *S. virginalis*.

No question has arisen as to what river system *Gila elegans* and *Ptychocheilus vorax* belong. The exact locality of capture is not known, but ample opportunity was offered to fish in the waters of the Colorado from Coochetopa Creek to Green River, and fishes of both species readily take a baited hook.

Girard does not indicate where specimens of *Tigoma egregia* were collected. The United States National Museum register records it from Humboldt River, the entry having been made in February, 1857, and the type is in all respects like fishes of the species living in that river. The Humboldt was reached June 8, 1855, at a point not far from Imlay, where the river passes through the gap between the Eugene and Humboldt mountains. "There are no fish in this part of it larger than minnows," writes Lieutenant Beckwith, and those which they apparently caught, *Richardsonius egregius* and *Siphateles obesus*, are the only species there which take the hook readily.

Algansea obesa was described from two specimens—one collected by J. S. Bowman, the other by Lieutenant Beckwith. Girard was apparently satisfied as to the correctness of the locality assigned to the first, and it (Cat. No. 193 U.S.N.M.) is regarded by the present writer as typical of a Lahontan species, *Siphateles obesus*. The second example (Cat. No. 194 U.S.N.M.) apparently belongs to the same species as the first, but it is not given a locality in the museum register. Girard at first refers it to the Humboldt River and later records it as doubtful.

Tigoma humboldti is included in Girard's general report, but no specimens are there accredited to Beckwith, as in the original description. One example (Cat. No. 225 U.S.N.M.) is preserved. The catalogue records two collected by J. S. Bowman. The species represented by the single specimen has not since been found in the Humboldt River. It differs from *R. egregius* in having 11 rays in the anal fin, a deeper body, larger head, and larger eyes. There are 54 scales in the lateral series, 13 above the lateral line, 7 below, and 27 between occiput and dorsal fin.

The type of *Tigoma gracilis* is lost, the locality unknown, and the description too brief and general to admit of the name being applied without doubt to any particular species.

It now remains to compare some of the other types with specimens which a future collector may be fortunate enough to secure from Cottonwood and Utah creeks near the crossings of the old Sante Fe trail.

SOME EOCENE INSECTS FROM COLORADO AND WYOMING

By T. D. A. Cockerell,

Of the University of Colorado, Boulder.

The insects described below were obtained by or for the United States Geological Survey and are now the property of the United States National Museum. Those from White River, Colorado, and Green River, Wyoming, come from the collection accumulated by S. H. Scudder many years ago. It is generally understood that all these fossils are of Green River age; but they come from different horizons, evidently by no means contemporaneous. It is a matter for the future to minutely study the series of rocks ascribed to the Green River period and determine what subdivisions are necessary. These strata are of peculiar interest at the present time, as they include oil shales, which are expected to prove of great economic importance.

ORTHOPTERA.

Family GRYLLIDAE.

PRONEMOBIUS ORNATIPES, new species.

Plate 8, fig. 8.

Length, 11.5 mm.; width of abdomen, 5.5 mm.; anterior femur, about 2.7 mm.; hind femur, 7 mm.; hind tibia, about, 5.4 mm.; width of hind femur, 2 mm. Anterior femora dark above, but below or posteriorly with a large colorless patch, notched in front and behind, and near the apex with a small spot. Middle femora with the same marks, except that the large spot is almost or quite divided into two elongate ones. Hind femora with oblique stripes as in modern *Nemobius*, but I can not see any hairs. Each side of abdomen with a series of transverse spots, each connected in the middle with the next, forming a longitudinal moniliform band. Ovipositor apparently quite short, exserted about 2.5 mm.

Eocene. "Cathedral Bluffs south of Little Tommies Draw, at point where samples were taken." (Winchester 17–5; U. S. G. S.) Colorado. Certainly very close to *P. tertiarius* Scudder, but larger throughout, and probably distinct. Scudder's insect came from the Green River of Wyoming. Scudder does not describe any marking of the anterior and middle femora of his species, but his figure indicates that there was some banding. The ovipositor in *P. ornatipes* is considerably shorter than in *P. tertiarius*, so that at first I wondered whether it was all there; but one of the two impressions is very distinct and I feel sure it is complete.

Holotype.—Cat. No. 66918, U.S.N.M.

ODONATA.

Family LIBELLULIDAE.

STENOGOMPHUS (?) SCUDDERI, new species.

Plate 8, figs. 5, 9.

Female.—Abdomen stout, cylindrical, about 28 mm. long from base of second segment to end of appendages, depth (width in lateral view) about 3.5 mm., uniform to near apex; color as preserved dark brown, second segment with faint sublateral pale marks, segments 3 to 7, with sublateral longitudinal colorless bands, ending abruptly on each segment about 1 mm. from the posterior margin, the band on the seventh segment shorter and less distinct; appendages about 2.5 mm. long, spear-head shaped (but sides mainly parallel), pointed. The segments measure along the dorsal surface as follows, in mm.: (2) 3.5, (3) 4, (4) 4, (5) 4, (6) 4, (7) 3.8, (8) 2, (9) 1.5, (10) 1. In another specimen (No. 1417), showing only a few segments, the measurements are (6) 4, (7) 4, (8) 2.5, (9) 1.5, (10) 1. It is from this specimen that the appendages are measured. There is a large, oblique, thornlike process beneath the eighth and ninth segments.

Eocene. Type, U. S. G. S. 834 (reverse 752), Green River, Wyoming. No. 1417, showing complete appendages, is recorded as from White River, Colorado; but it is in exactly the same kind of rock, and I suspect that it also came from Green River. Another fragment is 787, from Green River.

This is apparently one of the Corduliinae, closely related to *Somatochlora*, but with a more primitive abdominal color pattern. Scudder's genus *Stenogomphus*, based on a wing from Roan Mountain, Colorado, falls in exactly the same vicinity, so there is no apparent reason why the present insect should not be referred to it.

Holotype and paratype.—Cat. Nos. 66919, 66920, U.S.N.M.

DIPTERA.

Family EMPIDIDAE.

RHAMPHOMYIA (?) ENENA, new species.

Plate 8, fig. 7.

Female.—Length, 3 mm.; wings about 3 mm.; thorax about 1 mm. long, elevated, with thin rather long hair (as in the living *R. sudigeronis* Coquillett, from Palo Alto, California); general color dark brown as preserved, the head darkest; wings slightly dusky, not spotted, venation apparently normal for the genus, anterior cross-vein not far from base of discal cell; proboscis rigid, longer than depth of head; oral region showing many short dark bristles and one long one; legs unusually stout, especially the hind femora and tibiae; hind legs quite thickly beset with short hairs.

Eocene. "Cathedral Bluffs south of Little Tommies Draw at point where samples were taken" (Winchester 17–5; U. S. G. S.) Colorado. The very small size and thick legs are peculiar, but the living *R. compta* Coquillett is as small, and the legs in the different species of *Rhamphomyia* (see, for instance, those in Baltic amber) show much diversity. It therefore seems best not to propose a new generic name. There is a rather strong resemblance to the fossil *Microphorus defunctus* Handlirsch, from British America (Tulameen River), but our insect is smaller, with the hind femora very much more robust.

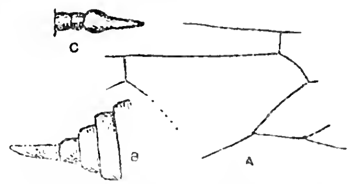


FIG. 1.—RHAMPHOMYIA ENENA. *A*. PART OF WING. *B*. END OF ABDOMEN. *C*. ANTENNA.

A detached wing, a little over 3 mm. long, is from Roan Mountain, Colorado (Scudder; U. S. G. S. 52). So far as can be seen, it agrees with *R. enena*. It shows the well-developed anal lobe, broadly rounded and not projecting backward.

Holotype.—Cat. No. 66921, U.S.N.M.

Family ASILIDAE.

ASILUS PALAEOLESTES, new species.

Female.—Length, nearly 14 mm.; black, the wings hyaline, with dark veins; abdomen robust; legs spinose as in living forms. Veins bounding end of second basal cell and base of fourth posterior forming a cross, as in *Asilus* (*Tolmerus*) *notatus* Wiedemann; discal cross-vein oblique, its lower end 1,280 μ beyond level of base of fourth posterior cell, 480 μ before basal corner of third posterior, and 1,090 μ before end of discal cell.

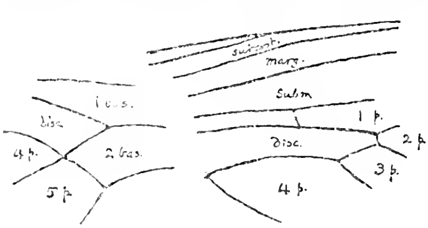


FIG. 2.—ASILUS PALAEOLESTES. DETAILS OF WING.

Eocene; White River, Colorado. (U. S. G. S. 391.) So far as can be seen, this insect is entirely of a modern type.

Holotype.—Cat. No. 66922, U.S.N.M.

Family STRATIOMYIIDAE.

SARGUS (?) VETUS, new species.

Plate 8, fig. 3.

Probable length not less than 10 mm., the apical part of abdomen lost, the parts preserved measuring a little over 8 mm.; wings fully 7 mm. long. Head, 3 mm. broad, with the hemispherical shape (seen from above) and large eyes of the modern *Sargus;* occiput pallid; thorax, 3.4 mm. long and about 2.2 mm. broad (considerably narrower than head), dorsally dark, as far as scutellum (which is unarmed), but apparently pallid at sides, especially posteriorly; wings hyaline, with only a faint cloud in the stigmatic region; venation difficult to make out in detail, the accompanying figure may not be entirely correct, but it shows what could apparently be seen; abdomen pale, without markings, covered with fine short hair, the base at least as broad as thorax, not at all contracted. The pallid sides of thorax may be observed in some modern Stratiomyiidae, such as *Odontomyia truquii* Bellardi, which I have taken at Roswell, New Mexico, and have from Santa Clara County, California (Baker).

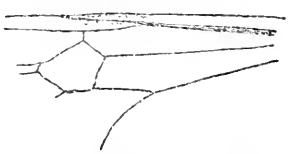


FIG. 3.—SARGUS VETUS. PART OF WING.

Eocene; White River, Colorado (U. S. G. S. 682). This can not well be separated from modern *Sargus* on the basis of the visible structures, but it very possibly represents an extinct genus, with perhaps some characters of the Beridinae, suggested by certain details of the venation. The generic name *Sargus* is to be used in preference to *Geosargus* Bezzi, because *Sargus* Klein, supposed to preoccupy *Sargus* Fabricius, was not binomial.

Holotype.—Cat. No. 66923, U.S.N.M.

NEMOTELUS (?) EOCENICUS, new species.

Only abdomen and wing preserved. Abdomen broad (4.2 mm. wide), shaped as usual in *Nemotelus* and related genera, with lateral cuneiform pale markings as shown in the figure, quite in the manner of modern forms. Wing probably about 8 mm. long (from base to end of discal cell 5.2 mm.), hyaline, with the strong veins dark. Venation as in modern *Nemotelus*, so far as visible, except that the fourth vein before the discal cell is distinctly arched (compare *Euparyphus* and *Rhaphiocera*). Discal cell on first posterior 800 μ. Other details are sufficiently indicated in the figure. The anal cell is closed, and formed as in *Nemotelus*.

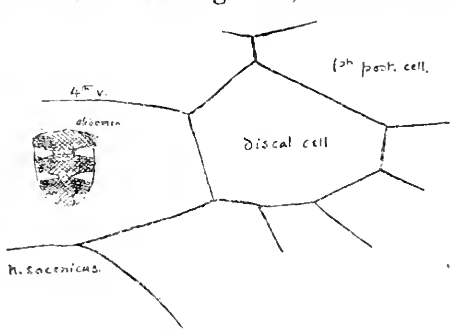


FIG. 4.—NEMOTELUS EOCENICUS. ABDOMEN AND PART OF WING.

Eocene. U. S. G. S. 367; White River, Colorado. This is clearly one of the Clitellarinae, and is referred to *Nemotelus* because that is one of the dominant genera, and the characters do not distinctly contradict the reference. It is very likely, however, that if we knew the antennae and scutellum it would be possible to recognize a distinct type, now extinct.

Holotype.—Cat. No. 66924, U.S.N.M.

Family MUSCIDAE (sens. lat.).

ACANTHOMYITES, new genus.

Rather stout flies of moderate size, with thick (deep, not narrowly cylindrical) abdomen; wings not preserved in the type. Characterized by the great number of large dark bristles on head, abdomen and legs.

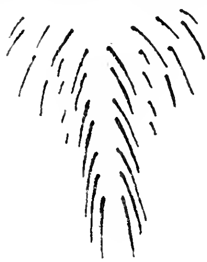


FIG. 5.—ACANTHOMYITES ALDRICHI. DIAGRAMMATIC FIGURE OF DORSAL BRISTLES OF THORAX.

FIG. 6.—ACANTHOMYITES ALDRICHI. ANTERIOR LEG.

The largest are the acrostichals on thoracic dorsum, but the dorsocentrals appear to be very small. An attempt has been made in the accompanying figure to diagrammatically show the distribution of the dorsal thoracic bristles, but it is not exact, and the sutures can not be seen at all. The bristles on abdomen, head, and legs are smaller than the acrostichals; there is the usual row on the underside of the anterior femora.

Type.—*Acanthomyites aldrichi*, new species.

ACANTHOMYITES ALDRICHI, new species.

Plate 8, fig. 12.

Length, nearly 6 mm.; as preserved brown, the sides of the abdomen pallid. Head rather small; legs of moderate length, not especially robust.

Eocene. "Cathedral Bluffs south of Little Tommies Draw at point where samples were taken." (Winchester, 17–5; U. S. G. S.) Colorado. Named after Dr. J. M. Aldrich, who examined it when visiting my laboratory, and agreed that such an interesting form ought to be recorded, in spite of the loss of the wings and other important features. It is certainly a striking circumstance that the system of large bristles characteristic of the higher flies should have been so fully developed as far back as the Eocene. To-day this development of large bristles is more especially characteristic of forms which have larvae parasitic on other insects; but it would be going too far to affirm that *Acanthomyites* was necessarily parasitic. Doctor Aldrich writes: "I do not recall any cases among existing flies where the dorsocentral bristles are reduced, and at the same time the anterior acrostichals are larger than common, or in fact larger than the dorsocentrals."

Holotype.—Cat. No. 66925, U.S.N.M.

HOMOPTERA.

Family FULGORIDAE.

DELPHAX (sens. latiss.) VETERUM, new species.

Plate 8, fig. 6.

Length about 3.5 mm.; tegmina 4.3 mm. long and 1.8 mm. wide; fuscous, except the metathorax, basal 0.5 mm. of abdomen, and last two abdominal segments (except laterally), which are colorless; body stout, abdomen nearly 1.5 mm. wide; head short, obtuse; scutellum large, very distinctly tricarinate, its lateral margins only very feebly concave; tegmina broad, with convex costa, the shape and dark color suggestive of Cercopidae. The details of the venation can not be made out, but the little that can be seen, both on tegmina and hind wings, agrees sufficiently with Delphacinae. In the hind wing the median cell ends broadly in the usual manner.

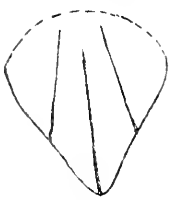


FIG. 7.—DELPHAX ETERUM. SCUTELLUM.

Eocene; "Cathedral Bluffs south of Little Tommies Draw at point where samples were taken." (Winchester 17–5, U. S. G. S.) Resembles *Delphax senilis* Scudder, from the White River Eocene, but is larger. I follow Scudder in using the name *Delphax* in a broad sense, as it is not possible to determine the genus accurately. The sides of the scutellum are straighter than in the majority of modern American Delphacinae.

Holotype.—Cat. No. 66926, U.S.N.M.

HETEROPTERA.

Family PENTATOMIDAE.

DINIDORITES, new genus.

Narrow for Pentatomidae, the general outline suggesting *Margus* in the Coreidae; head prominent, broad, obtuse; antennæ four jointed, the joints darkened apically, pallid basally; pronotum short, fully twice as broad as long, broadly rounded laterally, not angulate; scutellum large but not reaching to middle of abdomen; pronotum and scutellum with numerous dark punctures; abdomen with dark lateral spots marking the junction of the segments, the margin distinctly projecting at these points.

Type.—*Dinidorites margiformis*, new species.

DINIDORITES MARGIFORMIS, new species.

Plate 8, fig. 10.

Length, 9.6 mm.; head, 1.6 mm. long and about 2 mm. broad; antennae, 4.8 mm. long, the first two joints pale with the apex narrowly dark, the others broadly darkened; pronotum about 2 mm. long and 4 mm. broad, with three pallid lines joined transversely at posterior end by a curved one; scutellum broadly triangular, sides longer than base, length about 3 mm.; abdomen about 4.6 mm. wide near base, its apex over 3 mm. from end of scutellum.

Eocene; "Cathedral Bluffs south of Little Tommies Draw at point where samples were taken." Colorado. (Winchester 17–5, U. S. G. S.)

The Dinidorinae include 10 living genera, widely scattered over the earth. The character of the short scutellum was especially noted by Scudder in his studies of the American fossil Pentatomidae. The present genus has the narrow form of *Byrsodepsus*, but the pronotum is much more like that of *Cyclopelta*. The abdominal margin is like that of *Byrsodepsus*. Aside from the scutellum, there is a curious resemblance to *Pentatoma appendiculatum* Heer, at least in the marking of the pronotum and abdomen. There is probably no real affinity; the true generic position of Heer's fossil is unknown.

Holotype.—Cat. No. 66927, U.S.N.M.

COLEOPTERA.

Family CARABIDAE.

LEBIA PROTOSPILOPTERA, new species.

Plate 8, fig. 2.

Elytron 3.7 mm. long, about 1.4 mm. broad; shape as usual in the genus, the apex broadly truncate as in *L. divisa* LeConte; nine very distinct delicate striae, under a high power resolved into series of punctures, and a short (about 550 μ long) stria at the inner basal corner; a series of large round punctures, appearing colorless on a dark ground, situated as follows: One near the apical margin, about 240 μ from the inner corner; two, close together, near the rounded outer apical corner; seven in the interval between the first and second striae, counting from without, and mostly touching the second stria. Elytron as preserved brown, with a very large subquadrate colorless humeral patch, extending as far as the second stria from the inner margin, and with a large colorless subapical patch, one side of which is along the inner margin, while its outer margin is more than halfway to outer margin of elytron.

Eocenes. "Back of house at Smith's ranch, shale of Green River formation with thin beds oil-shale interbedded." (Winchester 17–3. U. S. G. S.). Colorado. A pretty little species, congruous with modern *Lebia* in every respect. A species of *Lebia* (*L. amissa* Heyden) has been recorded from the Oligocene of Germany.

Holotype.—Cat. No. 66928, U.S.N.M.

Family SCARABAEIDAE.

MELOLONTHITES AVUS, new species.

Plate 8, fig. 4.

A melolonthoid beetle preserved in ventral view, without the head. Length as preserved about 13 mm., of which 5 mm. is posterior to the hind legs; width in region of hind legs about 7 mm.; all the femora very robust, the hind ones fully 1.5 mm. across; middle legs contiguous at base; middle tibiae about 2.4 mm. long, not specially enlarged or spinose, but with well-developed spurs; first joint of middle tarsus only about 6 mm. long, second and third joints shorter; hind tibiae simple, with a longitudinal ridge, apex moderately expanded, ending in a short spine externally.

Eocene. U. S. G. S. 894, White River, Colorado. Heer used the term *Melolonthites* for fossil melolonthine or Pleurostict Scarabaeidae of uncertain generic position. The present insect is of interest as indicating the existence of this type of beetle in the American Eocene.

Holotype.—Cat. No. 66929, U.S.N.M.

Family CALANDRIDAE.

SCIABREGMA TENUICORNIS, new species.

Plate 8, fig. 1.

Length, 5.6 mm.; prothoracic process extending about 640 μ beyond head, fingerlike, slender, and curved, fully three times as long as thick; eyes rather large and round; beak as in *S. rugosa* Scudder; upper margin of prothorax straight in lateral profile, front of head to posterior end of prothorax 2 mm.; surface of prothorax rugosopunctate; legs apparently as in *S. rugosa;* elytra 3 mm. long and 1.5 wide, with nine rows of very distinct punctures; about the middle the rows are a little more widely separated than the consecutive punctures in a row, and the interval between the latter is about equal to the width of a puncture.

Eocene of Colorado. "Back of house at Smith's ranch, shale of Green River formation, with thin beds oil-shale interbedded." (Winchester 17–3. U. S. G. S.). In white rock. A beautifully preserved specimen, evidently congeneric with Scudder's *S. rugosa* from Roan

Mountains, but apparently quite distinct by the long slender thoracic process. At first I wondered whether this could be illusory, and the apparent process be a leg elevated behind the head; but closer inspection negatives this, and moreover, as in Scudder's insect, both legs can be seen in the usual position.

Holotype.—Cat. No. 66930, U.S.N.M.

HYMENOPTERA.

Family ICHNEUMONIDAE.

TILGIDOPSIS, new genus.

Similar in general appearance and venation to the oriental genus *Tilgida*, but apparently falling in or closely related to the Paniscini. Stigma lanceolate, not much broadened; radius sharply angled, V-like at first intercubitus; no areolet; basal nervure nearly meeting nervulus. Body rather slender, the abdomen slender basally, broadly banded; terebra exserted a short distance. The terebra is not well preserved, and I am not sure that it is correctly described, but it seems to be clearly present and exserted. In the Paniscini, the genera *Opheltoideus* Ashmead and *Parca* Morley lack the areolet, but our insect can hardly be associated with either. It is probably significant that *Tilgida* Cameron, of which the female is unknown, is of uncertain position owing to its lack of distinctive features. It may perhaps be an ancient type, really related to our fossil.

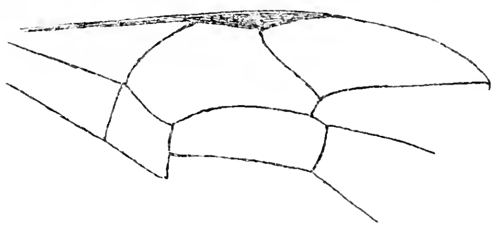


FIG. 8.—TILGIDOPSIS HAESITANS. WING.

Type.—*Tilgidopsis haesitans*, new species.

TILGIDOPSIS HAESITANS, new species.

Female.—Length about 8 mm.; anterior wings slightly over 5 mm., hyaline, with the apical half faintly dusky; stigma and veins dark; head and thorax black or dark brown; abdomen slender, with alternating broad light and dark bands; ovipositor apparently exserted about 1 mm. beyond abdomen. Marginal cell 2560 μ long; first brachial cell 1280 μ long.

Eocene: White River, Colorado (U. S. G. S. 676). Among the Eocene species, this resembles *Ichneumon petrinus* Scudder in many respects, but Scudder's insect is too imperfectly preserved to be placed generically.

Holotype.—Cat. No. 66931, U.S.N.M.

Family FORMICIDAE.

EOFORMICA, new genus.

Male (apparently).—Of fair size, but with the head small; eyes well developed, convex, placed high up, almost on vertex; mandibles thick, with at least three sharp terminal teeth; thorax massive, elevated, unarmed, the dorsal profile in lateral view sharply elevated in front and gradually descending posteriorly; wings not preserved; legs slender, with very long femora; petiole of abdomen rather long, gibbous but not much elevated above the highest point (which is broadly rounded in lateral profile) behind the middle; gaster short and rounded.

Type.—*Eoformica eocenica*, new species.

EOFORMICA EOCENICA, new species.

Plate 8, fig. 11.

Length 7 mm.; thorax 3 mm. long; abdomen 3.1 mm. of which 2.2 mm. is gaster; length of hind femur about 3.4 mm. Eyes 335 μ long, about the same distance apart but about 540 μ from mandibles. Body apparently not hairy. The suture at the base of the metathorax is impressed.

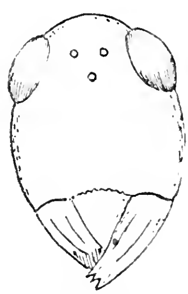


FIG. 9.—EOFORMICA EOCENICA. RESTORATION OF HEAD.

Eocene. "Back of house at Smith's ranch, shale of Green River formation, with thin beds of oil shale interbedded" (Winchester 17–3, U. S. G. S.). Colorado. On the same piece of rock as the type *Lebia protospiloptera*, and 17 mm. from it.

This may possibly be identical with Scudder's *Liometopum pingue* from White River, Utah. The pedicle in Scudder's insect appears to be different, but it is seen in the dorsal aspect. The length of hind femora, given as 4.3 mm. by Scudder, must be a misprint, possibly for 3.4. It is certain that our insect is not related to *Liometopum*.

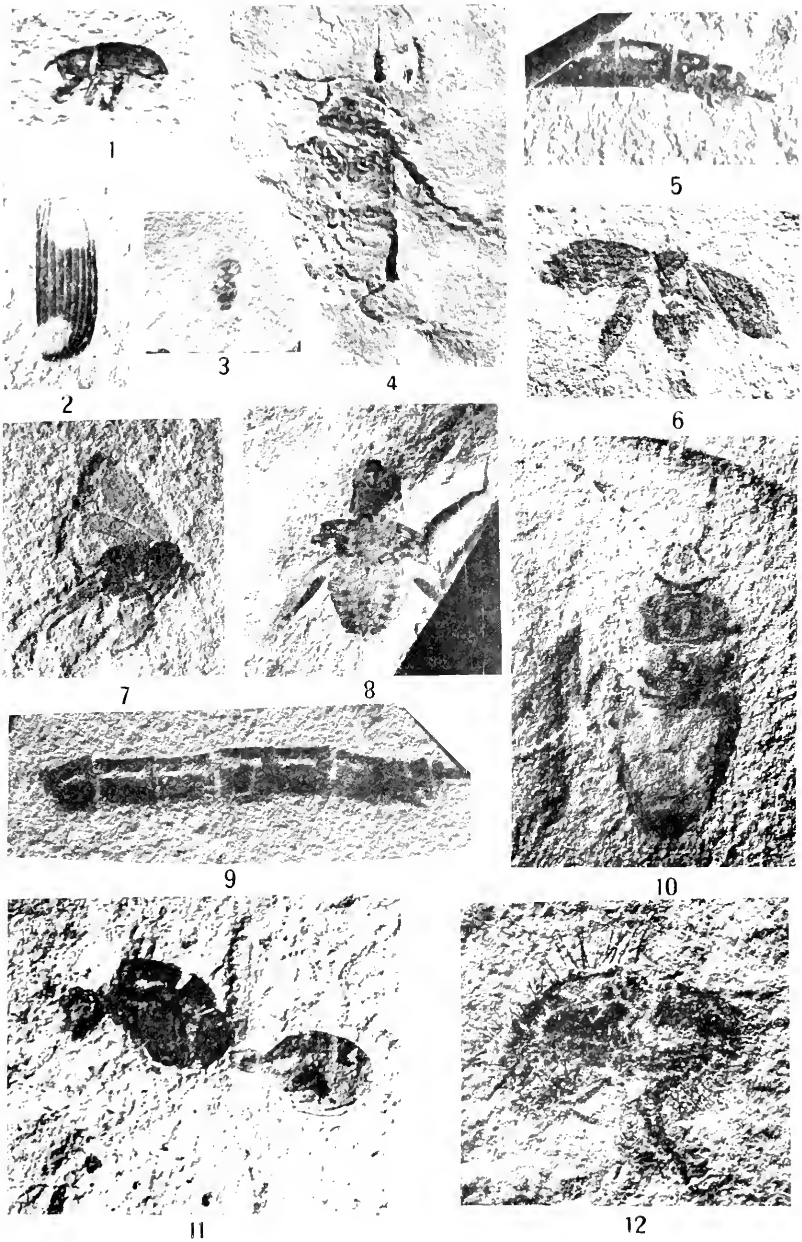
I offer a new generic name for this insect, which seems to be a primitive type related to *Oecophylla;* the small head suggests a male. The pedicle, gaster, and slender legs are quite like those of *Oecophylla;* but the mandibles appear to differ, and if the specimen is a male, the pedicel is very thick for the living genus. *Oecophylla* is an Old-World genus, so far as at present known.

I have attempted a restoration of the head of *Eoformica*, omitting those structures which can not be seen in the fossil. The ocelli are between the eyes instead of far above them as in males of *Camponotus* and *Formica*. The margin of the clypeus seems to be denticulate.

Holotype.—Cat. No. 66932, U.S.N.M.

DESCRIPTION OF PLATE 8.

FIG. 1. *Sciabregma tenuicornis*, new species × 3.
2. *Lebia protospiloptera*, new species.
3. *Sargus vetus*, new species × 1.5.
4. *Melolonthites avus*, new species × 2.
5. *Stenogomphus scudderi*, new species × 2.
6. *Delphax veterum*, new species × 4.
7. *Rhamphomyia enena*, new species × 4.
8. *Pronemobius ornatipes*, new species.
9. *Stenogomphus scudderi*, new species ×2.
10. *Dinidorites margiformis*, new species.
11. *Eoformica eocenica*, new species.
12. *Acanthomyites aldrichi*, new species × 6.



EOCENE INSECTS FROM COLORADO AND WYOMING.

FOR DESCRIPTION OF PLATE SEE PAGE 39.

THE FOSSIL ANNELID GENUS HAMULUS MORTON, AN OPERCULATE SERPULA.

By Bruce Wade,
Of the Tennessee State Geological Survey.

INTRODUCTION.

Among some of the recent discoveries in the large and well-preserved Ripley Fauna of the Upper Cretaceous at Coon Creek, McNairy County, Tennessee, are a number of opercula from the Serpula *Hamulus* Morton. Species of this genus are widely distributed in the Cretaceous, but if the opercula have ever been found previously they are still unknown in the literature; so it is the purpose of this brief paper to describe one new species and the calcareous opercula from two species of this interesting group of fossil annelids.

This paper is published by the permission of Wilbur A. Nelson, State Geologist of Tennessee.

GENERAL REMARKS.

The Sea-worms or Polychaeta included in the suborder *Tubicola* are distinguished by the fact that they inhabit variously formed tubes, to which they are not organically connected, and in which they can move freely by means of their setigerous foot tubercules. Owing to their possession of an investing tube branchiae are only developed in the anterior region of the body, this being the only part which is ordinarily exposed to the action of sea water; hence the *Tubicola* are sometimes called the "cephalo-branchiate" Annelids.[1]

The protecting tube of the Tubicolar Annelids may be composed of calcium carbonate, of grains of sand, or other foreign matter, or of chitinous material. When the tube is calcareous it presents certain resemblances to the shells of some of the Mollusks, such as *Vermetus*, *Dentalium*, or certain of the Rudistes. In the living state it is easy to make a distinction between these, for the Tubicolar Annelids are in no way organically attached to their tubes, whereas the Mollusks are always attached to their shell by proper muscles. In the fossil condition, however, it may be very difficult to refer a given calcareous tube to its proper place. As a general rule, however, the calcareous tubes of Annelids, such as *Serpula*, are less regular and symmetrical

[1] Nicholson and Lydekker, Manual of Palaeontology, ed. 3, vol. 1, Edinburgh and London, 1889.

than those of *Vermetus*, while the latter are partitioned by shelly septa, which do not exist in the former. Again, the tube of *Dentalium* is open at both ends, whereas it is closed at one end of the *Serpula*. In the Annelidous genus *Ditrupa*, however, the tube is open at both ends, so that this distinction is one not universally applicable. The tubes of the serpuloid genus *Hamulus* are quite regular and symmetrical and its species have frequently been described as *Dentalia*. Tubes of certain species of *Hamulus* together with their opercula have a superficial resemblance to certain species of Rudistes such as *Radiolites lombricalis* d'Orbigny [2] and *Hippurites variabilis* Munier Chalmas [3] from the Upper Cretaceous of France. The apophyse of the operculum of *Hamulus* resembles very much the apophyse of the upper valve of certain of the Rudistes, but the operculum of *Hamulus* is truly an operculum of a circular aperture, while the upper valve of the Rudistes does not fit into a circular cavity of a lower valve. Another difference is the absence of any evidence of muscular attachments on the inner surface of the tubes of species of *Hamulus*.

The operculate form *Hamulus onyx* Morton is probably related to some such form as the existing species *Serpula contortuplicata* [4] (pl. 9, fig. 4). There are existing quite a group of Serpulas with calcareous opercula; these are the Vermilias that are still abundant along the sea coasts to-day. Existing species with chitinous opercula are quite common and some of the forms that may be cited as analogous to *Hamulus onyx* are *Enponatus dipona* Schmarda and *Pomatoceros tetraceros* Schmarda [5] both from near New South Wales; and also *Crucifera websteri* Benedict [6] and *Spirobranchus giganteus* (Pallas) Mörch [7] from the Gulf of Mexico.

Fossil operculate Serpulas are rare. Among these may be mentioned the English Eocene species *Serpula crassa* Sowerby [8] (pl. 10, fig. 11), and the Maryland Upper Cretaceous form *Ornataporta marylandica* Gardner.[9] The former has a calcareous operculum and a three-sided tube, which is usually attached along one side to some foreign object. Gabb has described some serpuloid tubes with a triangular cross section, *Paliurus triangularis* Gabb [10], from the Upper Cretaceous at Vincentown, New Jersey. Gabb's species has no known operculum, but its triangular tubes are somewhat analogous to those of Sowerby's Eocene species. There are specimens of *Serpula heptagona* [11] with opercula from the Barton Beds of the Eocene of England in the British Museum.

[2] d'Orbigny, A., Paléontologie Française, Terrains Crétacés, vol. 4, 1860, p. 214, pl. 555, figs. 4–7.
[3] Douvillé, H., Mem. Société Géologique de France, Mem. no. 6, p. 50, pl. 7, figs. 4–7, 9–12, 14, 15.
[4] Nicholson and Lydekker, Manual of Paleontology, 1889, p. 471, fig. 333a.
[5] Schmarda, Ludwig, K., Neue wirbellose Thiere, 1861, p. 30, pl. 21, fig. 179, Leipzig.
[6] Benedict, J. E., Proc. U. S. Nat. Mus., vol. 9, 1886, p. 550, pl. 21, figs. 24, 25.
[7] Idem, p. 551, pl. 23, figs. 38–42; pl. 24, figs. 43–47.
[8] Agassiz, L., German edition of James Sowerby's Mineral Conchology, 1814, 1842, p. 52, pl. 30.
[9] Gardner, J. A., Maryland Geological Survey, Upper Cretaceous volume, 1916, p. 748, pl. 47, figs. 16–18.
[10] Gabb, W. M., Proc. Acad. Nat. Sci. Philadelphia, 1876, p. 324, pl. 17, figs. 11–13.
[11] Guide to the Fossil Invertebrate Animals in the British Museum, ed. 2, London, 1911, p. 79.

SYSTEMATIC DESCRIPTIONS.

Class ANNELIDA.

Order POLYCHAETA.

Suborder TUBICOLA.

Family SERPULIDAE.

Genus HAMULUS Morton.

Hamulus MORTON, Syn. Org. Rem. Cret. Group, 1834, p. 73.

Type.—Hamulus onyx Morton.

"Tubular, regular, involuted; volutions distinct; aperture circular." Morton, 1834.

Tubes with from three to seven axial ribs; larval or early stages attached, usually broken away and solitary in the adult; nuclear shell portions circular and often triangular in cross section; inner surface of the tubes smooth; operculum calcareous, consisting of a circular anterior disk with a three-cornered, elongate posterior process or apophyse.

HAMULUS ONYX Morton.

Plate 9, figs. 1, 2, 3, 5, 6.

Hamulus onyx MORTON, 1834, Syn. Org. Rem. Group, p. 73, pl. 2, fig. 8; pl. 16, fig. 5.—GABB, 1859, Cat. Inv. Fossils. Cret. Form. U. S., p. 1.—STEPHENSON, 1914, U. S. Geol. Surv. Prof. Paper 81, p. 24, tables 2, 8.—GARDNER, 1916, Md. Geol. Sur. Upper Cret., p. 747 (part).

Description.—"With six elevated, angular, longitudinal ribs extending from base to apex. Length about an inch. The imperfect specimen figured on Plate II was obtained by Dr. Blanding at Lynchs Creek, South Carolina, in the green sand, and on a former occasion was supposed to be a *Dentalium*. Plate XVI, figure 5, however, represents the perfect shell from the older Cretaceous deposits of Erie, Alabama. I have a small individual from New Jersey. It has never been found attached." Morton, 1834.

Type locality.—Erie, Alabama.

Tube small, compact, and rather strong; in form a very elongate, gently curved, ribbed, or corrugated cone; shell of tube made up of two layers—an inner layer of lamellar calcareous material, and an outer layer of chitinous calcareous material bearing the external sculpture; nucleus or protoconch unknown, tube attached to some foreign object during nuclear stage; external sculpture consisting of six prominent axial ribs and sulci; transverse or incremental lines fine and very numerous in some individuals, quite obscure in other individuals; internal surface smooth; aperture circular; apertuarl margin smooth and sharp; operculum tack-shaped with a three-cornered spick or tooth situated on the edge of the tack head or basal circular plate; anterior surface of basal plate concave marked with a few fine lines radiating from the center and a few irregular concentric lines; posterior side of the basal plate and the sides of the three-cornered tooth or apophyse marked by irregularly ramifying and deeply impressed grooves or sulci which probably represent the seats of muscular or ligamental attachments; posterior extremity of the tooth pointed and tripartate; operculum in place is entirely behind the anterior margin of the aperture, thus forming a water-tight stopper for the tube.

This species is one of the commonest fossils in the Ripley formation at Coon Creek. It is represented in the collections from that locality by hundreds of specimens, several dozen of which retain the operculum in place. A few immature forms have been found attached, but none of the specimens preserve the complete nucleus. This is broken away from all the specimens examined, leaving the apices perforate. This species is somewhat similar to the species *Hamulus jonahensis* (Cragin) [12] from the Austin Chalk of Texas, but does not possess the vigorous incremental sculpture that characterizes the tubes of the Texas species. The species *Serpula sexsulcata* Münster,[13] a species of *Hamulus*, from the Upper Cretaceous of Germany, has six axial ribs on the tube, but most commonly the European species of this genus are characterized by seven ribs instead of six. Two of these are:

Dentalium deformis d'Orbigny [14] (pl. 9, figs. 7, 8) from the Cenomanian, Le Mans, France; and *Serpula septemsulcata* Reich and Cotta [15] (pl. 2, fig. 10) widely distributed in the Cenomanian of Saxony and especially abundant in the Serpulitensand of Bannewitz near Dresden. The Ripley species *Hamulus major* Gabb [16] from Eufaula, Alabama, has only three or four low axial costae on its tubes which are less regular and symmetrical than the type species of this genus. The Oxfordian species *Serpula vertebralis* Sowerby,[17] a Jurassic species found in both England and in France, has only four axial ribs, but in many respects it resembles *Hamulus onyx* Morton and should be included in the genus *Hamulus*.

Occurrence.—Ripley Formation. Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collections.—Philadelphia Academy of Natural Sciences. Johns Hopkins University. Vanderbilt University. U. S. National Museum (Cat. No. 32460).

---

[12] Cragin, F. W., Fourth Ann. Rept. Geol. Survey of Texas, 1893, pl. 29, figs. 12–14, Austin.

[13] Goldfuss, Petrefacta Germaniae, vol. 1, p. 238, pl. 70, fig. 13.

[14] Geinitz, H. B., Grundriss der Versteinerungskunde, p. 252, pl. 16, fig. 18*a*, *b*, *c*. Dresden, 1842.

[15] Wanderer, K., Tierversteinerungen aus der Kreide Sachsens, 1909, p. 21, pl. 3, fig. 12, Jena.

[16] Gabb, W. M., Journ. Acad. Nat. Sci. Phila., 1860, p. 399, pl. 68, fig. 46.

[17] Sowerby, Mineral Conchology, pl. 599, figs. 6–9. Bronn, H. G., Lethaea Geognostica, vol. 6, p. 415, pl. 27, fig. 5*a*, *b*. Stuttgart, 1852.

Outside Distribution.—*Monmouth Formation* of Maryland; *Selma* and *Ripley Formations* of Mississippi, Alabama; *Eutaw Formation* of Alabama; *Austin Chalk*, Texas.

HAMULUS ANGULATUS, new species.

Plate 10, figs. 1, 2, 8, 9.

Description.—Tube small, thick, and strong, but brittle; in form an elongate, gently curved, and often slightly spiral cone: inner shell layer thick, outer layer thin; nucleus unknown; external surface marked by six low, sharp, angular, axial ridges; interaxial spaces broad and gently concave, alternate interaxial spaces marked by a fine impressed axial line; growth lines obscure on the earlier stages of the shell; interrupted growth lines, irregular and common near the aperture; aperture circular, its margin smooth and thin; internal surface smooth.

Dimensions.—Imperfect specimen—length, 8 mm.; maximum diameter, 3.5 mm.

The tubes of this species are brittle and are usually broken. They may be readily distinguished from those of *Hamulus onyx* Morton by their low, angular axial costae, broad smooth, gently concave interaxial spaces, and by the impressed axial line in alternate interaxial spaces.

Occurrence.—*Ripley Formation.* Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collections.—Johns Hopkins University. Vanderbilt University. U. S. National Museum.

Cotypes.—Cat. No. 32459, U.S.N.M.

HAMULUS SQUAMOSUS Gabb.

Plate 10, figs. 6, 7.

Hamulus squamosus GABB, 1859, Cat. Inv. Foss. Cret. Form. U. S., p. 1; 1860, Journ. Acad. Nat. Sci., Phila., ser. 2, vol. 4, p. 398, pl. 68, fig. 45.—STEPHENSON, 1914, U. S. Geol. Surv. Prof. Paper 81, p. 24, table 2, 8.

Description.—"Elongated, curved at the narrow end into a hook sometimes with as much as three-fourths of a whorl, all in the same plane; mouth slightly constricted, nearly circular, edge thin; surface marked by two or three wrinkled longitudinal folds on each side and a heavy squamose plate, very irregular in the plane of the curve on each side."

Dimensions.—"Length about 1 inch exclusive of the curve; greatest width of the plates 0.4 inch, diameter of mouth 0.12 inch." Gabb, 1860.

This species is closely related to *Hamulus onyx* Morton, but may be readily distinguished by the broad wing-like appendages on the first and fourth axial costae. *Hamulus squamosus* Gabb is evidently a mud-loving form since it is extremely rare in the Coon Creek beds and common in the Selma clay.

Occurrence.—Ripley Formation. Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collection.—U. S. National Museum (Cat. No. 32461).

Outside Distribution.—Ripley Formation, Lees Mill, Mississippi. *Selma Chalk,* Mississippi, Alabama, Georgia.

HAMULUS, species.

Plate 10, figs. 3, 4, 5.

Operculum small and fragile, consisting of a circular disk and an elongate three-cornered posterior process or apophyse; circular disk marked on both the anterior and posterior sides of lines radiating from the center; margin of disk slightly serrate; position of apophyse on the disk eccentric.

This species of operculum is known from a single individual which was found detached from a tube. It is most likely that it belongs either to *Hamulus squamosus* Gabb or *Hamulus angulatus*, probably the latter.

Occurrence.—Ripley Formation. Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collection.—U. S. National Museum (Cat. No. 32462).

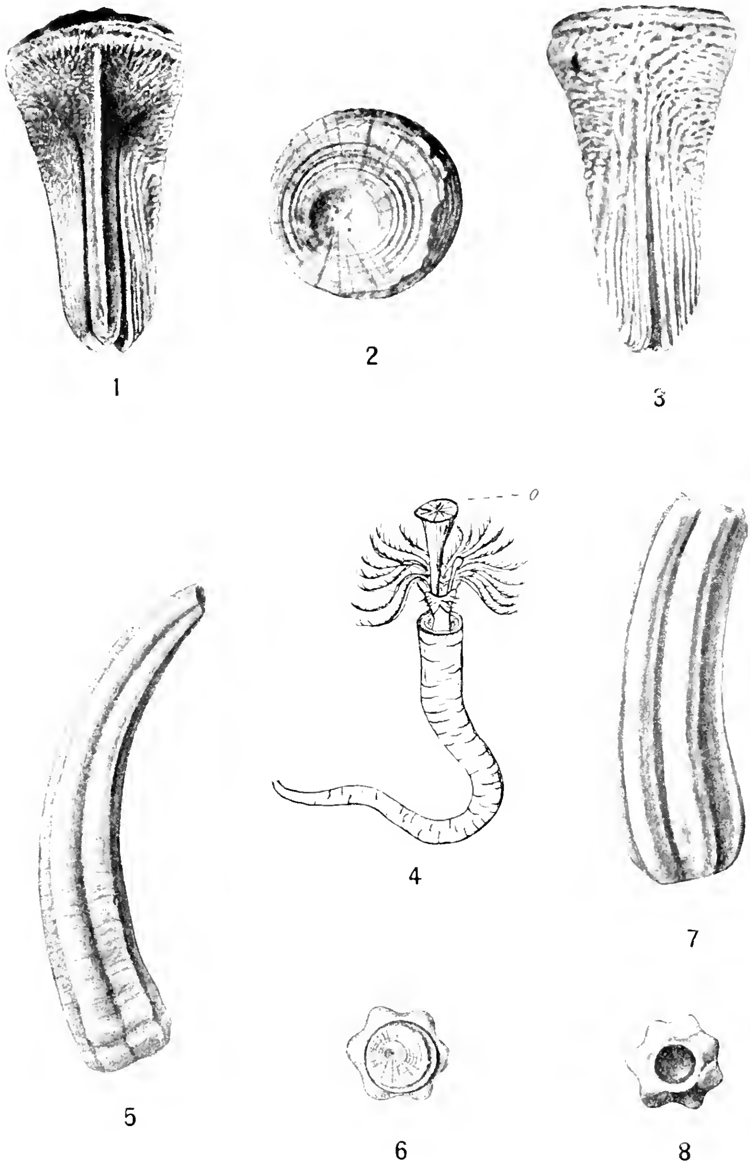
EXPLANATION OF PLATES.

Plate 9.

Fig. 1. Operculum of *Hamulus onyx* Morton. × 10, front view.
2. Operculum of *Hamulus onyx* Morton. × 10, basal view.
3. Operculum of *Hamulus onyx* Morton. × 10, rear view.
4. *Serpula contortuplicata*, a recent operculate Annelid. figure taken from Nicholson and Lydekker. *O.*=operculum.
5. *Hamulus onyx* Morton. × 4, side view.
6. *Hamulus onyx* Morton. × 4, basal view showing operculum in place.
7. *Hamulus deformis* (d'Orbigny). × 4, side view, an imperfect specimen from the Cenomanian, Le Mans, France (Cat. No. 32463 U.S.N.M.).
8. Same as figure 7. × 4, apertural view.

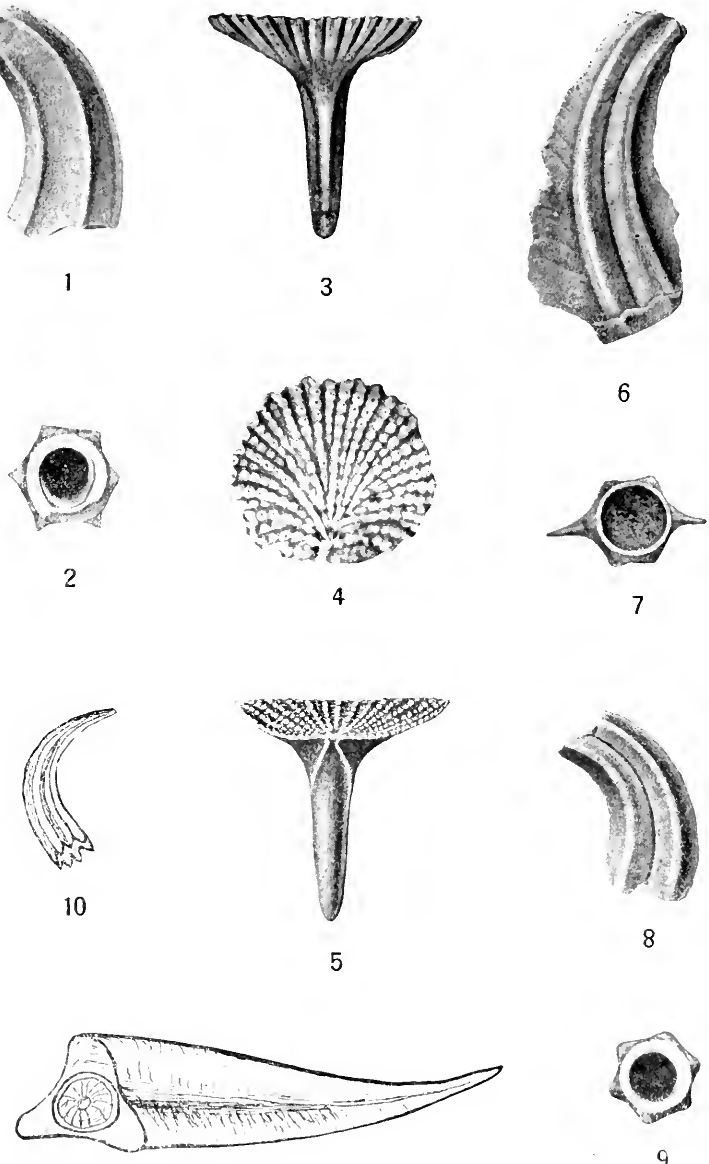
Plate 10.

Fig. 1. *Hamulus angulatus* new species. × 4, side view.
2. Same as figure 1. × 4, apertural view.
3. Operculum of *Hamulus*, species. × 10, front view.
4. Operculum of *Hamulus*, species. × 10, basal view.
5. Operculum of *Hamulus*, species. × 10, rear view.
6. *Hamulus squamosus* Gabb. × 4, side view.
7. Same as figure 6. Apertural view.
8. *Hamulus angulatus*, new species. × 4, side view showing one of the three axial depressions.
9. Same as figure 8, × 4, apertural view.
10. *Hamulus septemsulcata* Reich and Cotta, a species common in the Cenomanian of Saxony. Figure taken from Wanderer.
11. *Serpula crassa* Sowerby an operculate annelid from the Eocene of England, figure taken from L. Agassiz.



THE GENUS HAMULUS MORTON, AN OPERCULATE SERPULA.

FOR EXPLANATION OF PLATE SEE PAGE 46.



THE GENUS HAMULUS MORTON, AN OPERCULATE SERPULA

FOR EXPLANATION OF PLATE SEE PAGE 46.

FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

By Joseph A. Cushman,

Of the Boston Society of Natural History.

While in Jamaica in February and March, 1912, with the Carnegie Institution Expedition under Dr. Alfred G. Mayor, I took advantage of spare moments to collect foraminiferal material. There is very little actually known about the shallow-water foraminifera of the West Indies. D'Orbigny's Monograph of the Foraminifera of the Shore Sands of Cuba included other West Indian shore sands as well.[1] Flint recorded a few species from Puerto Rico.[2] Most of the other records are from deeper waters.

In working over this Jamaican material it was evident that the species fitted those described in d'Orbigny's Cuban Monograph much better than any others. This same fact I had also observed in working out the later tertiary material of the West Indies. Therefore, as d'Orbigny had Jamaican specimens in his material, it has seemed desirable to make rather close comparisons of the Jamaican material with the figures and descriptions of the Cuban Monograph. The result has been rather surprising in the accuracy with which most of the material fits these descriptions and figures. Many of d'Orbigny's species have been allowed to lapse and are not referred to in the literature since their original publication in 1839; others have been placed in the synonymy of other species; and still others are in good usage for tropical species. If the synonymy and the original figures and descriptions of many species are carefully studied it will be apparent that d'Orbigny's species in many cases do not deserve the fate of synonyms. Others now in good use, based on Brady's use of them in the *Challenger* Report, are used for entirely different things from those of the originals. I have, therefore, in the present paper tried to reconcile the Jamaican material with d'Orbigny's species and have tried to indicate the results.

In this connection the following quotation from the excellent work of Heron-Allen.[3] in regard to the Cuban Monograph may not be out of place:

> Ramon de la Sagra had intrusted d'Orbigny with the arrangement of the zoological portion of his History of Cuba, and among the material was a small quantity of sand,

[1] D'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères."

[2] Bulletin U. S. Fish Commission, 1900, pp. 415–416.

[3] Alcide d'Orbigny, His Life and His Work, Journal Microscopical Society, 1917, pp. 1–105, pls. 1–13 pp. 44, 45).

the richness of whose foraminiferal fauna struck d'Orbigny at once. He communicated with de Cande, a naval officer stationed in the West Indies, who supplemented de la Sagra's material with sands from Cuba, Haiti, St. Thomas, Jamaica, Martinique, and Guadelupe, and a year's assiduous work on the material proved to d'Orbigny that Cuba provides all the species to be found in any West Indian gatherings, besides many species not found elsewhere in the West Indies. He pronounces the dictum that Cuba can not be compared for Foraminiferal fauna with any place in the world excepting the Adriatic. He found in the Cuban sands 117 species, "one-tenth of the whole of the foraminifera known up to the present day;" and on these results being communicated to de la Sagra they agreed that the work "should serve as a basis for the study of the foraminifera comprehending my general views, my classification, and the succinct characters of all the genera," and he therefore gives an abstract of the general observations which he proposes to publish later in his "ouvrage special." He points out that until that moment nothing at all was known of the Foraminifera of the Antilles except about 20 species that he had noted in the "Tableau Methodique." At the end of his introduction he makes the astonishing statement that so specialized are the Cuban forms that of the whole 117 he had only found 5 in other parts of the world, but this must be read in the light of his views on species from different geographical areas. Very many of his peculiarly Cuban species have been swallowed up in the synonymies of other species of wide tropical distribution. At the same time it may be remarked that he recorded several species in 1826 (from material furnished by de Ferussac) which he did not find again in the 1839 material.

A study of the Jamaican material shows that the species of the Cuban Monograph which are represented fall into three groups: First, those species which are of wide distribution and were found in the West Indies for the first time and are not distinctively tropical or West Indian. Such species are *Globigerina bulloides*, *G. rubra*, *G. dutertrei*, and *Pulvinulina menardii*. Secondly, there are species which are known to have a wide distribution in tropical seas, such species as *Textularia candeiana*, *Cymbalopora poeyi*, *Tretomphalus bulloides*, and *Triloculina linneiana*. The third group contains species so far as known characteristic of the general West Indian regions such as *Truncatulina rosea*, *Polystomella lanieri*, *Asterigerina carinata*, and *Quinqueloculina tricarinata*.

The figures in d'Orbigny's work are occasionally somewhat conventionalized, but as a rule are very faithful in the representation of the species they illustrate, especially when compared, as they should be, with material from the same general region as that from which the originals were obtained.

A comparison of the general characters of the Jamaican collections and of d'Orbigny's species shows that the West Indian region in less than 10 fathoms (18 meters) has a marked scarcity of Astrorhizidae, Lituolidae, and Lagenidae. The great preponderance of the Miliolidae is what would be predicted in a tropical coral reef region. The Textulariidae and Rotaliidae are represented by comparatively few species, not as many as might have been expected.

The region of Montego Bay on the northwest coast of Jamaica is open to the Caribbean, but the area behind the reefs, and especially the material from among the Bogue Islands, represents the faunal constituents of quiet, protected waters.

All the dredgings are in water of 10 fathoms (18 meters) or less and three of them in 1 fathom (2 meters) or less, so that they correspond well with d'Orbigny's "shore sands."

The material about Montego Bay collected by the writer was from the following stations:

1. In very shallow water, 2 feet deep at mean tide, in the area covered by the short "eel grass," consisting of a sandy mud from a quiet and protected area.
2. In water 1 fathom (2 meters) deep in a protected cove of the Bogue Islands, bottom of fine mud.
3. In 3 fathoms (5 meters) on the inner side of the reefs in the western part of Montego Bay, sandy.
4. In 6 fathoms (11 meters) in a pocket of the reefs surrounded by living coral.
5. In 9 fathoms (16 meters) in muddy sand.
6. In 10 fathoms (18 meters) in "coral sand" of the outer reef.

The material from Runaway Bay was from about the base of calcareous algae collected by Mrs. G. L. Cheney and given me by Mr. Charles W. Johnson, of the Boston Society of Natural History.

Family LITUOLIDAE.

Genus AMMOBACULITES Cushman, 1910.

AMMOBACULITES REOPHACIFORMIS Cushman.

Ammobaculites reophaciformis CUSHMAN, Proc. U. S. Nat. Mus., vol. 38, 1910 p. 440, figs. 12–14.

Specimens are rare at Montego Bay in 6 fathoms (11 meters) and at Runaway Bay. There is nothing corresponding to this species figured in d'Orbigny's work.

It occurs in various parts of the West Indies and on the coast of Florida, and extends westward to the Philippines and other tropical regions of the Indo-Pacific.

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

TEXTULARIA AGGLUTINANS d'Orbigny.

Plate 11, figs. 1–3.

Textularia agglutinans D'ORBIGNY, Foram. Cuba, 1839, p. 144, pl. 1, figs. 17, 18, 32–34.

Specimens are fairly common in the material occurring both at Montego Bay, stations 2, 4, 5, 6, and at Runaway Bay. It is a common species in the West Indies noted by d'Orbigny from Cuba, St. Thomas, Martinique, and Jamaica. The figures given by d'Orbigny show a rather smooth species, but the description says "rugose." The Jamaican specimens are, however, smoother than specimens I have seen from other regions.

The figures given by many writers and referred to this species show that the name has been used to cover many forms, many of which do not represent this species as it is figured by d'Orbigny and as it occurs in the West Indies. It is evidently found in shallow tropical waters in many regions, but it is very doubtful if the material from deep, cold water often referred to it is the same at all.

TEXTULARIA CONICA d'Orbigny.

Plate 11, figs. 4–6.

Textularia conica D'ORBIGNY, Foram. Cuba, 1839, p. 143, pl. 1, figs. 19, 20.

D'Orbigny's figure is somewhat conventionalized and smooth, but otherwise illustrates fairly well this common tropical species found in shallow water of the West Indies and other regions. D'Orbigny recorded it from Cuba and Jamaica.

At Montego Bay it occurred at the two deeper stations at 9 and 10 fathoms (16 and 18 meters), but not in the shallower water nor at Runaway Bay.

TEXTULARIA CANDEIANA d'Orbigny.

Plate 11, figs. 7, 8.

Textularia candeiana D'ORBIGNY, Foram. Cuba, 1839, p. 143, pl. 1, figs. 25–27.

D'Orbigny does not mention Jamaica, although he found the species in material from Cuba, Martinique, and St. Thomas. The Jamaican specimens I have are very close to those figured by d'Orbigny except perhaps slightly shorter. The great increase in size toward the apertural end is fully as striking as in the types. There are several specimens from Montego Bay in 10 fathoms (18 meters), but not from the shallower stations.

This is one of the specific names allowed to lapse by subsequent authors. It is not again recognized until Millett, in 1899, referred a Malay form to this name as a variety under *T. sagittula*.[4] This is a short form not unlike this in some ways, and with the material I referred to *T. candeiana* in 1911 from the Hawaiian Islands and Gaspar Straits it would seem that this species has a wide distribution in shallow waters in the tropics.

[4] Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 12.

Genus BOLIVINA d'Orbigny, 1839.

BOLIVINA PUNCTATA d'Orbigny.

Plate 11, figs. 9, 10.

Bolivina punctata D'ORBIGNY, Voy. Amer. Mérid., vol. 5, pt. 5, "Foraminifères," 1839, p. 63, pl. 5, figs. 10–12.

Textularia caribaea D'ORBIGNY, Foram. Cuba, 1839, p. 145, pl. 1, figs. 28, 29.

A comparison of the two sets of figures given above with the original descriptions leaves very little to choose between the two. The material from Jamaica might represent either and it does not seem possible to distinguish the two, so that the earlier name is here used. As this name has been extensively used while *T. caribaea* has been entirely neglected, the choice of the two is fortunate. D'Orbigny's records for *T. caribaea* are Cuba, Jamaica, and Martinique. A few specimens occurred at station 2, Montego Bay.

Genus BIGENERINA d'Orbigny, 1826.

BIGENERINA NODOSARIA d'Orbigny.

Bigenerina nodosaria D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 261, pl. 11, figs. 9–11; Modèles, 1826, No. 57.

It seems strange that this species does not occur in the Cuban Monograph. It is one of the commonest species in shallow water in the West Indies. It occurred at Montego Bay at stations 4, 5, and 6, and at Runaway Bay also.

D'Orbigny's original specimens to this species come from the Adriatic, both his figures and Modèle showing much more regular form of test than is usually found in West Indian and other tropical material that I have seen.

Genus VERNEUILINA d'Orbigny, 1840.

VERNEUILINA SPINULOSA Reuss.

Verneuilina spinulosa REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12.

Specimens of this shallow water tropical species occur at two stations at Montego Bay, stations 2 and 4. It is not common.

More characteristic species occur along the Florida Keys in comparatively shallow water.

Genus VALVULINA d'Orbigny, 1826.

VALVULINA OVIEDOIANA d'Orbigny.

Plate 11, figs. 11–14.

Valvulina oviedoiana D'ORBIGNY, Foram. Cuba, 1839, p. 103, pl. 2, figs. 21, 22.

This species has been entirely neglected since its first description and was not even used by Brady as a synonym in the *Challenger* Report. The material from Jamaica is fairly common at the three shallowest stations, Montego Bay, stations 1 and 2, and Runaway Bay.

D'Orbigny's figure is perhaps a little too smooth and even, but it shows the characteristic outline and apertural region of the species. The chambers are angled and well set apart from one another, as is well shown in the type figures.

This seems certainly a species which should be revived at least for the West Indian material, which is like nothing else and was well characterized and figured by d'Orbigny. D'Orbigny's types were from Cuba, and as it is found at both localities in Jamaica it undoubtedly has a wider range in the shallow water of the West Indian region. This species is very close to *V. davidiana* Chapman, from Funafuti Atoll, Ellice Islands.

This is evidently the same as the material I have referred to *Verneuilina affixa* from the coast of Florida.[5] It has a wide range in the West Indian region and in the Gulf of Mexico, and is very constant in its characters.

Either this species is closely allied to *V. davidiana* Chapman, or else both represent a single species of wide tropical distribution.

Genus VIRGULINA d'Orbigny, 1826.

VIRGULINA PUNCTATA d'Orbigny.

Plate 11, fig. 15.

Virgulina punctata D'ORBIGNY, Foram. Cuba, 1839, p. 139, pl. 1, figs. 35, 36.

This species, recorded by d'Orbigny from Cuba and Jamaica, has occurred in the material from Montego Bay at station 5. This is another of d'Orbigny's species allowed to lapse without being used as a synonym. It is very clearly the species found in this material and as such should be used for the recent West Indian form. The figure given by d'Orbigny with the narrow oblique chambers is a very good representation of the Montego Bay specimen.

It is quite likely that the specimens I have referred to *V. squamosa* from Fort Jefferson Channel, Tortugas, Florida,[6] may belong to this species.

Genus CLAVULINA d'Orbigny, 1826.

CLAVULINA TRICARINATA d'Orbigny.

Plate 12, figs. 1, 2.

Clavulina angularis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 268, pl. 12, fig. 7.
Clavulina tricarinata D'ORBIGNY, Foram. Cuba, 1839, p. 111, pl. 2, figs. 16-18.

The original specimens of d'Orbigny's *Clavulina angularis* were from the Mediterranean, from the shores of the Island of Corsica.

The figure shows an elongate test, the early portion of which is triangular in cross section, the later chambers rounded after the

[5] Papers from the Department of Marine Biology, Carnegie Institution of Washington, vol. 9, 1918 pp 271, etc.
[6] Idem, p. 284.

early portion. D'Orbigny's West Indian *Clavulina tricarinata* shows the test triangular throughout, except perhaps for the last-formed chamber, which is more rounded. His specimens were from Cuba and Jamaica.

Such specimens are very common in the West Indies and on the coast of Florida, not only in shallow water, but at moderate depths. They are very constant in their characters, and it seems quite likely that this may differ from the Mediterranean *Clavulina angularis*. A comparison of the specimens from these two regions should determine this.

It is interesting in this connection to note that Sidebottom in his paper on the foraminifera from the Bay of Palermo [7] figures a specimen which is very much like that given by d'Orbigny in 1826, also from the Mediterranean, but it is very unlike the typical *C. tricarinata* of the West Indies. This seems to throw some evidence on the side of the two being distinct from one another.

The *Challenger* figures (pl. 48, figs. 22–24) are more definitely angular. Although the locality for these is not given, they are probably from the East Indies, where rather typical specimens occur in abundance.

A species evidently like many others occurs in the West Indian region and across the tropical Pacific, and that from the Mediterranean may, like other examples, be separated from it when a study is made of the two.

It occurred at Montego Bay at stations 2, 4, 5, and 6, and at Runaway Bay. It was most common at the stations in deeper water, although in considerable numbers even in the shallow water of Runaway Bay.

CLAVULINA NODOSARIA d'Orbigny.

Plate 12, fig. 3.

Clavulina nodosaria D'ORBIGNY, Foram. Cuba, 1839, p. 110, pl. 2, figs. 19, 20.

This is another species which has remained neglected. In the examination of the Montego Bay material a small slender species was found at two stations, 2 and 6, which is evidently this species. The early chambers are rounded triangular, the uniserial ones subglobose, with constricted sutures and distinctly nodular as in the original figure. While found at these stations with *C. angularis*, it is, nevertheless, very distinct as it is rounded at a very early stage, has nodosarian chambers, and does not attain but a fraction of the size of *C. angularis*. D'Orbigny's specimens were from Cuba and Martinique, which, with the Jamaica record, shows that it is probably widely distributed in the West Indies.

---

[7] Proc. Mem. Manchester Lit. Philos Soc. ,vol. 54, no. 16, 1910, p. 11, pl. 1, fig. 10.

Family LAGENIDAE.

Genus POLYMORPHINA d'Orbigny, 1826.

POLYMORPHINA cf. VITREA (d'Orbigny).

Plate 12, fig. 4.

Guttulina vitrea D'ORBIGNY, Foram. Cuba, 1839, p. 133, pl. 2, figs. 1–3.

A single station from Montego Bay, station 6, is nearer to this than any other of d'Orbigny's species. As there is but the single specimen, it is difficult to say whether it is an adult or an immature specimen. It is the only representative of the family in the Jamaican material which is remarkable, as several of the genera are abundant

FIG. 1.—CLAVULINA NODOSARIA D'ORBIGNY. SPECIMEN FROM 10 FATHOMS, MONTEGO BAY. OUTLINE. × 100.

FIG. 2.—POLYMORPHINA CF. VITREA D'ORBIGNY. SPECIMEN FROM 10 FATHOMS, MONTEGO BAY. × 50.

at moderate depths in the Gulf of Mexico and Caribbean. In d'Orbigny's work, however, the family was represented by but few species, showing that they are not common in the very shallow water

Family GLOBIGERINIDAE.

Genus GLOBIGERINA d'Orbigny, 1826.

GLOBIGERINA BULLOIDES d'Orbigny.

Plate 12, fig. 5.

Globigerina bulloides D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 277, No. 1; Modèles, Nos. 17 and 76.
Globigerina siphonifera D'ORBIGNY, Foram. Cuba, 1839, p. 83, pl. 4, figs. 15–18.

Specimens of this widespread species occurred at four stations, Montego Bay, stations 2, 4, and 6, with few specimens in each; and rare at Runaway Bay. D'Orbigny does not record this species in the Cuban Monograph. However, his *G. siphonifera* is apparently the same species and may account for it, being a specimen with the bases of the spinose projections still attached to the test. Such specimens are not uncommon in well preserved material of *G. bulloides* throughout its range. D'Orbigny recorded *G. siphonifera* from Cuba and Jamaica.

GLOBIGERINA RUBRA d'Orbigny.

Plate 12, fig. 6.

Globigerina rubra D'ORBIGNY, Foram. Cuba, 1839, p. 82, pl. 4, figs. 12–14.

The only specimens of this species are from Montego Bay, stations 4 and 6. Specimens are not at all common in spite of the fact that the species is very common in the general region in deeper water. D'Orbigny describes it from shore sands of Cuba, and also recorded it from Jamaica, Guadeloupe, and Martinique. Specimens both with and without the reddish coloring occur in the material, the form alone being sufficient to determine the species. The West Indian material of this species has a peculiar deep red color; but, although the species is recorded from the Pacific, while it often has a similar form, it almost invariably lacks the color.

GLOBIGERINA DUTERTREI d'Orbigny.

Plate 12, fig. 7.

Globigerina dutertrei D'ORBIGNY, Foram. Cuba, 1839, p. 84, pl. 4, figs. 19–21.

D'Orbigny described this species from Cuba and recorded it also from Martinique and Guadeloupe. It occurred at Montego Bay, at stations 4 and 6, and also at Runaway Bay. It is now known to be widely distributed.

Family ROTALIIDAE.

Genus PLANORBULINA d'Orbigny, 1826.

PLANORBULINA ACERVALIS H. B. Brady.

Plate 12, fig. 8.

Planorbulina acervalis H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 657, pl. 92, fig. 4.

Somewhat of a problem is presented by the Jamaican specimens of *Planorbulina*. All the material—and it is abundant—seems very definitely to be *P. acervalis*. In the Cuban Monograph d'Orbigny describes *P. vulgaris*, which seems from the figures and notes to be identical with *P. mediterranensis* d'Orbigny, described in 1826, Neither species as figured by d'Orbigny seems like actual material I have examined, and one is brought to the conclusion that the regular spiral condition shown is due to the conventionalizing of the drawings. The Cuban specimen is evidently curved and seemingly an attached form. At Montego Bay the most abundant locality for *Planorbulina* was the short eel grass of the protected areas behind the Bogue Islands. There it was in great numbers attached to the eel grass. It was, however, also found at stations 2, 4, 5, 6, and at Runaway Bay.

Typical *P. mediterranensis* is not definitely known from the West Indian region in shallow water. Goës, in 1882, records and figures two forms under the name *Planorbulina farcta* var. *vulgaris*, of which figure 227 seems most like *P. mediterranensis* or *P. vulgaris*. Figure 226, however, is *P. acervalis* H. B. Brady without any doubt. These were both from the Caribbean. In 1896 Goës [8] records *Planorbulina* again from the Caribbean as *P. mediterranensis*, and places his earlier *P. farcta*, var. *vulgaris* as a synonym, but figure 226 as *P. acervalis*, as noted above. Goës gives the following not very clear note (p. 74):

A pygmy form of this species is not seldom met with in the Caribbean Sea in 300 fathoms of water. A variety of higher development that Brady has described under a separate denomination (*P. acervalis*) is also joined with the type, but of more rare occurrence.

As both forms occur together and one is a "pygmy form" it is possible that this is but the young of *P. acervalis*. Flint [9] records both species from the Gulf of Mexico, a single specimen of *P. mediterranensis* from *Albatross* station D2377, and *P. acervalis* from D2399 (number of specimens not given). The diameter of the former is given as 1 mm., that of the latter 1.5–2.5 mm. The specimen given as *P. mediterranensis* is evidently broken, from the evidence of the figure. The accumulative evidence then shows that *P. acervalis* is abundant in the West Indies and *P. mediterranensis* very rare or of doubtful occurrence.

Therefore it might seem from the incomplete evidence that d'Orbigny's *P. vulgaris* might possibly be the same as *P. acervalis* of Brady, and if so, would necessarily be used instead of *acervalis* for this species. The only means of really settling the problem would be the examination of the type specimens of *P. vulgaris* if they are extant, but the problem is here raised for consideration.

Genus TRUNCATULINA D'Orbigny, 1826.

TRUNCATULINA ROSEA (d'Orbigny).

Plate 13, figs. 1–3.

Rosalina rosea D'ORBIGNY, Foram. Cuba, 1839, p. 72, pl. 3, figs. 9–11.

This is typically a West Indian species described by d'Orbigny in the Cuban Monograph and recorded but a few times since. It is recorded from the shores of Cuba, Martinique, Guadeloupe, St. Thomas, Jamaica, and Haiti. Flint records it from Puerto Rico.[10] In the latter case, however, it is noteworthy that Flint records it only from the shallowest station depths 4–7½ fathoms (7–15 meters), and not in any of the others from 14¾–23 fathoms (27–42 meters), indicating

[8] Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 73.

[9] Ann. Rept. U. S. Nat. Mus., 1897 (1899), p. 328.

[10] Bull. U. S. Fish Commission, 1900, p. 415-416.

that its natural habitat is very shallow water. In the Montego Bay material it is astonishingly abundant, the specimens giving color to the finer material. It occurs at all the stations at Montego Bay, and also from Runaway Bay. It was very abundant in from 1–3 fathoms (2–5 meters), much less so in the 6–10 fathoms (11–18 meters) of the deeper stations. I recorded a single specimen from the dock piles at Woods Hole [11] which was very typical, but there are not any intermediate records. I have recorded this species from Fort Jefferson Channel, Tortugas, Florida,[12] and it occurs at other stations in the Gulf of Mexico, always, so far as I have seen, in shallow water. Egger [13] records *T. rosea* from West Australia in 90–359 fathoms (165–656 meters) depth. Egger's figures, however, do not remotely suggest the real characters of this species, and it is evidently not this species.

Just what the habits of this species are which keep it so closely confined to shallow water in the West Indies, yet allow it to occur there in such numbers, would be interesting to determine. Its color is very attractive, being one of the few foraminifera showing a red color.

TRUNCATULINA CANDEIANA (d'Orbigny).

Plate 13, figs. 4, 5.

Rosalina candeiana D'ORBIGNY, Foram. Cuba, 1839, p. 97, pl. 4, figs. 2–4.

Specimens identical with this species as figured by d'Orbigny were found at Montego Bay stations 4, 5, and 6, and from Runaway Bay. D'Orbigny's specimens were from Cuba.

This name has been entirely neglected since its application. It seems to have been applied to a definite species, the distribution of which outside the West Indian region is at present unknown. Most of the specimens are close to the 0.5 mm. diameter given by d'Orbigny.

TRUNCATULINA ANTILLARUM (d'Orbigny).

Plate 13, figs. 6–8.

Rosalina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 75, pl. 5, figs. 4–6.

Description.—Test nearly equally convex, punctate, margin carinate, spire conical, slightly convex; chambers seven in the last-formed coil, curved and oblique from above; sutures obliquely curved; below triangular, the sutures straight and radial; aperture elongate, slightly curved as the inner margin of the chamber. Diameter, 0.5–1 mm.

This is another of the species described by d'Orbigny which has been entirely neglected. Material from Montego Bay, stations 5 and 6, is very close to the original figures of d'Orbigny's Monograph. D'Orbigny's specimens were from Cuba and Jamaica.

[11] Proc. Boston Soc. Nat. Hist., vol. 34, No. 2, 1908, p. 30.

[12] Publ. 213 Carnegie Inst., Washington, 1918.

[13] Abh. Kais. Akad. Wiss. München, vol. 18, 1893, p. 397, pl. 16, figs. 4–6.

Genus CYMBALOPORA Hagenow, 1850.

CYMBALOPORA POEYI (d'Orbigny).

Plate 13, figs. 9–12.

Rotalia squammosa D'ORBIGNY (*nomen nudum*), Ann. Sci. Nat., vol. 7, 1826, p. 272, No. 8.

Rosalina poeyi D'ORBIGNY, Foram. Cuba, 1839, p. 92, pl. 3, figs. 18–20.

[?] *Rosalina squammosa* D'ORBIGNY, Foram. Cuba, 1839, p. 91, pl. 3, figs. 12–14.

D'Orbigny described this species from the West Indies, noting that it occurs plentifully adhering to *Fucus* and *Ulva Lactuca*. The form described as *R. squammosa* has a much higher spire, but seems, from the figures at least, to be very close, if not identical with, *C. poeyi*. The low form is the one that is abundant at Jamaica.

Although not observed attached to algae at Montego Bay, the specimens were noted as occurring in much greater abundance in depths of 1 fathom (2 meters) or less, than in 3–10 fathoms (5–18 meters). At the lesser depths it was very abundant. Specimens were collected at stations 1, 2, 4, and 6 at Montego Bay and at Runaway Bay.

This is one of the species which is widely distributed either in its typical form or varieties in the tropical Pacific, as well as the West Indian region.

Genus TRETOMPHALUS Moebius, 1880.

TRETOMPHALUS BULLOIDES (d'Orbigny).

Plate 13, fig. 13.

Rosalina bulloides D'ORBIGNY, Foram. Cuba, 1839, p. 98, pl. 3, figs. 2, 3.

Cymbalopora bulloides CARPENTER, PARKER, and JONES, Introd. Foram., 1862, p. 216.

Tretomphalus bulloides MOEBIUS, Beitr. Meeresfauna Insel Mauritius, 1880, p. 98, pl. 10, figs. 6–9.

This is rare in 6 fathoms (11 meters) at Montego Bay. It is a pelagic species at least in adult condition, and has a wide range in comparatively shallow water in the Pacific and Indian Oceans, as well as south to Australia.

Genus SIPHONINA Reuss, 1849.

SIPHONINA RETICULATA (Czjzek).

Rotalina reticulata CZJZEK, Haidinger's Nat. Abh., vol. 2, 1848, p. 145, pl. 13, figs. 7–9.

Truncatulina reticulata BRONN, Lethaea Geognostica, ed. 3, vol. 3, 1853–1856, p. 227, pl. 35 (?), figs. 23*a–c*.

There seems to be no figure or description in d'Orbigny's Cuban Monograph which at all apply to this species. Specimens were found at Montego Bay at stations 1 and 5, at both of which it was rare.

The numerous forms or species referred to this species are evidently a complex which needs revision. There are numerous species in this general region, both living, and in the Tertiary, a close study of which should give some idea as to the relation of the different forms.

Genus DISCORBIS Lamarck, 1804.

DISCORBIS AUBERII (d'Orbigny).

Plate 14, figs. 1–3.

Rosalina auberii D'ORBIGNY, Foram. Cuba, 1839, p. 94, pl. 4, figs. 508.

Description.—Test trochoid, with a low spire, periphery carinate, acute, ventral side slightly if at all convex, composed of several coils with four chambers in each, sutures distinct, wall of the chambers rather coarsely perforate, aperture at the base of the last-formed chamber, elongate. Diameter, 0.4 mm.

The only specimens were from Runaway Bay.

This species has not been referred to since its first description, but it fits admirably the material above mentioned. D'Orbigny's specimens were from Cuba and Martinique.

DISCORBIS VALVULATA (d'Orbigny).

Plate 14, figs. 4, 5.

Rosalina valvulata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 271, No. 4; in Barker, Webb, and Berthelot, Hist. Nat. Îles Canaries, 1839, vol. 2, pt. 2, "Foraminifères," p. 136, pl. 2, figs. 19–21; Foram. Cuba, 1839, p. 96, pl. 3, figs. 21–23.

Description.—Test much compressed, translucent, very thin-walled, dorsally with a very low slightly convex spire, ventrally slightly concave; chambers with the periphery rounded and slightly thickened, sutures distinct but only very slightly depressed, on the ventral side with slight alar projections toward the umbilicus; wall thin except at the chamber margins; punctations very fine; aperture at the inner margin of the ventral side of the chamber; color slightly yellowish. Length, about 0.5 mm.

The only material which belongs to this species is from 6 fathoms (11 meters) at Montego Bay. It is, however, very typical and shows that the figures of d'Orbigny were very accurate for this species. It is evident also that the figures of the Canaries Monograph are much poorer copies of the same figures as in other cases. The original specimens mentioned by d'Orbigny in 1826 were from the coast of Martinique in the West Indies. It is also clear that Brady referred to this species material which is very different and does not belong here. The figures of the *Challenger* Report (pl. 87, figs. 5–7) show a much thicker, heavier test, with coarse punctations, entirely different shape, fewer chambers, and in short the two have nothing in common except the limbate sutures, which in the Cuba specimen are more a difference in texture of the wall than truly limbate in character.

Brady's species, therefore, is an entirely different one from the West Indian one described by d'Orbigny.

DISCORBIS ORBICULARIS (Terquem).

Rosalina orbicularis TERQUEM, Anim. sur la Plage de Dunkerque, 1876, p. 75, pl. 9, figs. 4*a*, *b*.
Discorbis orbicularis BERTHELIN, Foram. de Borgneuf et Pornichet, 1878, p. 39, No. 63.
Discorbina orbicularis H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 647, pl. 88, figs. 4–8.

This is another of the species of the West Indies which d'Orbigny does not seem to have had in his material. Brady gives it as plentiful amongst the West Indies. Very typical material was obtained at Montego Bay, in 6 fathoms (11 meters).

Genus PULVINULINA Parker and Jones, 1862.

PULVINULINA MENARDII (d'Orbigny).

Rotalia menardii D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 273, No. 26; Modèles, No. 10.
Pulvinulina menardii OWEN, Journ. Linn. Soc. London (Zool.), vol. 9, 1867, p. 148, pl. 5, fig. 6.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 690, pl. 103, figs. 1, 2.

This species, a pelagic one of open oceans, was not recorded by d'Orbigny in his Cuban Monograph. It did not occur in the shallow water material at Montego Bay or Runaway Bay, but rare specimens were found at the deeper stations at Montego Bay in 9 and 10 fathoms, (16 and 18 meters) evidently coming in from open water.

PULVINULINA OBLONGA (Williamson).

Nautilus auricula, var., FICHTEL and MOLL, Test. Micr., 1803, p. 108, pl. 20, figs. *d–f*.
Rotalina oblonga WILLIAMSON, Rec. Foram. Great Britain, 1859, p. 51, pl. 4, figs. 98-100.
Pulvinulina oblonga, H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 688, pl. 106, figs. 4*a–c*.

A single specimen of this species was found in the dredging from 10 fathoms (18 meters), Montego Bay. Specimens of this general form are common in the tropics, both in the West Indian region and in the tropical Pacific, but need close study to determine whether or not they all belong to one species.

Genus ASTERIGERINA d'Orbigny, 1839.

ASTERIGERINA CARINATA d'Orbigny.

Plate 14, figs. 6–8.

Asterigerina carinata D'ORBIGNY, Foram. Cuba, 1839, p. 118, pl. 5, fig. 25; pl 6, figs. 1–2.

D'Orbigny described this species from shore sands of Cuba and Jamaica. In the material both from Runaway Bay and Montego Bay this is one of the most common of the species found. It is very definite in its characters, and shows that *Asterigerina*, at least as far as this species and *A. lobata* are concerned, is very close to *Amphistegina* rather than to *Discorbis*, as it is placed by Brady. The characters are very constant, and there is evidently in this region a remarkable development of foraminifera of this genus, both in recent sands and in late tertiary deposits. The figures given by d'Orbigny of this species are excellent. Specimens exceed somewhat the diameter given by d'Orbigny of one-half mm., but do not attain a size of more than 0.75–0.80 mm. in this material. An examination of the West Indian and Florida material shows that this species is very abundant in comparatively shallow water throughout a large part of the region, extending north as far as Cape Hatteras on the Atlantic coast.

Genus NONIONINA d'Orbigny, 1826.

NONIONINA GRATELOUPI d'Orbigny.

Plate 14, figs. 9–11.

Nonionina grateloupi d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 294, No. 19; Foram. Cuba, 1839, p. 46, pl. 6, figs. 6–7.—CUSHMAN, Publ. 291, Carnegie Inst. Washington, 1919, p. 48.

Specimens identical with this species as figured by d'Orbigny were dredged at Montego Bay in 1, 6, and 10 fathoms (2, 11, and 18 meters). D'Orbigny's specimens were from Cuba, Jamaica, and Martinique. D'Orbigny's figure of the side view, with the peculiar angle made by the last few chambers and the swollen median portion in front view, are characteristic.

N. sloanii, which was not found in the Jamaican material, is, however, found in the later Tertiary of the West Indies, occurring both in Cuba and Santo Domingo. It seems to be a valid species, and with its greater compression in front view can be distinguished from forms usually assigned to *N. boueana*.

Genus POLYSTOMELLA Lamarck, 1822.

POLYSTOMELLA LANIERI d'Orbigny.

Plate 14, figs. 12, 13.

Polystomella lanieri d'ORBIGNY, Foram. Cuba, 1839, p. 51, pl. 7, figs. 12-13.—CUSHMAN, Publ. 291, Carnegie Inst. Washington, 1919, p. 49.

Brady, in the *Challenger* Report (p. 736), places this species as a synonym of *P. crispa* Linnaeus. While this may be a reasonable disposition of the species, the Jamaican specimens are very close to d'Orbigny's figures of *P. lanieri*. They occurred at stations 1 and 2 at Montego Bay and at Runaway Bay.

No specimens were found of *P. sagra* d'Orbigny, but the species is found in the West Indies as a late Tertiary fossil, both in Santo Domingo and Cuba, and probably is a valid recent species. D'Orbigny noted it as rare in the shore sands of Cuba.

POLYSTOMELLA cf. STRIATO-PUNCTATA (Fichtel and Moll).

This is a much overworked species, which undoubtedly includes several distinct species or varieties.

The Jamaican specimens apparently represent two distinct forms, of which one is close to *P. poeyana* d'Orbigny of the Cuban Monograph. Until a revision of the genus can be attempted with abundant specimens the material had best be referred here. Specimens were from Montego Bay, stations 1, 4, and 6.

Genus AMPHISTEGINA d'Orbigny, 1826.

AMPHISTEGINA GIBBOSA d'Orbigny.

Amphistegina gibbosa D'ORBIGNY, Foram. Cuba, 1839, p. 120, pl. 8, figs. 1–3.

The Jamaican specimens, which are very numerous at nearly all the stations, but especially so from 6–10 fathoms (11–18 meters), are all of the form described by d'Orbigny in the Cuban Monograph. Whether this is really different from *A. lessonii* d'Orbigny may be questioned, but can be better answered after a study of the Recent and Tertiary material, where many forms of the genus occur.

Genus HETEROSTEGINA d'Orbigny, 1826.

HETEROSTEGINA ANTILLARUM d'Orbigny.

Heterostegina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 122, pl. 7, figs. 24–25.

Specimens were occasionally found in the Montego Bay material which in side view seemed very much like this species in all its characters, but in front view were seen to be the young of *Orbiculina adunca*, where the translucent character of the walls allowed the chamberlets to be seen apparently as markings on the outer wall. No true *Heterostegina* was found.

Family MILIOLIDAE.

Genus CORNUSPIRA Schultze, 1854.

CORNUSPIRA INVOLVENS (Reuss).

Operculina involvens REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 370, pl. 45, fig. 20.

Cornupsira involvens REUSS, Sitz. Akad. Wiss. Wien, vol. 48, 1863 (1864), p. 39, pl. 1, fig. 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 200, pl. 11, figs. 1–3.

No specimens are recorded from Cuba by d'Orbigny which could possibly be this species. It is rare, being found at but two of the Jamaica stations at Montego Bay, 1 and 4.

Genus SPIROLOCULINA d'Orbigny, 1826.

SPIROLOCULINA ANTILLARUM d'Orbigny.

Plate 14, figs. 14, 15.

Spiroloculina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 166, pl. 9, figs. 3, 4(?).—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 155, pl. 10, figs. 21*a*, *b*.

An examination of the Jamaican material and a comparison of the material with the figures given by d'Orbigny seem to show that *S. antillarum* should be the name used for our recent species so common among coral reefs in shallow water. In that case it would take precedence over *S. grata* Terquem, which Brady took for the name for our recent species. A comparison of Terquem's and d'Orbigny's figures would seem to show that the Cuban species certainly as fully represents our recent species as does that from the Pliocene of the Isle of Rhodes. D'Orbigny's name was published nearly 40 years earlier. Brady's figure, which he refers to *Spiroloculina antillarum*, is not typical of this species, as it occurs in the West Indies.

Specimens were found in dredgings from Montego Bay, stations 1, 2, and 4, and from Runaway Bay.

SPIROLOCULINA ANTILLARUM d'Orbigny, var. ANGULATA Cushman.

Plate 14, fig. 16.

Spiroloculina grata H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 10, figs. 22, 23.

Spiroloculina grata TERQUEM, var. *angulata* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 36, pl. 7, fig. 5.

This variety occurs with typical *S. antillarum*. It was noted at Montego Bay at stations 1, 2, 3, and 10.

SPIROLOCULINA ARENATA, new species.

Plate 14, fig. 17.

Description.—Test compressed, chambers in a single plane, each much greater in diameter at the initial end, gradually narrowing to the aperture, both ends projecting beyond the ends of the preceding chamber, apertural end produced into a rounded neck, periphery broadly rounded, sutures deep and distinct; wall of sand grains rather coarse for the size of the test; aperture rounded. Length, 0.6–0.9 mm.

Type specimen (U.S.N.M. No. 15989) from station 2, Montego Bay, Jamaica. Specimens were also obtained from stations 1, 4, and 6 at Montego Bay.

This has a different form from *S. asperula* Karrer. Occasionally the chambers leave openings in the test where the newly-formed chamber is added without completely filling in the space between it and the previously formed coil.

SPIROLOCULINA cf. ORNATA d'Orbigny.

Spiroloculina ornata D'ORBIGNY, Foram. Cuba, 1839, p. 167, pl. 12, figs. 7, 7^1.

A single specimen from station 2 at Montego Bay is very much like the figure given by d'Orbigny under this name. The originals are from sands of Cuba; rare.

Genus VERTEBRALINA d'Orbigny, 1826.

VERTEBRALINA CASSIS d'Orbigny.

Plate 15, figs. 1–8.

Vertebralina cassis D'ORBIGNY, Foram. Cuba, 1839, p. 51, pl. 7, figs. 14–15.
Vertebralina mucronata D'ORBIGNY, Foram. Cuba, 1839, p. 52, pl. 7, figs. 16–19.

Brady placed this species as a synonym of *Articulina sagra* d'Orbigny. However, by the law of priority, the name *cassis* should take precedence, even though the two were considered the same. The development of the two genera has already been studied, and *Vertebralina* seems related to *Spiroloculina* as a derivative, while *Articulina* seems to have been derived from the Milioline series, either *Quinqueloculina* or *Triloculina*. As different genera the two need not be confused and in fact it does not seem that the two should ever have been placed together.

Vertebralina cassis is common in the Jamaican material at Montego Bay at stations 2, 4, and 6, and at Runaway Bay. The material is very typical at all the stations.

It seems evident that *V. mucronata* is a synonym of *V. cassis* as indicated by Brady.

D'Orbigny had material from several West Indian islands, and I have found it in the Gulf of Mexico and on the coast of Florida.

VERTEBRALINA, species?

In the Montego Bay material, from stations 4, 5, and 6, there are rare specimens, evidently young, of a smooth species of this genus, but not in sufficient quantity to warrant description.

Genus QUINQUELOCULINA d'Orbigny, 1826.

QUINQUELOCULINA ALVEOLINIFORMIS (H. B. Brady).

Miliolina alveoliniformis H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 181, pl. 8, figs. 15–20.
Quinqueloculina alveoliniformis CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 43.

This is a large species peculiar to tropical regions in fairly shallow water. Specimens occurred in the Runaway Bay material and in the dredgings from 9 fathoms (16 meters) in Montego Bay. It is singular that this species is not recorded in some form in the Cuban Monograph.

QUINQUELOCULINA AGGLUTINANS d'Orbigny.

Plate 15, figs. 9, 10.

Quinqueloculina agglutinans D'ORBIGNY, Foram. Cuba, 1839, p. 195, pl. 12, figs. 11–13.

This has become a convenient name to use for almost any arenaceous quinqueloculine species. The Jamaican material is of the form described and figured by d'Orbigny. It was common in the Montego Bay material and found at stations 1, 2, 4, and 5.

D'Orbigny's records are from Jamaica and rare in Cuba. I have had material from numerous stations in the shallow water of the Gulf

FIG. 3.—QUINQUELOCULINA AGGLUTINANS D'ORBIGNY. APERTURAL VIEW OF SPECIMEN FROM 1 FATHOM, BOGUE ISLANDS, MONTEGO BAY. × 40.

FIG. 4.—QUINQUELOCULINA BIDENTATA D'ORBIGNY. APERTURAL VIEW OF SPECIMEN FROM RUNAWAY BAY. × 40.

of Mexico and along the Florida Keys, as well as in the Bahamas. All have the typical form as shown in d'Orbigny's figure.

QUINQUELOCULINA BIDENTATA d'Orbigny.

Plate 15, figs. 11, 12.

Quinqueloculina bidentata D'ORBIGNY, Foram. Cuba, 1839, p. 197, pl. 12, figs. 18–20.

This species differs from *Q. agglutinans* in the shape of the chambers especially and the more elongate form. It was found frequently at Runaway Bay, but not at Montego Bay where *Q. agglutinans* is common.

D'Orbigny's specimens were from Cuba.

QUINQUELOCULINA LAMARCKIANA d'Orbigny.

Plate 15, figs. 13, 14.

Quinqueloculina lamarckiana D'ORBIGNY, Foram. Cuba, 1839, p. 189, pl. 11, figs. 14, 15.

Quinqueloculina auberiana D'ORBIGNY, Foram. Cuba, 1839, p. 193, pl. 12, figs. 1–3.

Quinqueloculina cuvieriana H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 162, pl. 5, figs. 12*a–c*.

In the Cuban Monograph *Q. lamarckiana* is given from Cuba and Jamaica, and *Q. auberiana* from Cuba and Martinique. The descriptions of the two are almost identical, and it seems that they should be considered as one species. In that case the name *Q. lamarckiana* must take precedence. Brady placed *Q. lamarckiana* as a synonym of *Q. cuvieriana*, but that species has the secondary costae marking the test and is distinct; also Brady's figures of *cuvieriana* do not represent that species as described and figured by d'Orbigny, but rather belong to *Q. lamarckiana*. It is a species widely distributed in the tropical Pacific as well as in the West Indies.

Jamaican material was obtained at Montego Bay at stations 1, 2, 4, 5, and 6, and also from Runaway Bay.

QUINQUELOCULINA CUVIERIANA d'Orbigny.

Plate 16, figs. 1, 2.

Quinqueloculina cuvieriana D'ORBIGNY, Foram. Cuba, 1839, p. 190, pl. 11, figs. 19–21.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 47, pl. 12, fig. 2.

This is not a common species, a few specimens being found at stations 1 and 5 at Montego Bay, and also at Runaway Bay.

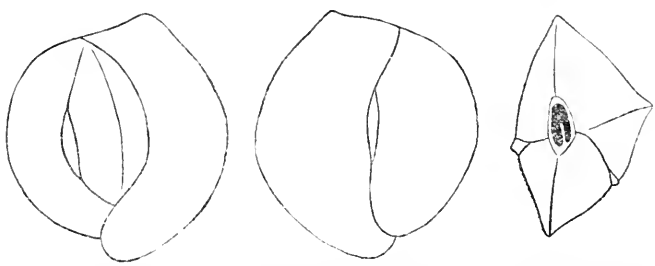


FIG. 5.—QUINQUELOCULINA LAMARCKIANA D'ORBIGNY. *a*, SIDE VIEW OF SPECIMEN; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW OF SPECIMEN FROM 9 FATHOMS, MONTEGO BAY. × 50.

D'Orbigny's specimens were from Cuba. I found similar specimens in material from Hongkong in shallow water.

QUINQUELOCULINA BRADYANA Cushman.

Miliolina undosa H. B. BRADY (not *Quinqueloculina undosa* Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 176, pl. 6, figs. 6–8.

Quinqueloculina bradyana CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 52, pl. 18, fig. 2.

Most of the records for this species are from the Indo-Pacific, but it has been found in the Jamaican material at Runaway Bay, and at stations 1, 2, 4, 5, and 6 at Montego Bay.

QUINQUELOCULINA POLYGONA d'Orbigny.

Plate 16, figs. 3, 4.

Quinqueloculina polygona D'ORBIGNY, Foram. Cuba, 1839, p. 198, pl. 12, figs. 21–23.

Brady gives this as a synonym of *Q. ferussacii* d'Orbigny, but the two do not seem to hold much in common. Apparently the species of Jamaica and Cuba described by d'Orbigny as *Q. polygona* is a very definite species, as shown by the Montego Bay material. These are very different from the slender elongate species usually assigned to *Q. ferussacii*. The chambers are clear cut and squarish, as shown in the type figure.

It occurs at stations 3–6 at Montego Bay and is a much smaller species than *Q. ferussacii*.

QUINQUELOCULINA DILATATA d'Orbigny.

Plate 16, figs. 5, 6.

Quinqueloculina dilatata D'ORBIGNY, Foram. Cuba, 1839, p. 192, pl. 11, figs. 28–30.—SCHLUMBERGER, Mem. Soc. Zool. France, vol. 6, 1893, p. 217, figs. 29, 30; pl. 3, figs. 70–74; pl. 4, figs. 87–90.

This species, described from Cuba and St. Thomas by d'Orbigny as rare, has been recorded by Schlumberger from the region of Marseilles and by Wiesner from the Adriatic.

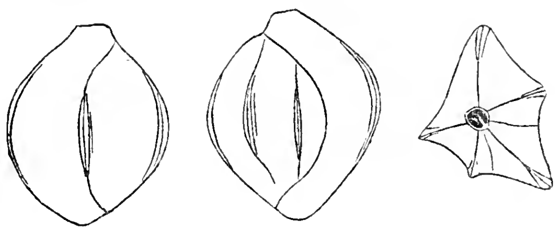


FIG. 6.—QUINQUELOCULINA CUVIERIANA D'ORBIGNY. *a*, SIDE VIEW; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW. APERTURAL VIEW OF SPECIMEN FROM RUNAWAY BAY. × 50.

It is not common in the Jamaican material, the only station being in 1 fathom (2 meters) at Montego Bay.

QUINQUELOCULINA POEYANA d'Orbigny.

Plate 16, figs. 7, 8.

Quinqueloculina poeyana D'ORBIGNY, Foram. Cuba, 1839, p. 191, pl. 11, figs 25–27.

In the Jamaican material this species stands out very distinctly, of the form and characters shown in d'Orbigny's figure, which is excellent. The species has been allowed to lapse since its description, even Brady, strangely enough, not including it as a synonym under any of the species of the *Challenger* Report.

Specimens were obtained at Montego Bay from stations 1, 4, 5, and 6.

QUINQUELOCULINA ANTILLARUM d'Orbigny.

Plate 16, figs. 9, 10.

Quinqueloculina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 194, pl. 12, figs. 4–6.

The reticulate ornamentation of the triloculine and quinqueloculine series seems to be largely confined to tropical species. From material

I have been able to examine from widely separated areas in the tropics there seem to be definitely characterized species, which seem to have definite geographical ranges. The *Q. antillarum* of d'Orbigny has very fine reticulations, with numerous transverse wrinkles and a broad truncate peripheral margin. Such specimens were found at Montego Bay in 9 fathoms (16 meters). D'Orbigny's material was from Cuba and Jamaica.

QUINQUELOCULINA TRICARINATA d'Orbigny.

Plate 16, figs. 11, 12.

Quinqueloculina tricarinata D'ORBIGNY, Foram. Cuba, 1839, p. 187, pl. 11, figs. 7–9, 11.

This is another of the d'Orbignyan species that has been ignored since its description. The figure gives the impression of an abnormal specimen, but the study of the Jamaican material shows that it is an accurate figure of this peculiar species, and gives one decided confidence in d'Orbigny's figures as true representations of the material he had. There is some little variation in the material, but it keeps close to the form described by d'Orbigny.

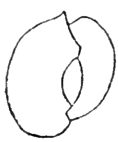


FIG. 7.—QUINQUELOCULINA DILATATA D'ORBIGNY SPECIMEN FROM 1 FATHOM, BOGUE ISLANDS, MONTEGO BAY. SIDE VIEW. × 50.

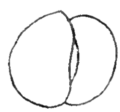


FIG. 8.—QUINQUELOCULINA DILATATA D'ORBIGNY. SIDE VIEW OF ANOTHER SPECIMEN FROM THE SAME LOCALITY. × 50.

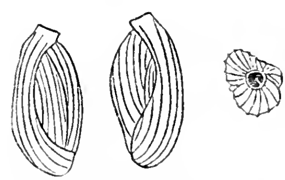


FIG. 9.—QUINQUELOCULINA POEYANA D'ORBIGNY. *a*, SIDE VIEW; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW. SPECIMEN FROM 10 FATHOMS, MONTEGO BAY.

Quinqueloculina tricarinata was found at all but one of the Jamaican stations, at Montego Bay at stations 1, 2, 4, 5, and 6, and also at Runaway Bay.

It is in certain characters close to *Q. kerimbatica* Heron-Allen and Earland, which was described from the Kerimba Archipelago and which is common in the Philippine region and probably elsewhere in the Indo-Pacific.

D'Orbigny's specimens were from Cuba and Jamaica.

The specimens which I have referred to as *Quinqueloculina*, species cf. *Q. kerimbatica* (Heron-Allen and Earland)[14] may belong to this species. They were from the Tertiary of Santo Domingo.

[14] Publ. 291, Carnegie Institution of Washington, 1919, p. 67, pl. 14, fig. 5.

QUINQUELOCULINA PARKERI (H. B. Brady), var. OCCIDENTALIS, new variety.

Description.—Test differing from the typical in the great number of the fine transverse or slightly oblique ridges or crenulations, and the tendency for the chambers to become squarely truncate or even tricarinate.

Type specimen (U.S.N.M. No. 15990) with others from station 5 in 9 fathoms (16 meters), Montego Bay, Jamaica.

The typical form is characteristic of coral reef areas of the Indo-Pacific area.

Genus TRILOCULINA d'Orbigny, 1826.

TRILOCULINA TRIGONULA (Lamarck).

Miliolites trigonula LAMARCK, Ann. du Mus., vol. 5, 1804, p. 351, No. 3.
Triloculina trigonula D'ORBIGNY, Ann. Sci Nat., vol. 7, 1826, p. 299, No. 1, pl. 16, figs. 5–9; Modèles, No. 93.

Specimens occurred at stations 2, 4, and 6 at Montego Bay, but only as single specimens from each station.

TRILOCULINA OBLONGA (Montagu).

Plate 17, figs. 5, 6.

Vermiculum oblongum MONTAGU, Test. Brit., 1803, p. 522, pl. 14, fig. 9.
Triloculina oblonga D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 16; Modèles, No. 95; Foram. Cuba, 1839, p. 175, pl. 10, figs. 3–5.

This species is found in the material from all but one of the Jamaican stations. From Runaway Bay a few specimens only were found, but are more numerous at Montego Bay at stations 1, 2, 4, 5, and 6.

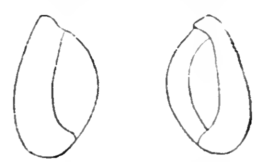


FIG. 10.—TRILOCULINA OBLONGA (MONTAGU). *a*, SIDE VIEW; *b*, OPPOSITE SIDE. SPECIMEN FROM MONTEGO BAY. × 50.

TRILOCULINA SUBORBICULARIS d'Orbigny.

Triloculina suborbicularis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 12: Foram. Cuba, 1839, p. 177, pl. 10, figs. 9–11.
Quinqueloculina suborbicularis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 302, No. 29.

The only material of this species was found in the dredging from 6 fathoms (11 meters) in Montego Bay.

TRILOCULINA CIRCULARIS Bornemann.

Triloculina circularis BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 349, pl. 19, fig. 4.

This widely distributed species is in the material from nearly all the Jamaican stations, from Runaway Bay and from stations 1, 2, 4, and 6 from Montego Bay.

TRILOCULINA LABIOSA d'Orbigny.

Plate 16, figs. 13, 14.

Triloculina labiosa D'ORBIGNY, Foram. Cuba, 1839, p. 157, pl. 10, figs. 12–14.

D'Orbigny described this species from Cuba. Specimens were rare in the Cuban material from stations 2, 4, and 6 at Montego Bay.

TRILOCULINA FICHTELIANA d'Orbigny.

Plate 17, figs. 1, 2.

Triloculina fichteliana D'ORBIGNY, Foram. Cuba, 1839, p. 171, pl. 9, figs. 8–10.

The only material of this species is from shallow water at Runaway Bay and in 1 fathom (2 meters) at Montego Bay. D'Orbigny's material was from Cuba and Jamaica, and he later recorded it from the Canaries.

TRILOCULINA LINNEIANA d'Orbigny.

Plate 17, figs. 3, 4.

Triloculina linneiana D'ORBIGNY, Foram. Cuba, 1839, p. 172, pl. 9, figs. 11–13.

D'Orbigny gives this species as common in Cuba and Jamaica, and it certainly is one of the common shallow water species of the West Indian region, as well as elsewhere in the tropics.

Specimens occurred in the material from Runaway Bay and from stations 1, 2, 4, 5, and 6 at Montego Bay.

TRILOCULINA TRANSVERSESTRIATA (H. B. Brady).

Miliolina transversestriata H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 45: Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 177, pl. 4, figs. 6*a–c*.

This is evidently a very rare species, or else, as suggested by Brady, overlooked on account of its small size. A single very typical specimen was found at station 4 in Montego Bay.

Brady's specimens were from Torres Strait and Mauritius.

A further study of the West Indian material has shown that this distribution is not unusual for a considerable number of species.

TRILOCULINA PLANCIANA d'Orbigny.

Plate 17, figs. 7, 8.

Triloculina planciana D'ORBIGNY, Foram. Cuba, 1839, p. 173, pl. 9, figs. 17–19.

This is given by Brady as a synonym of *T. oblonga*, stating "the only difference being in its slightly rugose surface." The surface is made up of slightly interrupted costae and the chambers are more nearly rounded in section than oblong and are more definitely set apart. In the Jamaican material the two would hardly be thought of as at all related when seen side by side in the same dredging.

D'Orbigny's material was from Cuba and Jamaica. It has occurred only at the very shallow stations, 1 and 2 at Montego Bay and also at Runaway Bay.

TRILOCULINA QUADRILATERALIS d'Orbigny.

Triloculina quadrilateralis d'ORBIGNY, Foram. Cuba, 1839, p. 173, pl. 9, figs. 14-16.

Specimens of this species were found in the dredgings from Montego Bay from stations 4 and 5. D'Orbigny's specimens were from Cuba. It is somewhat variable, as he says, and the chambers are not all quadrilateral, especially the younger ones.

TRILOCULINA CARINATA d'Orbigny.

Plate 17, figs. 9, 10.

Triloculina carinata d'ORBIGNY, Foram. Cuba, 1839, p. 179, pl. 10, figs. 15-17.

This is the most common reticulate species of the Jamaican material. It is very common at stations 1, 2, 4, and 6, at Montego Bay. The form is constant and the reticulations rather fine and regular as shown

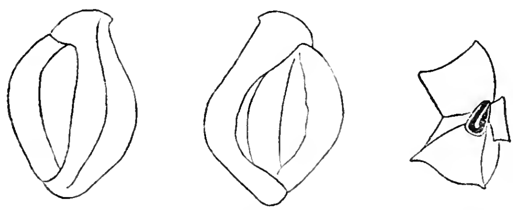


FIG. 11.—TRILOCULINA QUADRILATERALIS D'ORBIGNY. *a*, SIDE VIEW; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW. SPECIMEN FROM 6 FATHOMS, MONTEGO BAY. × 50.

by d'Orbigny. The basal portion of the last chamber sometimes becomes bifurcate. The species reminds one strongly of var. *reticulata* Heron-Allen and Earland, of *Massilina secans* d'Orbigny.

TRILOCULINA CARINATA d'Orbigny, var. OBSCURA, new variety.

Plate 17, fig. 11.

Description.—Test in the early stages as in the typical, but later adding a covering of closely cemented sand grains which may become thick and entirely hide the reticulations.

Type specimen (U.S.N.M. No. 15991), from station 6 in Montego Bay, Jamaica, in 10 fathoms (18 meters). At this station it was abundant and also found at stations 2, 4, and 5.

It was only when the under surface occasionally showed through in places that the true relation of this abundant variety was seen. In some specimens the coating is of very fine sand grains covering but not entirely obscuring the reticulations, but in others it may show only in small portions, or be entirely covered and the reticulations wholly obscured.

Genus HAUERINA d'Orbigny, 1846.

HAUERINA BRADYI Cushman.

Hauerina compressa H. B. BRADY (not *H. compressa* d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 190, pl. 11, figs. 12, 13.

Hauerina bradyi CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 62, pl. 23, fig. 2.

This species, known from the tropical Indian and Pacific Oceans, is now found in the West Indian region. It was rather rare, being found in few numbers at only one station, 10 fathoms (18 meters), in Montego Bay.

This species was found in shallow water material from the Tortugas region and from the Gulf of Mexico, and is probably widely distributed in similar locations in the West Indies.

HAUERINA ORNATISSIMA (Karrer).

Quinqueloculina ornatissima KARRER, Sitz. Akad. Wiss. Wien, vol. 58, 1868, p. 151, pl. 3, fig. 2.

Hauerina ornatissima H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 192, pl. 7, figs. 15–22.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 63, pl. 23, figs. 1, 5.

Specimens are very rare, having been found at stations 4, Montego Bay, and also at Runaway Bay. It has previously been known from the Indo-Pacific.

Genus MASSILINA Schlumberger, 1893.

MASSILINA ASPERULA (Karrer).

Spiroloculina asperula KARRER, Sitz. Akad. Wiss. Wien, vol. 57, 1868, p. 136, pl. 1, fig. 10.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 8, figs. 13, 14.

This is a rare species, the few records in recent seas being from the Philippines and South Seas. Specimens were found at Jamaica from station 6. Both the large and small specimens were found as recorded by Brady, and indicating both megalospheric and microspheric specimens.

MASSILINA INAEQUALIS, new species.

Plate 17, figs. 12, 13.

Description.—Test much elongate, in the adult, spiroloculine, from one side very much excavate, the other nearly plane, early chambers quinqueloculine, later ones spiroloculine, chambers very elongate, irregularly quadrate in transverse section, the peripheral side broader than the inner one, one of the other sides angled, the other straight; surface polished, shiny, but with numerous fine, linear depressions breaking the eveness of the surface; aperture rounded, apertural end of the test somewhat projecting; color glistening white. Length up to 1.5 mm.

Type specimen (U.S.N.M. No. 15992) from station 6, Montego Bay, Jamaica, in 10 fathoms (18 meters). Specimens were also obtained at stations 4 and 5.

Genus ARTICULINA d'Orbigny, 1826.

ARTICULINA CONICO-ARTICULATA (Batsch).

Plate 18, fig. 1.

Nautilus (Orthoceras) conico-articulatus BATSCH, Conch. des Seesandes, 1791, p. 3, pl. 3, fig. 11.

Vertebralina conico-articulina PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 22, pl. 1, fig. 2.

Articulina conico-articulata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 185, pl. 12, figs. 17, 18; pl. 13, figs. 1, 2.

This is one of the common tropical species not recorded by d'Orbigny in the Cuban Monograph. It may not be common in the West Indies. A single typical specimen was found in material from station 6 at Montego Bay.

ARTICULINA SAGRA d'Orbigny.

Plate 18, figs. 2–5.

Articulina sagra D'ORBIGNY, Foram. Cuba, 1839, p. 183, pl. 9, figs. 23–26.

Typical specimens were dredged at Montego Bay in 9 and 10 fathoms (16 and 18 meters), but they are rare. D'Orbigny records it from Cuba, Jamaica, and Martinique.

ARTICULINA LINEATA H. B. Brady.

Plate 18, fig. 6.

Articulina lineata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 183, pl. 12, figs. 19–21.

Brady described this species from the Fiji Islands, Torres Strait, and off the Bermudas, depths ranging from 155–435 fathoms (283-796 meters), and it has since been recorded in other tropical parts of the world.

Specimens were found in the material from stations 4 and 6 in Montego Bay.

Genus BILOCULINA d'Orbigny, 1826.

BILOCULINA SUBSPHAERICA d'Orbigny.

Biloculina subsphaerica D'ORBIGNY, Foram. Cuba, 1839, p. 162, pl. 8, figs. 25–27.

Specimens agreeing with this small species are common at Runaway Bay and at stations 4, 5, and 6 at Montego Bay. They are all very small, but have the characters described by d'Orbigny in shape of aperture, bifid tooth, and the slight curve of the chamber in side view.

D'Orbigny's specimens were from Cuba and Jamaica.

BILOCULINA DENTICULATA (H. B. Brady).

Biloculina ringens (Lamarck), var. *denticulata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 4, 5.
Biloculina denticulata CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 180, pl. 33, fig. 1.

This is a common species of the Indo-Pacific in shallow water. It occurred at Runaway Bay and at stations 4, 5, and 6 at Montego Bay. Specimens occur at other localities in the West Indian and Florida region.

BILOCULINA ELONGATA d'Orbigny.

Biloculina elongata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 298, No. 4.
Biloculina oblonga D'ORBIGNY, Foram. Cuba, 1839, p. 163, pl. 8, figs. 21–23.

This is the least common of the Jamaican species of *Biloculina*. It is represented by single specimens from Runaway Bay and at station 4 in Montego Bay.

As near as can be determined d'Orbigny's *Biloculina oblonga* of the Cuban Monograph is also this species. It is recorded by d'Orbigny from Cuba and Jamaica.

Genus PENEROPLIS Montfort, 1808.

This genus has usually been treated as containing a single variable species. Basing on the *Challenger* report most writers have followed Brady's example. In their paper on the Foraminifera of the Kerimba Archipelago Heron-Allen and Earland have examined into the early descriptions and figures of *Peneroplis* and after an exhaustive treatment have made five species. Such a treatment seems admirable, and all workers on the group will be duly grateful for such a helpful labor. Anyone who has worked over tropical material containing specimens of this genus has probably realized that there are numerous groups which, although variable, are nevertheless variable only within certain limits, and the groups do not merge with one another.

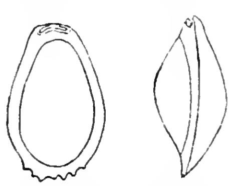


FIG. 12.—BILOCULINA DENTICULATA (H. B. BRADY). *a*, FRONT VIEW: *b*, SIDE VIEW. SPECIMEN FROM 6 FATHOMS, MONTEGO BAY. × 50.

The treatment of the Jamaican material follows that of Heron-Allen and Earland with the exception of the addition of two others based upon the West Indian material. D'Orbigny described and figured *Peneroplis proteus* from Cuba and Jamaica, and it has been found to be the most common species in this material. The form described by Flint in 1899 as var. *discoideus* is here placed as a valid species after finding it abundant and constant in both recent and fossil material of the West Indies, showing that its characters must have been fixed for a considerable length of time. For the data arriving at the division into species the reader is referred to the original work of Heron-Allen and Earland.

PENEROPLIS PERTUSUS (Forskål).

Plate 18, figs. 7, 8.

Nautilus pertusus Forskål, Descr. Anim., 1775, p. 125, No. 65.
Peneroplis pertusus Jones, Parker, and H. B. Brady, Foram. Crag., 1865, p. 19.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, figs. 16, 17.
Peneroplis elegans d'Orbigny, Foram. Cuba, 1839, p. 61, pl. 7, figs. 1, 2.

This is not a common species in the Jamaican material, occurring as few or rare specimens at Runaway Bay and at stations 1, 3, 5, and 6 at Montego Bay. D'Orbigny's *P. elegans* is clearly this species and was obtained both in Cuba and Jamaica.

PENEROPLIS PLANATUS (Fichtel and Moll).

Plate 18, fig. 9.

Peneroplis planatus d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 285, No. 1: Modèles, No. 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, fig. 15.

A few specimens at Montego Bay from stations 4 and 6.

PENEROPLIS ARIETINUS (Batsch).

Plate 18, fig. 10.

Peneroplis arietinus Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 26, pl. 1, fig. 18.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, figs. 18, 19, 22.

The only specimens are from station 4 at Montego Bay.

PENEROPLIS CYLINDRACEUS (Lamarck).

Plate 18, fig. 11.

Peneroplis cylindraceus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, figs. 20, 21.

A single specimen was obtained in the dredging from station 4, Montego Bay.

PENEROPLIS CARINATUS d'Orbigny.

Plate 18, fig. 12.

Peneroplis carinatus d'Orbigny, Foram. Amér. Mérid., 1839, p. 33, pl. 3, figs. 7, 8.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, fig. 14.

The only specimens are from station 1 in Montego Bay.

PENEROPLIS PROTEUS d'Orbigny.

Plate 18, figs. 13–19.

Peneroplis protea d'Orbigny, Foram. Cuba, 1839, p. 60, pl. 7, figs. 7–11.
Peneroplis dubius d'Orbigny, Foram. Cuba, 1839, p. 62, pl. 6, figs. 21, 22.

This is by far the most abundant species of *Peneroplis* in the dredgings, and it shows the variable form described and figured by d'Orbigny. If the very young are compared with the figure of *P. dubius* it will be seen that they are very like that figure, and when a comparison of the magnification of the figures of the two species is made it will be seen that this is probably a correct solution. *Proteus* is a well-chosen specific name, for some specimens were seen where a nearly complete specimen was growing directly from another, and various outgrowths are common.

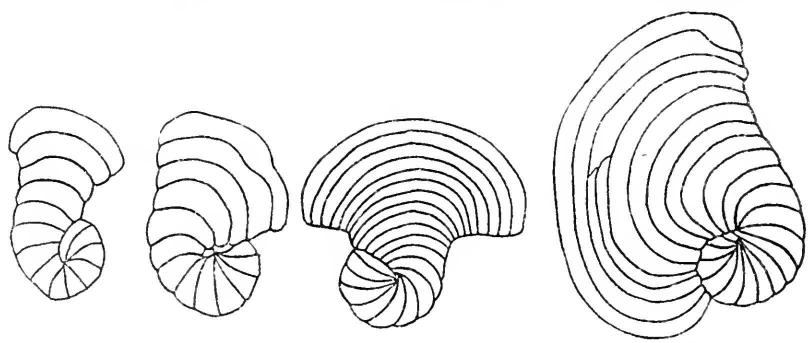
Specimens were common in Montego Bay at stations 3, 4, 5, and 6. D'Orbigny's specimens were from Cuba and Jamaica.

PENEROPLIS DISCOIDEUS Flint.

Plate 18, fig. 20; plate 19, figs. 1–3.

Peneroplis pertusus (Forskål), var. *discoideus* Flint, Ann. Rep. U. S. Nat. Mut., 1897 (1899), p. 304, pl. 49, figs. 1, 2.—Cushman, Publ. 291, Carnegie Inst. Washington, 1919, p. 69.

Specimens of this species were obtained at Montego Bay at station 4. It is found also as a fossil species in the West Indies in the Miocene of



13 14 15 16

Figs. 13-16.—Peneroplis proteus d'Orbigny. Specimens from 6 fathoms, Montego Bay, showing different forms of this species. × 50.

Santo Domingo, and deserves to rank with the other species of the genus.

Genus ORBICULINA Lamarck, 1816.

ORBICULINA COMPRESSA d'Orbigny.

Plate 19, figs. 4–6.

Orbiculina compressa d'Orbigny, Foram. Cuba, 1839, p. 66, pl. 8, figs. 4–7.—Cushman, Publ. 291, Carnegie Inst. Washington, 1919, p. 70, pl. 7, fig. 6.

There seems to have been a misunderstanding of this species, for it is very distinct from *O. adunca*. Brady remarks about this species, which he places as a synonym of *O. adunca*, as follows:

He [d'Orbigny] stops short, however, at the spiral varieties, and fails to perceive how slight is the modification involved in the addition of a few annular chambers to the already nearly discoidal shell, and distinguishes the circular or nearly circular specimens by a separate name, *Orbiculina compressa.*

There is a difference even in the early stages of the development of these two species, as I have shown.[15]

In this connection also it is interesting to note that d'Orbigny records it as rare in Cuba, more common in Guadeloupe and St. Thomas, but abundant in Jamaica. It may be that it is not widely distributed. However, it is certainly abundant at the deeper station at Montego Bay, occurring at stations 5 and 6 and also at Runaway Bay.

Fossil specimens occur in the Bowden Marl of Jamaica.

ORBICULINA ADUNCA (Fichtel and Moll).

Nautilus aduncus Fichtel and Moll, Test. Micr., 1803, p. 115, pl. 23.
Orbiculina adunca Lamarck, Tabl. Encyl. et Meth., 1816, p. 468, figs. 2*a–c*.—d'Orbigny, Foram. Cuba, 1839, p. 64, pl. 8, figs. 8–16.

This is probably the most abundant of the larger foraminifera of the West Indies, making up a large proportion of the dredgings in some places. It is most common at the deepest station, No. 10, but occurs in numbers at stations 2 and 5, and also at Runaway Bay.

Genus ORBITOLITES Lamarck, 1801.

ORBITOLITES DUPLEX Carpenter.

Orbulites macropora (?) Lamarck, Hist. Nat. Anim. sans Vert., vol. 2, 1816, p. 197, No. 5 (according to Carpenter).
"*Orbitolites* (duplex type)" Carpenter, Philos. Trans., 1856, p. 120, pl. 5, fig. 10; pl. 9, fig. 10.
Orbitolites duplex Carpenter, Rep. *Challenger*, "Orbitolites," 1883, p. 25, pl. 3, figs. 8-14; pl. 4, figs. 6–10; pl. 5, figs. 1–10.

This is the only species which is found in the material from Jamaica, and although both *O. marginalis* and *O. complanata* are recorded in the *Challenger* Report from the West Indian region in deeper water, I have found in the collections that I have seen that *O. duplex* is the common species. It grows attached to the short eel grass in great abundance with *Planorbulina*, and the young stages are easily seen in this way. Specimens were found with megalospheric young in the outer chambers of the parent test.

Specimens occurred at Runaway Bay and at stations 2, 4, and 5 at Montego Bay.

Genus ALVEOLINA d'Orbigny, 1826.

ALVEOLINA PULCHRA d'Orbigny.

Plate 19, figs. 7–9.

Alveolina pulchra d'Orbigny, Foram. Cuba, 1839, p. 70, pl. 8, figs. 19, 20.

I am not sure that this species is the same as *A. melo* as Brady places it, and as material for comparison is scarce, I place it under d'Orbigny's name. It occurred at Runaway Bay and at stations 2 and 4 at Montego Bay. D'Orbigny's material was from Cuba.

[15] Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pp. 89–91.

EXPLANATION OF PLATES.

Plate 11.

Fig. 1. *Textularia agglutinans* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 1, figs. 17 and 18.)

2. *Textularia agglutinans* d'Orbigny. *a*, front view; *b*, side view; *c*, apertural view. (After d'Orbigny, pl. 1, figs. 32–34.)

3. *Textularia agglutinans* d'Orbigny. Photograph of an irregular specimen from Runaway Bay, Jamaica. × 30.

4. *Textularia conica* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 1, figs. 19 and 20.)

5. *Textularia conica* d'Orbigny. Photograph of side view of specimen from Montego Bay, Jamaica. × 30.

6. *Textularia conica* d'Orbigny. Photograph of dorsal view of specimen from same locality. × 30.

7. *Textularia candeiana* d'Orbigny. *a*, front view; *b*, side view; *c*, apertural view. (After d'Orbigny, pl. 1, figs. 25–27.)

8. *Textularia candeiana* d'Orbigny. Photograph of front view of specimen from 10 fathoms (18 meters), Montego Bay. × 30.

9. *Bolivina punctata* d'Orbigny. *a*, front view; *b*, apertural view. (*Textularia caribaea* d'Orbigny; after d'Orbigny, pl. 1, figs. 28 and 29.)

10. *Bolivina punctata* d'Orbigny. Photograph of specimen from shallow water, Bogue Islands, Montego Bay, Jamaica. × 30.

11. *Valvulina oviedoiana* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 2, figs. 21–22.)

12. *Valvulina oviedoiana* d'Orbigny. Photograph of dorsal view of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. × 30.

13. *Valvulina oviedoiana* d'Orbigny. Photograph of front view. × 30.

14. *Valvulina oviedoiana* d'Orbigny. Photograph of apertural view. × 30.

15. *Virgulina punctata* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 1, figs. 35 and 36.)

Plate 12.

Fig. 1. *Clavulina tricarinata* d'Orbigny. *a*, front view; *b*, side view; *c*, apertural view. (After d'Orbigny, pl. 2, figs. 16–18.)

2. *Clavulina tricarinata* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay, Jamaica. × 30.

3. *Clavulina nodosaria* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 2, figs. 19 and 20.)

4. *Polymorphina* cf. *vitrea* (d'Orbigny). *a*, front view; *b*, side view; *c*, apertural view. (*Guttulina vitrea* d'Orbigny: after d'Orbigny, pl. 2, figs. 1–3.)

5. *Globigerina bulloides* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (*Globigerina siphonifera* d'Orbigny: after d'Orbigny, pl. 4, figs. 15–17.)

6. *Globigerina rubra* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (After d'Orbigny, pl. 4, figs. 12–14.)

7. *Globigerina dutertrei* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (After d'Orbigny, pl. 4, figs. 19–21.)

8. *Planorbulina acervalis* H. B. Brady. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay, Jamaica. × 30.

PLATE 13.

FIG. 1. *Truncatulina rosea* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina rosea* d'Orbigny: after d'Orbigny, pl. 3, figs. 9–11.)
2. *Truncatulina rosea* (d'Orbigny). Photograph of dorsal view of specimen from 3 fathoms (5 meters), Montego Bay, Jamaica. × 30.
3. *Truncatulina rosea* (d'Orbigny). Photograph of ventral view. × 30.
4. *Truncatulina candeiana* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina candeiana* d'Orbigny: after d'Orbigny, pl. 4, figs. 2–4.)
5. *Truncatulina candeiana* (d'Orbigny). Runaway Bay, Jamaica. × 30.
6. *Truncatulina antillarum* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina antillarum* d'Orbigny: after d'Orbigny, pl. 5, figs. 4–6.)
7. *Truncatulina antillarum* (d'Orbigny). Photograph of dorsal view of specimen from 9 fathoms (16 meters), Montego Bay, Jamaica. × 30.
8. *Truncatulina antillarum* (d'Orbigny). Photograph of ventral view. × 30.
9. *Cymbalopora poeyi* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina poeyi* d'Orbigny: after d'Orbigny, pl. 3, figs. 18–20.)
10. *Cymbalopora poeyi* (d'Orbigny). *a*, dorsal view; b, ventral view; *c*, side view. (*Rosalina squammosa* d'Orbigny: after d'Orbigny, pl. 3, figs. 12–14.)
11. *Cymbalopora poeyi* (d'Orbigny). Photograph of dorsal view of specimen from Montego Bay, Jamaica. ×30.
12. *Cymbalopora poeyi* (d'Orbigny). Photograph of ventral view. ×30.
13. *Tretomphalus bulloides* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina bulloides* d'Orbigny: after d'Orbigny, pl. 3, figs. 2 and 3.)

PLATE 14.

FIG. 1. *Discorbis auberii* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina auberii* d'Orbigny: after d'Orbigny, pl. 4, figs. 5–8.)
2. *Discorbis auberii* (d'Orbigny). Photograph of dorsal view of specimen from Montego Bay, Jamaica. ×30.
3. *Discorbis auberii* (d'Orbigny). Photograph of ventral view. ×30.
4. *Discorbis valvulata* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina valvulata* d'Orbigny: after d'Orbigny, pl. 3, figs. 21–23.)
5. *Discorbis valvulata* (d'Orbigny). Photograph of specimen from Montego Bay, Jamaica. ×30.
6. *Asterigerina carinata* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (After d'Orbigny, pl. 5, fig. 25; pl. 6, figs. 1 and 2.)
7. *Asterigerina carinata* d'Orbigny. Dorsal view of specimen from Montego Bay, Jamaica. ×30.
8. *Asterigerina carinata* d'Orbigny. Ventral view of specimen from Montego Bay, Jamaica. ×30.
9. *Nonionina grateloupi* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 6, figs. 6 and 7.)
10. *Nonionina grateloupi* d'Orbigny. Montego Bay, Jamaica. ×30.
11. *Nonionina grateloupi* d'Orbigny. Montego Bay, Jamaica. ×30.
12. *Polystomella lanieri* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 7, figs. 12 and 13.)
13. *Polystomella lanieri* d'Orbigny. Photograph of specimen from 2 feet, Bogue Islands, Montego Bay, Jamaica. ×30.

FIG. 14. *Spiroloculina antillarum* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 9, figs. 3 and 4.)

15. *Spiroloculina antillarum* d'Orbigny. Runaway Bay, Jamaica. ×30.

16. *Spiroloculina antillarum* d'Orbigny, var. *angulata* Cushman. Photograph of specimen from 2 feet, Bogue Islands, Montego Bay. ×30.

17. *Spiroloculina arenata* Cushman. Photograph of specimen from 1 fathom (2 meters), Montego Bay, Jamaica. ×30.

PLATE 15.

FIG. 1. *Vertebralina cassis* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 7, figs. 14 and 15.)

2. *Vertebralina cassis* d'Orbigny. Specimen with uncoiled chambers. *a*, side view; *b*, apertural view. (*Vertebralina mucronata* d'Orbigny: after d'Orbigny, pl. 7, figs. 16 and 17.)

3. *Vertebralina cassis* d'Orbigny. Specimen with coiled chambers only. *a*, side view; *b*, apertural view. (*Vertebralina mucronata* d'Orbigny: after d'Orbigny, pl. 7, figs. 18 and 19.)

4. *Vertebralina cassis* d'Orbigny. Photograph of coiled specimen from 10 fathoms (18 meters), Montego Bay. ×30.

5. *Vertebralina cassis* d'Orbigny. Photograph of uncoiled specimen from same locality. ×30.

6-8. *Vertebralina cassis* d'Orbigny. Montego Bay. ×30.

9. *Quinqueloculina agglutinans* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 11 and 13.)

10. *Quinqueloculina agglutinans* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

11. *Quinqueloculina bidentata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 18–20.)

12. *Quinqueloculina bidentata* d'Orbigny. Runaway Bay. ×30.

13. *Quinqueloculina lamarckiana* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 11, figs. 14 and 15.)

14. *Quinqueloculina lamarckiana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (*Quinqueloculina auberiana* d'Orbigny: after d'Orbigny, pl. 12, figs. 1–3.)

PLATE 16.

FIG. 1. *Quinqueloculina cuvieriana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 19–21.)

2. *Quinqueloculina cuvieriana* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay, Jamaica. ×30.

3. *Quinqueloculina polygona* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 21–23.)

4. *Quinqueloculina polygona* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

5. *Quinqueloculina dilatata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 28–30.)

6. *Quinqueloculina dilatata* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

7. *Quinqueloculina poeyana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 25–27.)

8. *Quinqueloculina poeyana* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

9. *Quinqueloculina antillarum* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 4–6.)

FIG. 10. *Quinqueloculina antillarum* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay. ×30.

11. *Quinqueloculina tricarinata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 7–9.)

12. *Quinqueloculina tricarinata* d'Orbigny. Photograph of specimen from Montego Bay. ×30.

13. *Triloculina labiosa* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 10, figs. 12–14.)

14. *Triloculina labiosa* d'Orbigny. Photograph of specimen from 6 fathoms (11 meters), Montego Bay, Jamaica. ×30.

PLATE 17.

FIG. 1. *Triloculina fichteliana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 9, figs. 8–10.)

2. *Triloculina fichteliana* d'Orbigny. Photograph of specimen from Runaway Bay, Jamaica. ×30.

3. *Triloculina linneiana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 9, figs. 11–13.)

4. *Triloculina linneiana* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay. ×30.

5. *Triloculina oblonga* Montagu. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 10, figs. 3–5.)

6. *Triloculina oblonga* Montagu. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

7. *Triloculina planciana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 9, figs. 17–19.)

8. *Triloculina planciana* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

9. *Triloculina carinata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 10, figs. 15–17.)

10. *Triloculina carinata* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

11. *Triloculina carinata* d'Orbigny, var. *obscura* Cushman. Photograph of specimen from Montego Bay, Jamaica. ×30.

12. *Massilina inaequalis* Cushman. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

13. *Massilina inaequalis* Cushman. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

PLATE 18.

FIG. 1. *Articulina conico-articulata* (Batsch). Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

2. *Articulina sagra* d'Orbigny. Specimen with a single linear chamber. *a*, side view; *b*, opposite side. (After d'Orbigny, pl. 9, figs. 23 and 24.)

3. *Articulina sagra* d'Orbigny. Specimen with two linear chambers. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 9, figs. 25 and 26.)

4. *Articulina sagra* d'Orbigny. Photograph of specimen from 9 fathoms, (16 meters), Montego Bay. ×30.

5. *Articulina sagra* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

6. *Articulina lineata* Brady. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

7. *Peneroplis pertusus* (Forskål). *a*, side view; *b*, apertural view. (*Peneroplis elegans* d'Orbigny: after d'Orbigny, pl. 7, figs. 1 and 2.)

Fig. 8. *Peneroplis pertusus* (Forskål). Photograph of specimen from 9 fathoms (16 meters), Montego Bay. ×30.

9. *Peneroplis planatus* (Fichtel and Moll). Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

10. *Peneroplis arietinus* (Batsch). Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

11. *Peneroplis cylindraceus* (Lamarck). Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

12. *Peneroplis carinatus* d'Orbigny. Photograph of specimen from 2 feet, Bogue Islands, Montego Bay. ×30.

13. *Peneroplis proteus* d'Orbigny. *a*, side view; *b*, apertural view. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, figs. 7 and 8.)

14. *Peneroplis proteus* d'Orbigny. Specimen with slender form. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, fig. 9.)

15. *Peneroplis proteus* d'Orbigny. Specimen with more flaring form. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, fig. 10.)

16. *Peneroplis proteus* d'Orbigny. Close-coiled form. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, fig. 11.)

17. *Peneroplis proteus* d'Orbigny. *a*, side view; *b*, apertural view. (*Peneroplis dubius* d'Orbigny: after d'Orbigny, pl. 6, figs. 21 and 22.)

18. *Peneroplis proteus* d'Orbigny. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

19. *Peneroplis proteus* d'Orbigny. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

20. *Peneroplis discoideus* Flint. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

Plate 19.

Fig. 1. *Peneroplis discoideus* Flint. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

2. *Peneroplis discoideus* Flint. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. × 30.

3. *Peneroplis discoideus* Flint. *a*, flat view; *b*, edge view. (*Orbiculina compressa* d'Orbigny (part): after d'Orbigny, pl. 8, figs. 5 and 6.)

4. *Orbiculina compressa* d'Orbigny. Adult full-grown specimen. (After d'Orbigny, pl. 8, fig. 4.)

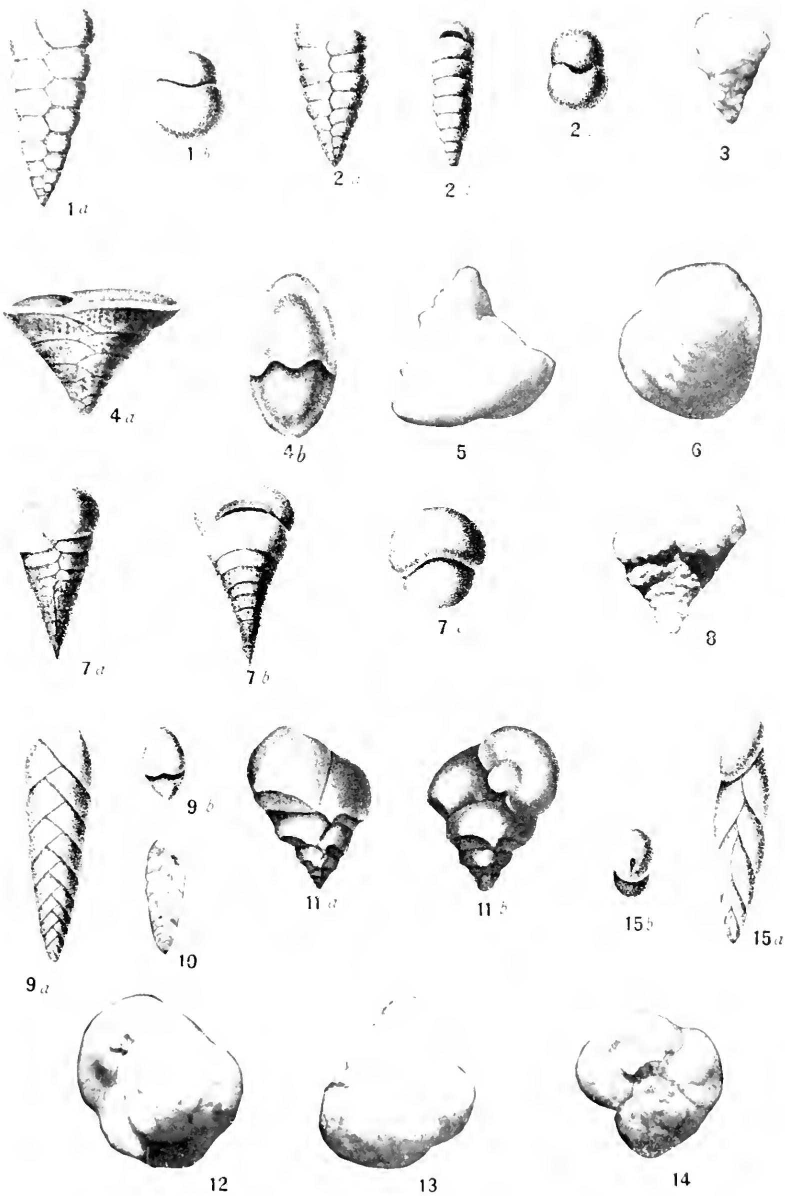
5. *Orbiculina compressa* d'Orbigny. Young specimen. (After d'Orbigny, pl. 8, fig. 7.)

6. *Orbiculina compressa* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. × 30.

7. *Alveolina pulchra* d'Orbigny. *a*, end view; *b*, apertural view. (After d'Orbigny, pl. 8, figs. 19 and 20.)

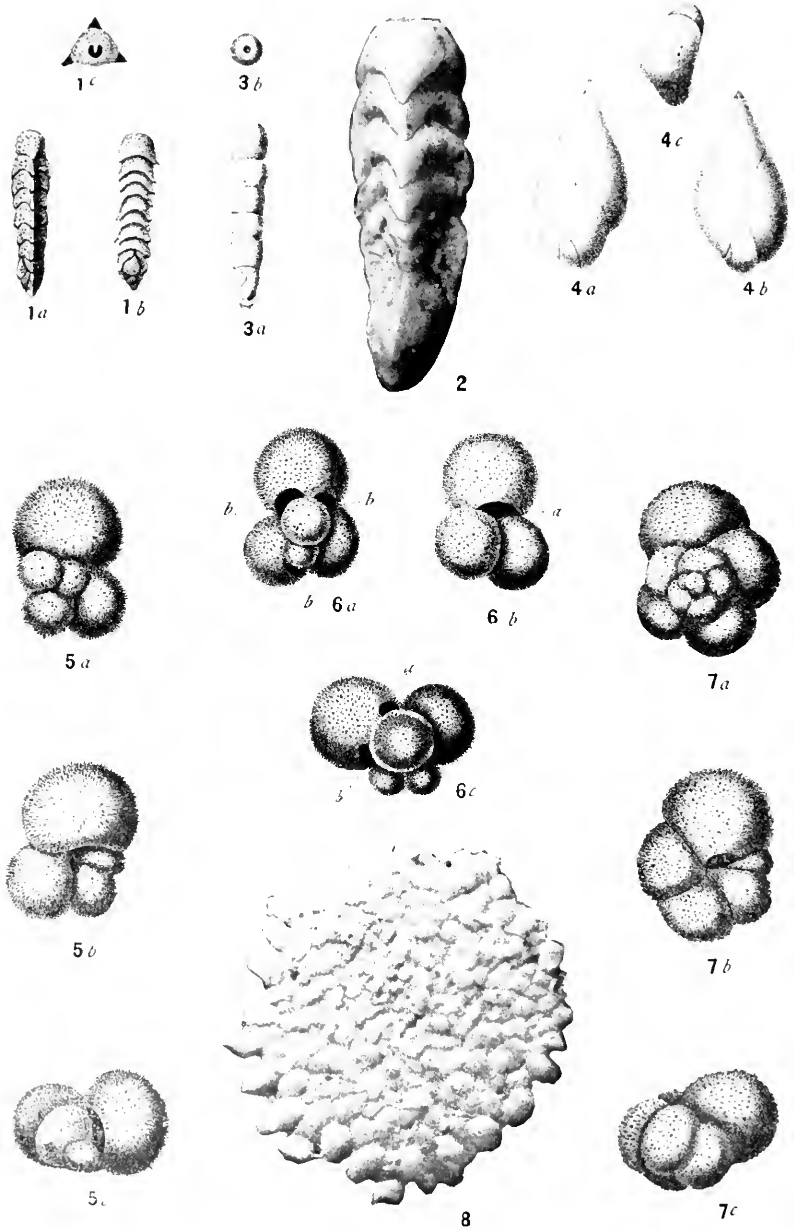
8. *Alveolina pulchra* d'Orbigny. Photograph of specimen from Runaway Bay, Jamaica. × 30.

9. *Alveolina pulchra* d'Orbigny. Photograph of specimen from Runaway Bay, Jamaica. × 30.



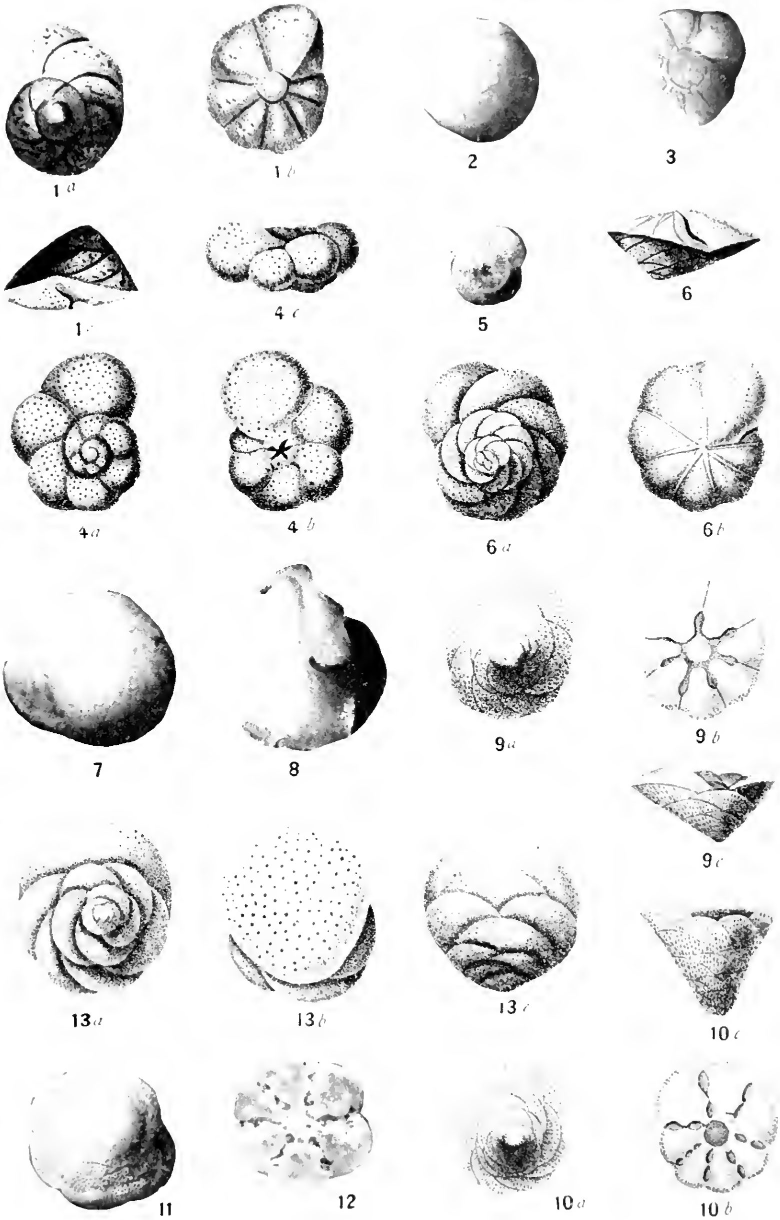
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 78



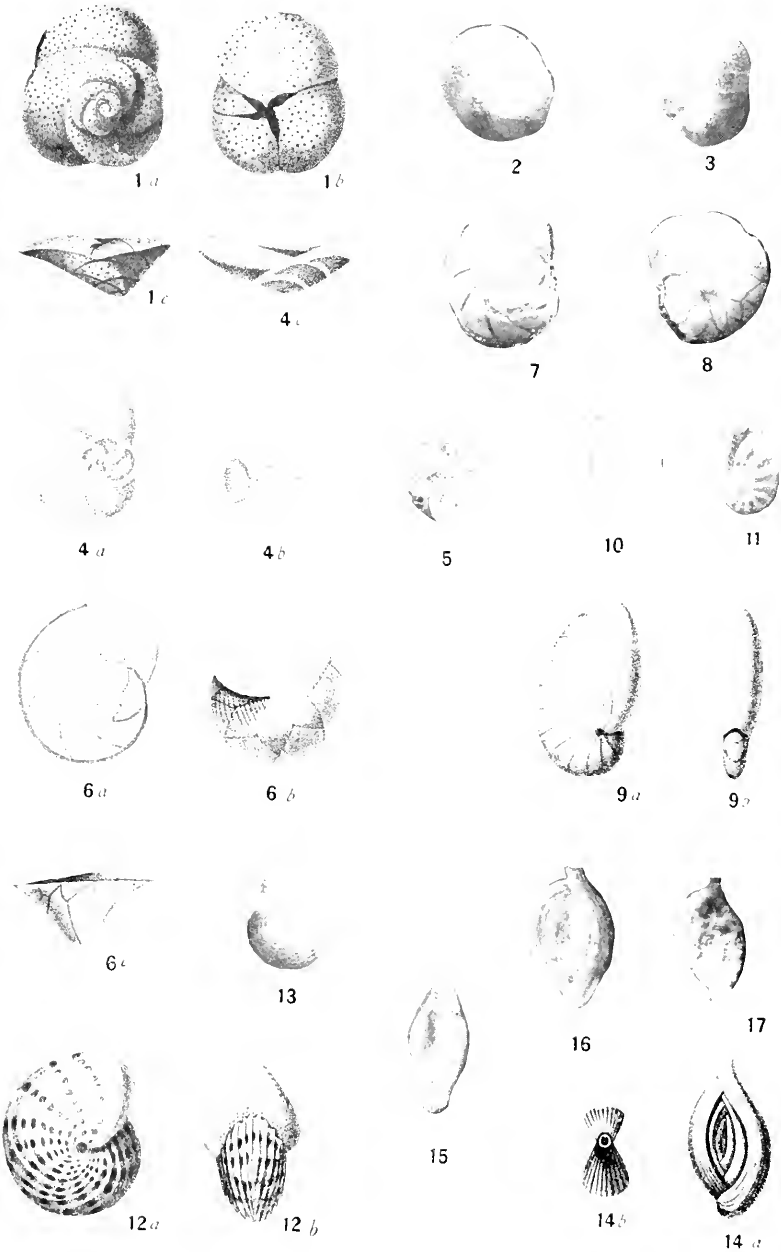
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 78.



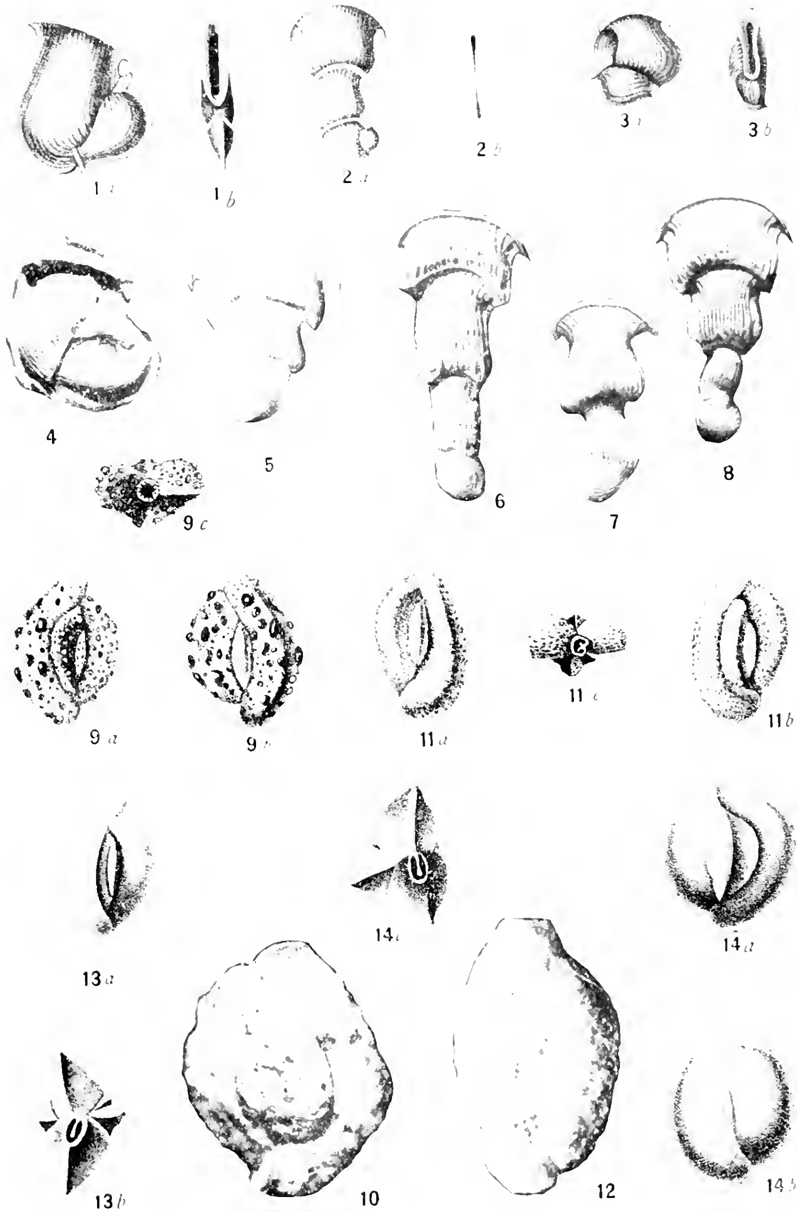
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 79.



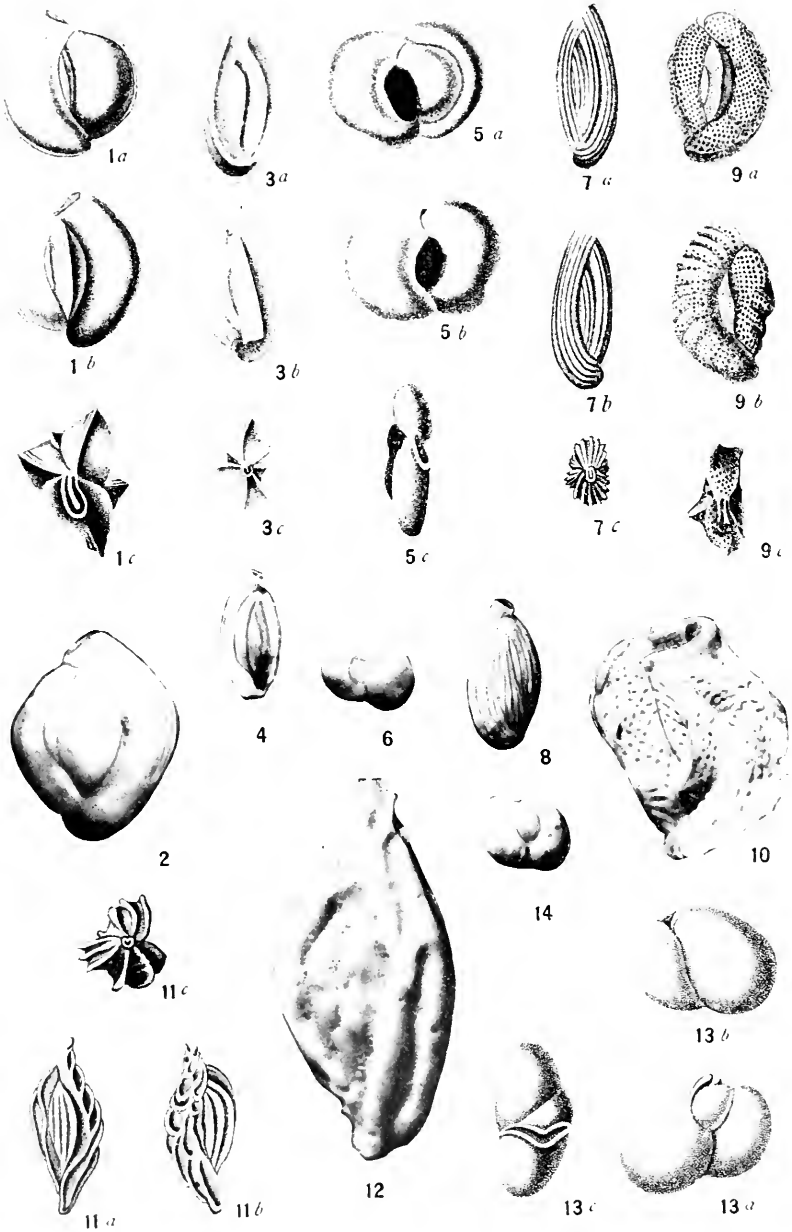
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOE DESCRIPTION OF PLATE SEE PAGES 79 AND 80.



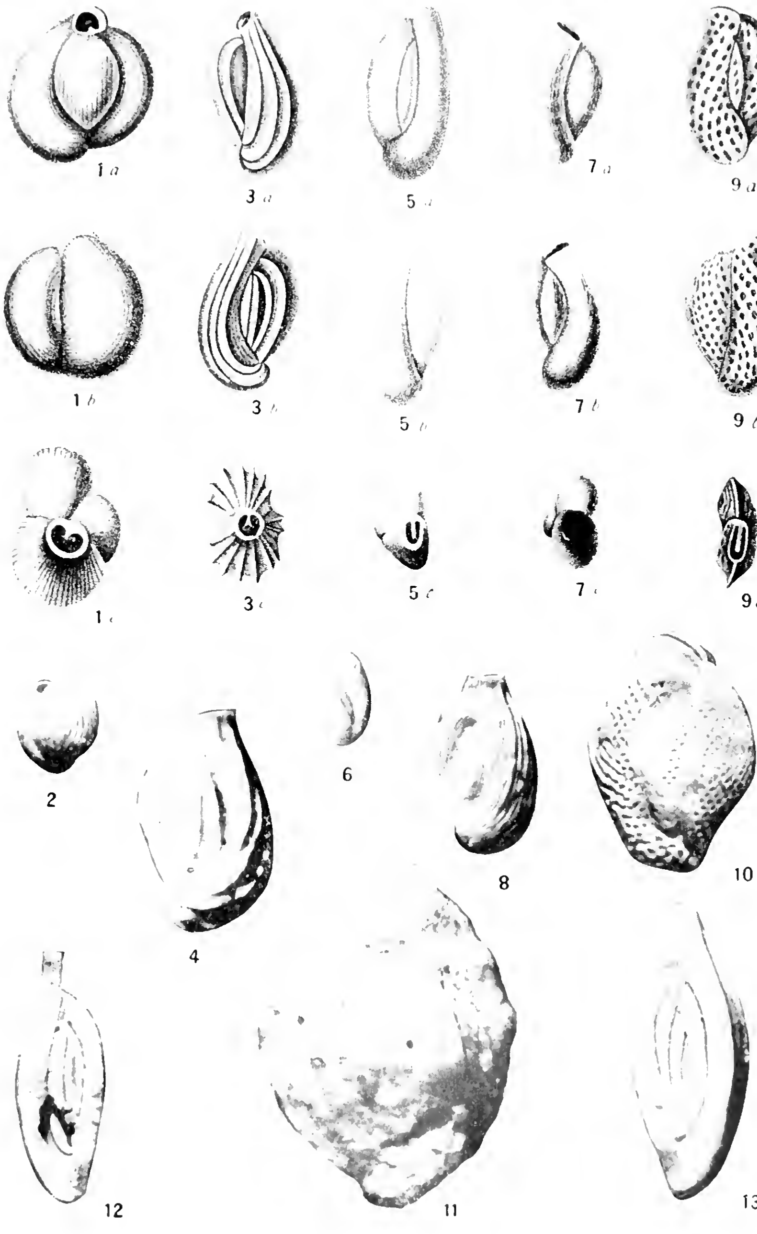
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 80.



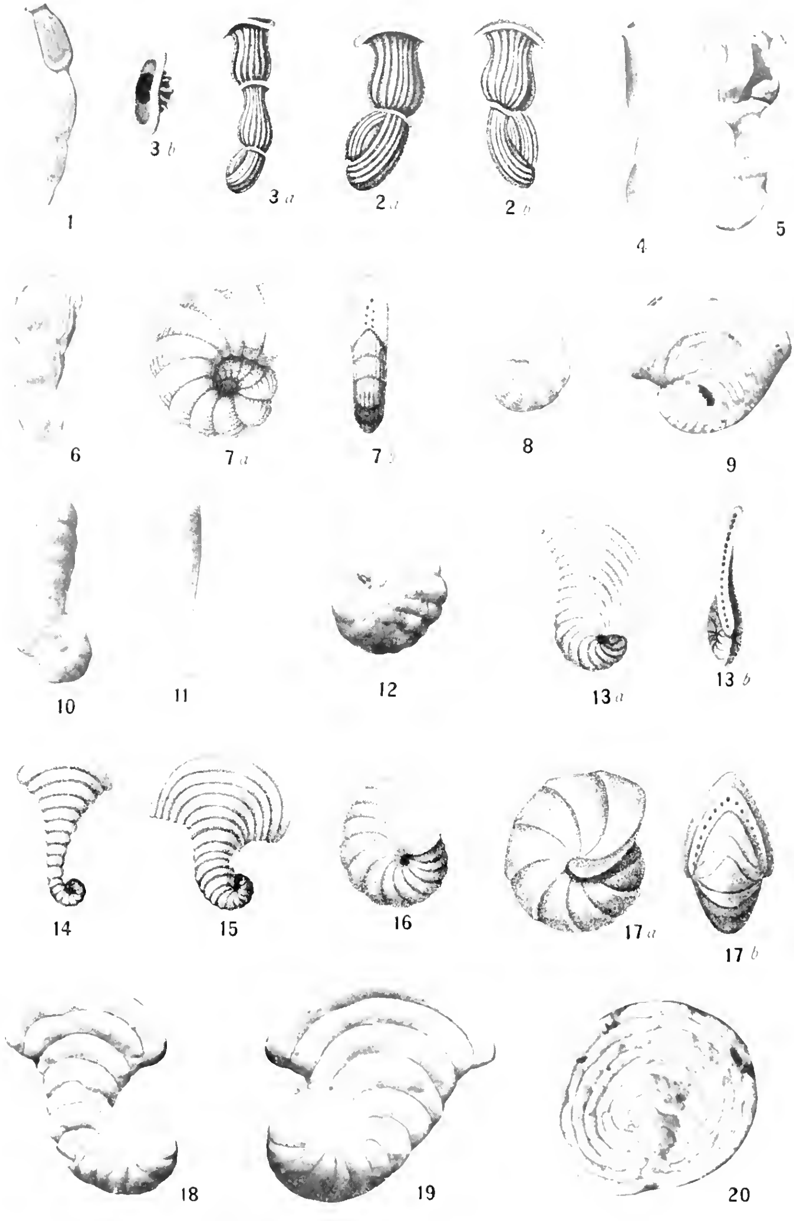
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCPIPTION OF PLATE SEE PAGES 80 AND 81.



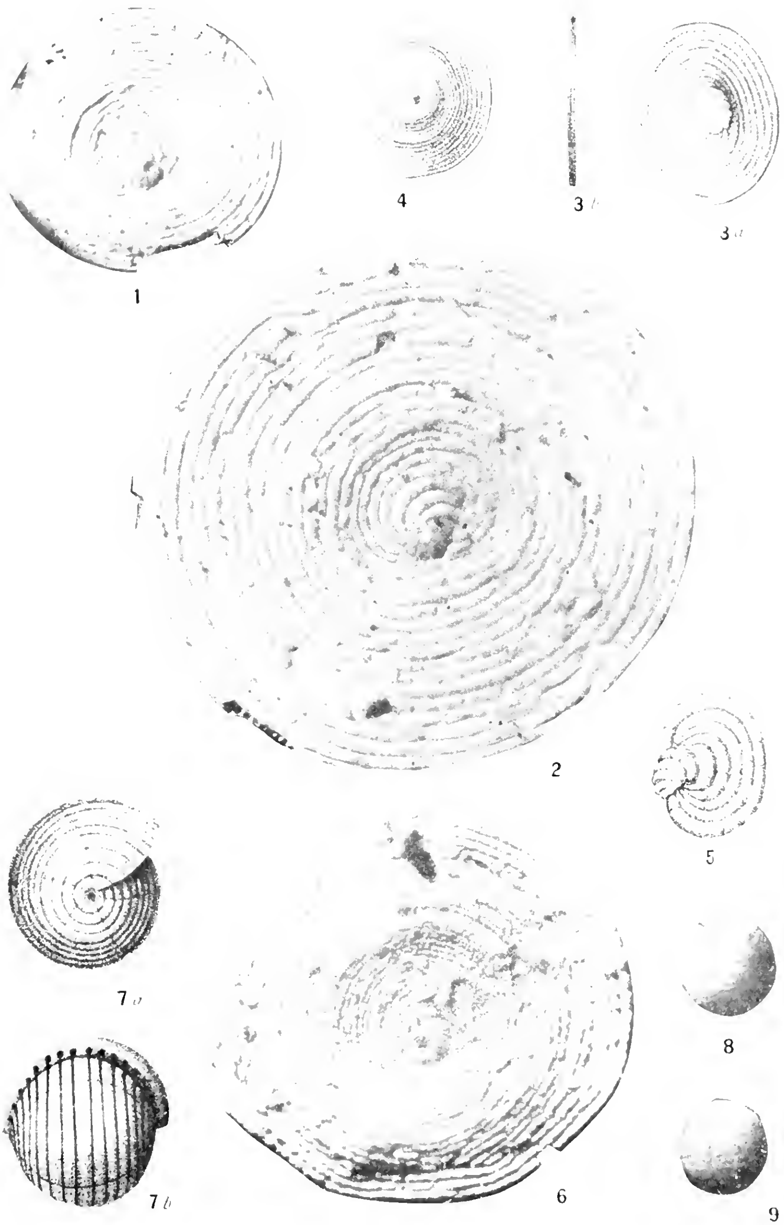
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 81.



FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOE DESCRIPTION OF PLATE SEE PAGES 81 AND 82.



FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 82.

NOTES ON SAWFLIES, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

By S. A. Rohwer,

Custodian of Hymenoptera, United States National Museum.

The types of most of the new species here described are in the collection of the United States National Museum. A few, however, are in the collections of other institutions which have forwarded the material to the author at his request and on the condition that the types be returned to them.

Suborder IDIOGASTRA.

STIROCORSIA KOHLI Konow.

A single male collected at Sandakan, Borneo, by C. F. Baker agrees fairly well with the description of the female given by Konow and is, I believe, the male of his species.

Length, 8 mm. Anterior trochanters and hind tibiae dark piceous; ventral sternite produced into a rather narrow truncate process apically, the ventral surface with six tubercules arranged so as to form a semicircle.

Suborder CHALASTOGASTRA.

Family XIPHYDRIIDAE.

XIPHYDRIA ABDOMINALIS Say.

Xiphydria abdominalis Say, Keating's Narr. Exped. appendix, vol. 2, 1824, p. 311; LeConte's Writings of Say, vol. 2, 1859, p. 208.

In my synopsis of the Nearctic species of *Xiphydria*[1] I considered this species to be the same as *attenuata* Norton and *rufiventris* Cresson, and made a specimen from Harrisburg, Pennsylvania, a neotype for Say's species. A single female specimen collected at Charter Oak, Pennsylvania, June 19, 1918, by H. B. Kirk, proves that this interpretation for the species is incorrect and that the specimen chosen as a neotype can not justly be considered as such.

[1] Ent. News, vol. 29, 1918, pp. 105–111.

The specimen collected by Kirk agrees in all ways with Say's description and can be separated from *attenuata* by the following key:

Wings uniformly brownish; legs entirely black .... *abdominalis* Say.
Wings hyaline to subhyaline; trochanters, bases of tibiae and tarsi more or less, whitish .... *attenuata* Norton.

XIPHYDRIA ATTENUATA Norton

Xiphydria attenuatus Norton, Proc. Ent. Soc. Phila., vol. 1, 1862, p. 144.
Xiphydria rufiventris Cresson, Trans. Amer. Ent. Soc., vol. 3, 1880, p. 34.
Xiphydria abdominalis Rohwer (not Say), Ent. News, vol. 29, 1918, p. 107.

Additional material proves that this is not, as the writer had previously considered, a synonym of *abdominalis* Say. (See above discussion under *abdominalis*.)

XIPHYDRIA CHAMPLAINI, new species.

Female.—In color this species suggests *erythrogastra* Ashmead and *abdominalis* Say, but may be distinguished from both these species by its larger size, yellow spots on abdomen, more sculpturing on the head, and the sharply constricted hind tibiae. Ignoring the color of the abdomen, it will run to *tibialis* Say, but the head is not as coarsely sculptured, the hind tibiae are longer and sharply constricted basally.

Length, 14 mm. Anterior margin of clypeus with a median tooth; head below lateral ocelli irregularly reticulate; front above the antennae with two oblique low ridges forming a broad V; area immediately behind a line tangent to lateral ocelli reticulato-granular; vertex polished with a few poorly defined punctures; ocellocular line distinctly longer than the postocellar line; cheeks and posterior orbits, nearly to the top of eye, with dorsal-ventrad aciculations; orbital carina distinct, extending well above the top of eye; antenna 19-jointed, strongly tapering, not extending much beyond tegulæ, second joint half as long as third and equal in length with fourth; prescutum broad, the anterior width subequal with the length, rounded posteriorly so the caudad width is half the cephalad width, with a distinct median longitudinal groove, the surface coarsely reticulate and anteriorly, with a tendency to form a transverse ridge; notauli broad, foveolate; scutum reticulate, with the usual granular areas laterally; suture between scutum and scutellum deep, foveolate; scutellum reticulate, the posterior lateral areas more finely so; mesepisternum coarsely reticulate, with a tendency to striation below; prepectus polished; mesosternum shining, with separate punctures; mesepimeron rugose; metapleura coarsely reticulate; propodeum shining, with separate punctures, the oblique depressions foveolate; transverse depression at base of second (first gastral) tergite reticulate; apical part of second tergite and all of the following (becoming finer apically) granular; posterior tibia one-third longer than their tarsus, constricted basally (more sharply dorsally), compressed and with a longitudinal furrow on outer surface; sheath straight above, nearly truncate apically, rounding to rather narrow base. Black, with yellow markings and a red abodmen; head yellow, antennae, apices of mandibles, band from bases of antennae (where it is tridentate and broader) to occiput, where it meets two oblique lines from top of eye, and the posterior face black; thorax black, prosternum, anterior and posterior angles of pronotum, tegulae, a spot above, spot on prescutum, two spots of scutum in front of scutellum, spot on mesepisternum and two spots on mesosternum yellow; legs yellow, bases of coxae, the femora and apices of hind tibiae black; abdomen rufous, propodum, base of second tergite and the sheath black, sides of second, third, fourth, fifth, eighth, and a small spot on ninth tergites yellow; wings hyaline, venation, except reddish costa, black.

Male.—Because of the shape of the prescutum the male would fall in with *abdominalis*, but it is larger than that species; the legs are stouter and the head immediately above the antennae more coarsely sculptured.

Length, 10 mm. The structure and markings of female except where noted. Antenna 15-jointed, second joint a little more than half as long as third and somewhat shorter than the fourth, the two basal joints reddish; postocellar line subequal with the ocellocular line; black of the head more extensive; upper part of mesepisternum spots on metapleura and propodeum yellowish; legs rufous, coxae except black bases yellowish; eight and ninth tergites without yellow; hypopygidium with an arcuate, median emargination; sternites five to eight, with black hair; tibia not as constricted as in female or as strongly compressed.

Paratype a has the black of the head greatly reduced, the entire venter and sides of thorax, sternites and margins of tergites and legs yellow. *Paratype b* has the antenna 16-jointed and mostly pale, the yellow thorax, legs and abdomen of paratype *a* and has the head, except posteriorly and a spot around the ocelli, yellow. The yellow on the mesonotum is more extensive than in any other specimen.

Since preparing the above more material has been received which indicates that paratype *a* is the typical color for the male. There is very little variation in the female.

Type locality.—Harrisburg, Pennsylvania.

Described from three females (one type) and twelve males (one allotype) reared May 26, 1919, from wood of *Carpinus caroliniana*. Material collected and reared by A. B. Champlain, for whom the species is named.

Type, allotype, and paratypes.—Cat. No. 22365 U.S.N.M. Paratypes (female and male) returned to Bureau of Plant Industry, Harrisburg, Pennsylvania.

XIPHYDRIA HERITIERAE, new species.

In the rufous head and general color the female recalls *X. ruficeps* Moscary, but it does not answer the description in all ways, being distinguished by the more joints to the antenna, the pale base of the wings, and different color of the legs. The male would go to *rufipes* Smith in Konow's key, but the sculpture, especially that of the abdomen, is quite different from that species.

Female.—Length, 16.5 mm. Anterior margin of the median part of clypeus with a low, rounded median tooth, laterally the clypeus has a rounded lobe-like tubercle; sides of face depressed (except at eye margin) and finely granular; area between bases of antennae convex, irregularly reticulate; frons to height of lateral ocelli striato-reticulate; middle fovea shallow with sloping walls; ocelli in a low triangle well below the supraorbital line; postocellar and ocellocular lines subequal; cheeks, temples, and head behind the ocelli smooth polished; antennae 17-jointed, scape strongly curved, flattened on the lateral surface, pedicellum subequal in length with the first joint of flagellum, more than half as long as the scape, curved and somewhat compressed laterally; flagellum hairy, very strongly tapering, the first joint distinctly longer than fourth, the joints decreasing in length toward apex, basal part of flagellum thicker than scape or pedicellum; prescutum and scutum coarsely reticulate; notauli well defined, more or less distinctly foveolate; axillae mostly granular; scutellum shining and with distinct, large, separated punctures; mesepisternum closely punctato-striate; mesepimeron with strong oblique striae; propodeum and base of second tergite shining and with distinct punctures which are closest medianly; apical part of second tergite, all of the next five, and basal part of eight opaque, closely punctured; apical part of eight and entire ninth tergite shining, and with scattered irregular, setigerous punctures; ninth tergite elongate, but rounded apically; sheath rather short, strongly tapering apically; third cubital but little shorter than the second, receiving both interradius and second recurrent close to base; nervulus at basal fifth. Black, with bluish reflection in bright sunlight; head and first two joints of antenna rufous; two spots on dorsal median part, and a spot on posterior ventral angle of pronotum, a small circular spot on side of second tergite, apical margin of eight tergite, lateral spot on apex of ninth tergite yellowish-white; legs black; anterior tibiae reddish; basal half of hind tibiae, hind basitarsus and extreme base of intermediate tibiae yellowish-white; wings hyaline, beyond the basal vein brownish; venation black.

Paratypes exhibit the following variations: Length, 12–20 mm.; ventral and posterior (lateral) margins of pronotum yellowish.

Male.—Length, 12 mm. Antennae 18-jointed, base of flagellum not so distinctly broader than the scape and pedicellum as in female;

hypopygidium rounded apically; otherwise structure as in female. Black, with bluish reflection in bright sunlight; scape piceous; a small spot on temples above and ventral margin of pronotum yellowish; legs below trochanters rufo-ferruginous; wings uniformly hyaline, iridescent; venation dark brown.

Paratypes show the following variation: Length, 10–12.5 mm.; propodeum with a dorsal yellow spot on anterior margin.

Type locality.—Sunderbans, Bengal, British India.

Described from seven females (one type) and six males (one allotype) reared from "Sundri" (*Heritiera fomes* Buch (=*minor*)) by C. F. C. Beeson.

Type, allotype, and paratypes.—Cat. No. 22588 U.S.N.M. Paratype females and males returned to office of forest zoologist, Dehra Dun, India.

XIPHYDRIA HERITIERAE, subspecies BORNEENSIS, new subspecies.

Female.—Length, 15 mm. Differs from the typical form in having the upper margin of mesepisternum smooth and polished, in nervulus being interstitial with basal and in the second and ninth tergites being entirely black.

Type locality.—Sandakan, Borneo.

Described from one female collected by C. F. Baker.

Type.—Cat. No. 22589 U.S.N.M.

XIPHYDRIA FLAVICORNIS, new species.

This species is, judging from the descriptions, closely allied to *testacea* Moscary, but there are slight difference in color, and the male is larger.

Female.—Length, 12 mm. Clypeus projecting over the bases of mandibles, laterally with oblique striae, medianly with a sharp triangularly shaped tooth; face with irregular dorsad-ventrad raised lines, frons rather coarsely reticulate, area between postocellar line and supraorbital line with irregular striae which become weaker dorsally; vertex and temples polished, without sculpture; lower cheeks with oblique striae; the occipital carina ending about opposite the middle of eye; ocelli in a low triangle well below the supraorbital line; postocellar line subequal with the ocellocular line; antenna 15-jointed not extending beyond tegula, slender and tapering from the second joint; second antennal joint two-thirds as long as the third and somewhat longer than the fourth, which is subequal with the fifth; prescutum truncate posteriorly, the anterior width subequal with the median length; notauli broad, shallow, foveolate; prescutum, scutum, and scutellum (anteriorly) reticulate; posterior part of scutellum opaque, granular, and with some irregular raised lines; anterior face of pronotum with dorsad-ventrad rugae; mesepisternum with irregular depressed areas which dorsally look like large, shallow punctures; mesosternum shining almost without sculptured; abdomen obtuse apically, the tergites dull, granular; sheath short, broad, rounded apically; hind basitarsus subequal in length with hind femur; hind tibiae subequal in length with hind tarsi and about twice as long as hind femora; venation normal. Black; basal two joints of antenna brownish, rest of antenna yellowish; base on mandibles, a spot above each antenna, inner margins of eyes (broader above), cheeks, temples, and posterior part of vertex yellow; upper angles of pronotum, three spots on scutellum, metanotum entirely, and upper part of mesepisternum yellow; basal four segments of abdomen, except inner margin of propodeal plates and median apical margins of tergites, which are brownish, ferruginous, apical part of abdomen black, the seventh and eighth tergites laterally and the apical one medianly *yellow;* legs ferruginous, with bases of tibiae and tarsi whitish; wings uniformly hyaline, venation dark brown.

Male.—Length, 8 mm. Sculpture and structural details as in female; antennae 14-jointed, with relationship of basal joints as in female; preultiminate sternite with a bunch of long bristles near middle of apical margin; apical sternite broadly rounded posteriorly. Pale ferruginous, broad line on middle of face, margins of thorax dorsally and tergites medianly brownish; basal two joints of antennae pale brownish, the remaining joints whitish; wings hyaline, venation pale brown.

Type locality.—Sandakan, Borneo.

Described from one female (type) and one male (allotype) collected by C. F. Baker.

Type.—Cat. No. 22379 U.S.N.M.

XIPHYDRIA PYRURA, new species.

The dark wings, black body with the red terminal segments should make it easy to pick out this species.

Male.—Length, 16 mm. Clypeus not extending over base of mandibles, its lateral surfaces shining, medianly with a sharp tooth; face and frons below ocelli with strong raised lines which medianly form dorsad-ventrad striations; area below anterior ocellus shining and sparsely punctured, somewhat depressed so there is a broad shallow middle fovea; area around ocelli, vertex, and temples polished, without sculpture; cheeks with a few strong striae; occipital carina strong, extending dorsally to a line drawn tangent to inner margin of eyes; ocelli in a low triangle, a short distance below supraorbital line; postocellar line distinctly longer than ocellocular; antennae short, 14-jointed, slightly thickened medianly, tapering apically, second joint half as long as the third and a little shorter than the fourth; anterior and lateral faces of pronotum shining, with strong rugae in the depressions; prescutum subgibbous, its anterior surface punctured; prescutum almost V-shaped, its anterior width slightly greater than the median length; prescutum, scutum, and base of scutellum coarsely reticulate, the posterior part of scutellum finely reticulate; mesepesturnum strongly ridged posteriorly, anteriorly coarsely reticulate, behind the ridge shining but with rugae in the depression; basal five tergites punctured (the basal ones more strongly so) the remaining tergites smooth; apical tergite long; hind basitarsus longer than the three following joints, slightly shorter than the hind femur; hind tarsi distinctly longer than the hind tibiae; venation normal. Black; tibiae and tarsi dark brownish black; apical two abdominal segments rufous; wings violaceous, venation black.

The paratype is about 13 mm. long and has the tibiae and tarsi reddish piecous.

Type locality.—Mount Makiling, Luzon, Philippine Islands.

One male collected by C. F. Baker. Also one male, collected March to June, 1911, by C. V. Piper, at Lamao, Luzon, Philippine Islands.

Type.—Cat. No. 22380 U.S.N.M.

FAMILY ARGIDAE.

ARGE ANNULITARSIS, new species.

In general color and markings of legs suggests *Arge rosae* (Linnaeus), but the wings are not yellowish and the scutum and prescutum are pale.

Female.—Length, 7 mm. Anterior margin of clypeus shallowly, arcuately emarginate; supraclypeal foveae connected with antennal foveae, elongate and deeper than antennal foveae; supraclypeal area strongly convex, but not carinated; middle fovea elongate, closed below, extending dorsad half the distance between bases of antennae and anterior ocellus, open above; antennal furrows dorsally, vertical and postocellar furrows obsolete; postocellar line distinctly shorter than ocellocular line; antenna clavate, flagellum carinate beneath; stigma rounded below; third cubital longer on radius, shorter on cubitus than second cubital; second recurrent about half the length of second intercubitus from base of third cubital; basal joining subcosta about the length of intercosta before origin of cubitus; nervulus slightly beyond the middle of cell; legs normal. Ferrugineous; head, antennae, mesosternum, most of scutellum, metanotum, and apex of sheath black; legs ferrugineous, apices of tibiae and tarsal joints black; spines yellowish; hair color of body; wings dusky hyaline; venation black.

Type locality.—Murree, 7,500 feet (about 2,272 meters), British India.

Described from one female collected August, 1917, by Dutt and forwarded by Imperial Entomologist of British India.

Type.—Cat. No. 22511 U.S.N.M.

ARGE DENTIPES, new species.

Much larger than *victoria* Kirby, which it resembles somewhat in color.

Female.—Length, 14 mm. Labrum broad, short, sparsely punctured, the apical margin truncate; clypeus nearly flat, broadly, shallowly, arcuately emarginate, the lateral angles rather sharp, surface with distinct, rather close punctures; supraclypeal foveae deep, elongate, oval, not connected with antennal fovea; antennal furrows complete, broad; middle fovea sharply defined by ridges laterally, open below, above with an oval-shaped depression; ocellar depression rather small, but well defined; vertical furrows poorly defined and present only anteriorly; postocellar furrow rather poorly defined, curved; postocellar line slightly longer than ocellocular line; face and front with distinct small punctures, closer on front; vertex and cheeks shining almost impunctate; antenna distinctly thickening apically; thorax and abdomen shining; third intercubitus with two curves; recurrent veins parallel, the second half the length of second intercubitus beyond it; nervulus distinctly before middle of cell; four anterior femora with a tooth above at about the apical third; posterior femora slender basally, suddenly enlarged dorsally at about the middle; hind tibiae somewhat compressed apically. Head and thorax deep metallic blue; abdomen beyond the propodeum rufo-ferrugineous with sheath and median spots on first eight tergites metallic blue; legs metallic blue; antennae black; wings dark brown with a violaceous tinge; venation black; head, thorax, and legs with short white hair.

Type locality.—Lashio, Burma.

Described from one female collected at an altitude of 3,000 feet (about 909 meters), August, 1914, by Fletcher and forwarded by the Imperial Entomologist of India.

Type.—Cat. No. 22506 U.S.N.M.

The unusual femora and central spots on the abdomen should make it easy to recognize this species. It is difficult to tell how much reliance should be placed on the tubercules on the four anterior femora, as the anterior one on the left side is almost normal. The sudden swelling of the posterior femora will, however, probably be constant.

Genus CIBDELA Konow.

As far as known the species belonging to this genus are confined to the oriental and the adjacent parts of the Palaearctic regions. All of the known species are entirely metallic bluish or bluish green and have the wings more or less dark. The species examined are closely allied and while they can be distinguished comparatively easily by comparison they are difficult to tabulate. The following key may be of service in distinguishing the forms here treated. The only species which is omitted is *scita* Konow. Specimens of a species which agrees with Konow's description of *scita* and were determined as that by Enslin are at hand but they belong to the genus *Arge*. Whether *scita* was wrongly placed by Konow or not can not be determined from the information at hand, and a comparison of the type will probably be necessary. The following tabulation is based on females.

KEY TO CERTAIN SPECIES.

1. Postocellar and ocellocular lines subequal 2
   Postocellar line distinctly longer than ocellocular line 3
2. Basal part of wings clear; a distinct dark brown spot below stigma, and apex of wings faintly brownish .... *maculipennis* (Cameron).
   Basal part of wings brownish; no distinct cloud below stigma, although this area is somewhat darker .... *chinensis*, new species.
3. Wings uniformly dark brown .... *melanoptera*, new species.
   Wings with at least basal and median cells subhyaline 4
4. Body purplish; ridges of middle fovea very prominent, especially opposite antennae; eyes distinctly reniform, converging below .... *poecilotricha* (Konow).
   Body greenish-blue; ridges of middle fovea less strong; eyes hardly reniform or converging below .... *janthina* (Klug).

CIBDELA MACULIPENNIS (Cameron).

Konow considered this to be synonymous with *janthina* (Klug), but later Enslin expressed the opinion that was a good variety. If the determination for the material before me is correct, I believe *maculipennis* to be a distinct species.

CIBDELA CHINENSIS, new species.

In general appearance more like *poecilotricha* (Konow), but easily distinguished from that species by having the postocellar and ocellocular lines subequal; on this character it falls next to *maculipennis* (Cameron), but differs from that species by the darker wings.

Female.—Length, 9.75 mm.; length of anterior wing, 9.75 mm. Anterior margin of labrum depressed, truncate; anterior margin of clypeus not depressed, gently, arcuately emarginate; supraclypeal foveae deep, short oval; lateral walls of middle fovea slightly constricted above antennal foveae, not extending below antennal foveae; inner margins of eyes only slightly converging below; postocellar and ocellocular lines subequal; postocellar furrow complete, not sharply defined; postocellar area parted by a median, impressed line; third cubital cell shorter, on both radius and cubitus, than the second; stigma broadest at base tapering to apex. Metallic with distinct purplish tinge; with the usual whitish pubescence; anterior wings pale brown with the area below the stigma darker; posterior wings subhyaline; venation blackish.

In the paratype the antennal furrows above the supraclypeal fovea are deep, and the second and third cubital cells are nearer the same length.

Type locality.—Hongkong, China.

One female collected, 1911, by F. W. Terry. Also one female paratype collected by H. R. Caldwell at Foochow, China.

Type.—In the British Museum of Natural History.

Paratype.—Cat. No. 22357 U.S.N.M.

CIBDELA MELANOPTERA, new species.

In size and appearance more like *poecilotricha* (Konow), but the darker wings will readily distinguish it from that species.

Female.—Length, 10 mm.; length of anterior wing, 11 mm. Anterior margin of labrum depressed, slightly emarginate; clypeus flat, the anterior margin distinctly arcuately emarginate; supraclypeal fovea deep, elongate oval; walls of middle fovea parallel, prominent, especially opposite antennae, extending somewhat below ventral margin of antennal foveae; eyes reniform, slightly converging below; postocellar line distinctly longer than ocellocular line; postocellar area feebly defined laterally, not parted; postocellar furrow distinct, angular anteriorly; stigma below nearly straight for half its length then distinctly tapering; second and third cubital cells subequal or radius. Metallic with a distinct purplish tinge; pubescence on top of head and thorax blackish, the rest whitish; wings (anterior and posterior) uniformly brownish; venation blackish.

The paratype has the basal part of the hind wings paler.

Type locality.—Iligan, Mindanao.

One female from C. F. Baker. Also one female paratype from Mount Merinjak, altitude 2,200 feet (about 66 meters), May 29, 1914.

Type.—Cat. No. 22358 U.S.N.M.

Paratype.—In the British Museum of Natural History.

CIBDELA POECILOTRICHA (Konow).

Syn. *Cibdela pruniosa* (CAMERON).

The specimens determined as this species agree well with Cameron's description of *pruniosa*, and there seems to be but little doubt that they are his species. They also agree with Konow's description of *poecilotricha*, but this description does not include sufficient characters to enable one to feel sure of the correctness of the identification. Konow has, however, synonymized *pruniosa* with *poecilotricha*, so I have used his name and accepted the synonymy.

Family TENTHREDINIDAE.

Subfamily DIPRIONINAE.

NEODIPRION (NEODIPRION) EXIMINA, new species.

This species is closely allied to *abbotii* Leach, but is readily separated by the black tergum and scutum.

Female.—Length, 6.5 mm. Clypeus gently convex basally, without sculpture, apical margin narrowly depressed and broadly, arcuately emarginate; supraclypeal foveae unusually prominent;

middle fovea deep, elongate, with sloping walls, not extending to the anterior ocellus; head subopaque; front and face with close punctures; vertex with the punctures slightly more separated than those on the front; posterior orbits with widely scattered punctures; postocellar area sharply defined, not arched, twice as wide as the median length; antennae 19-jointed; the median rami subequal in length with the length of the joints; and nearly uniform in width; third joint distinctly longer on the dorsal margin than the fourth; prescutum and scutum with close, well-defined punctures; scutellum wider than long, obtusely angled posteriorly, the surface with uniform well-defined punctures; mesepisternum with the punctures so close as to appear granular; tergites shining, highly polished; nates shining, when highly magnified the surface is reticulate and there are scattered, setigerous punctures; sheath when seen from below truncate apically, the pad-like plates three times as long as wide and well removed from the median ridge; last sternite with a broad, shallow, median emargination; tarsal claws with a small erect tooth at the middle; hind tarsi rather short; the basitarsis only a trifle longer than its apical width; the longer calcarium of the posterior tibiae only a trifle shorter than the hind basitarsus. Black; head ferruginous except the antennal furrows to the ocelli and a band between the ocelli which are black; pronotum, scutellum, the upper part of the mesepisternum, sides of the tergites, whitish; sternites medianly and nates ferruginous; legs rufo-ferruginous with apices of the anterior femora and the bases of all the tibiae and the base of the hind basitarsi whitish; wings hyaline, venation dark brown, stigma clear in the middle.

Type locality.—Tomahawk Lake, Wisconsin.

Described from one female reared from larvae collected on *Pinus resinosa* by S. A. Rohwer and recorded under Bureau of Entomology, No. Hopk. U. S. 10170.

Type.—Cat. No. 21775, U.S.N.M.

NEODIPRION (NEODIPRION) EXCITANS, new species.

Allied to *pinus-rigidae* (Norton), but may be distinguished in the female by the longer rami on the antennae, the more sparsely punctured head and mesepisternum, serrate upper apical margin of lance, teeth on basal rib of lancet, and only having thirteen teeth (the medium ones being larger) on seventh (from apex) rib of lancet.

Female.—Length, 8 mm. Anterior margin clypeus depressed, broadly arcuately emarginate; head shining with distinct separate punctures; middle fovea broad shallow; postocellar line distinctly longer than ocellocular line; median cephalo-caudad length of postocellar area fully half as great as the anterior width of postocellar area; postocellar area very slightly convex; antennae 16-jointed, third joint distinctly longer than the fourth, fourth, fifth and sixth subequal dorsally, rami longer than half the dorsal length of joint; prescutum and scutum shining, with small, distinct separate punctures; scutellum shining, rounded posteriorly, angulate anteriorly, with large well-separated punctures which are closer posteriorly; mesepisternum with separate large punctures on a shining surface; abdomen smooth shining; pad-like brush of sheath very narrow, remote from middle, the distance between brushes greater than their length so the sheath is broadly truncate when seen from below; lance serrate on dorsal apical margin; lancet with nine rows of teeth, the seventh from end armed with thirteen teeth, the medium ones being larger. Ferrugineous and brown; head ferrugineous, antennae, antennal furrows and postocellar furrow brownish-black; thorax dorsally brownish with lateral margins of prescutum and the scutellum sordid whitish; mesosternum and episternum below brownish; pronotum, upper part of mesipisternum, metaplura, sides of abdomen sordid whitish; tergum brownish; nates and eight sternite rufous; sternites brownish-ferrugineous; wings hyaline, viterous; venation black, middle of stigma pale.

Male.—Length, 5 mm. Head shining, with well-separated punctures which are closer near the mouth; postocellar area convex its median length about one-third its anterior width; antenna 16-jointed, short the basal ramulus nearly as long as flagellum; prescutum and scutum shining, with separate small punctures; scutellum with large separate punctures; mesepisternum shining with separate punctures which are somewhat larger and closer dorsally; tergites shining; hypopygidium short broadly rounded apically. Black; apical part of clypeus, labrum, palpi, legs below bases of coxae, and apical sternite rufo-ferrugineous; wings viterous hyaline; venation brown.

Some of the paratype males have most of the sternites rufo-ferrugineous but they were probably killed before they matured.

Type locality.—Montgomery County, Texas.

Described from eight (one type) females reared from cocoons sent in by G. M. Del Curte, assistant entomologist of Texas, and recorded under Bureau of Entomology No. Hopk. U. S. 10779*e*; and from two females and eleven (one allotype) males sent in by G. M. Del Curte, assistant State entomologist of Texas, as coming from eastern Texas.

Type.—Cat. No. 22389 U.S.N.M.

Subfamily ALLANTINAE.

TAXONUS ATTENATUS, new species.

Apparently allied to *Allomorpha pulchripes* Cameron, but can easily be distinguished by color and different antennae. In the relation of the antennal joints it is more like *Allomorpha incisa* Cameron, but that species has the head marked with yellow.

Female.—Length, 9.5 mm.; length of anterior wing, 7 mm.; length of antennae, 5 mm. Labrum smooth, polished, the apical margin obtusely angled; clypeus coarsely punctured, the anterior margin deeply subsquarely emarginate, lobes rather narrow, rounded apically; supraclypeal area gently convex, nearly quadrate in outline; middle fovea rather large, quadrate in outline but connected with a depression from the anterior ocellus; antennal furrows complete; postocellar line not quite half as long as the ocellocular line; postocellar furrow wanting; postocellar area flat, slightly longer than broad; head polished; flagellum very slightly thicker apically, the first joint somewhat longer than the second which is subequal with the third, fourth and seventh joints subequal in length and longer than the fifth and sixth which are subequal; scutum and prescutum polished; scutellum shining but coriaceous, posteriorly with some rather large punctures; upper part of mesepisternum (except just beneath wing) with large punctures; lower part of mesepisternum and the sternum shining, polished; abdomen shining; sheath rather narrow, straight above, rounded from upper apex; posterior basitarsis subequal in length with the following joints; stigma rounded below; interradius curved, joining the radius a short distance beyond middle of third cubital; third intercubitus twice as long as the second, which is oblique; recurrents joining the cubitus about the length of second interradius from the base of cells; nervulus practically at middle of cell; black; labrum, palpi, apical three joints of antennae, and apical joints of hind tarsi whitish; femora dark rufous, tibiae and tarsi more ferrugineous; wings hyaline; venation dark brown, base of stigma pale.

Type locality.—Soochow, China.

Described from a single female collected by N. Gist Gee.

Type.—Cat. No. 22609 U.S.N.M.

TAXONUS FLETCHERI, new species.

Judging from the description this species is apparently allied to *Allomorpha pulchripes* Cameron, but the following differences are to be noted: Prescutum entirely black, mesopleurae black, supraclypeal area yellow, color of abdomen somewhat different.

Female.—Length, 9 mm.; length of anterior wing, 8.5 mm.; length of antenna, 10 mm. Labrum polished, the anterior margin broadly rounded; clypeus coarsely, irregularly punctured, the anterior margin deeply, squarely emarginate, lobes rather broad rounded apically; supraclypeal area gently convex, smooth, triangular in outline; depression in front of the anterior ocellus deep, with sloping walls, extending to near bases of antennae, U-shaped in outline; antennal furrows well defined, complete; postocellar line not much more than half as long as ocellocular line; postocellar furrow well defined, angulate anteriorly and with a short furrow extending to the anterior ocellus; postocellar area convex, well defined; its length and width subequal; inner margins of eyes subparallel, the distance between them at the antennae distinctly more than the length of an eye; malar space nearly as long as the apical width of pedicellum; antennae long, filiform, third, fourth, and fifth joints subequal, the remaining shorter and each joint shorter than the preceding; mesonotum, shining, almost impunctate; scutellum flat; mesepisternum above coarsely reticulato-granular; lower part of mesepisternum and the entire sternum polished; abdomen polished; sheath straight above obliquely truncate apically then gradually widening to base; hind basitarsus subequal in length with the following joints; claws cleft, the inner tooth larger; wings slender, the hind unusually narrowed apically; interradius curved, joining the radius a short distance beyond the middle of the third cubital cell; recurrent veins join cubitus near base of cells; nervulus its length beyond basal; no discal cells in hind wing. Black; base of mandibles, labrum, clypeus, palpi, supraclypeal area, spot on scutellum, hind coxae above, sides of first, second, third, fourth, and the entire terminal tergite, and hind tarsi except basal two-thirds of first joint, whitish; posterior margin of pronotum, tegulae, spot on side of pronotum, apical margins of second and third tergites, four anterior legs (except coxae beneath), hind legs (including coxae beneath) rufo-piceous or rufous; antennae brownish, joints five and six blackish, seven and following whitish; wings hyaline, venation dark brown, base of stigma yellowish.

In the paratypes the apical margins of tergites two and three are broadly testaceous.

Type locality.—Shillong, 5,000 feet (about 1,515 meters), British India.

Described from three females (one type) collected in June and July, 1918, by T. B. Fletcher, for whom the species is named.

Type.—Cat. No. 22608 U.S.N.M.

Paratype returned to office of Imperial Entomologist, Pusa, India.

Subfamily TENTHREDININAE.

Genus BELDONEA Cameron.

Konow considered that *Beldonea* Cameron was synonymous with *Macrophya* Dahlbom, but after a study of the genotype of Cameron's genus it seems to the writer that it should be considered as belonging to a distinct group. In Konow's generic synopsis,[3] the genotype of *Beldonea* runs to *Perineura* Hartig, but may be distinguished from members of that genus by absence of the malar space, position of propodeal spiracle, etc. *Beldonea* may be separated from *Macrophya* by having both tibial spurs of anterior tibiae simple, by the smaller

[3] Genera insect, fasc., 29, 1905, p. 118.

metaepimeron and malar space, etc. It is probably more closely allied to *Sciapteryx* Stethens, but may be distinguished from that genus by the short malar space, the simple anterior calcaria. The following characters are given to supplement the original description.

Belongs to Tenthredinini; slender; inner margins of eyes nearly parallel and at the level of the antennae separated by a distance greater than the length of eye; clypeus emarginate; malar space line like; head and thorax more or less coarsely punctured; third antennal joint longer than fourth; occiput not carinate; both calcarium of anterior tibiae simple; claws cleft; hind basitarsis subequal in length with the following joints; hind coxae of normal size; metepimeron not especially large; propodeum divided; two discal cells in hind wing; anellan cell petiolate.

BELDONEA LUBENS (Konow).

Macrophya lubens Konow, Ent. Nachr., vol. 24, 1898, p. 88.
Beldonea rugifrons, Cameron, Mem. Proc. Manchester Soc., vol. 43, no. 3, 1899, p. 36.

A single female of this species was collected at Shillong, 5,000 feet (about 1,515 meters), India, June or July, 1918, by T. B. Fletcher.

JERMAKIA DENTISTERNA, new species.

There is much about this species which recalls *Dipteromorpha rotundiventris* (Cameron), and it may possibly be the female of that species, but it does not answer the description entirely, and it seems best to place it in *Jermakia* where it would run in Konow. The description of *Diptermorpha* and even my manuscript notes do not include enough information to satisfactorily place the genus. The species here described differs from the published description of *Diptermorpha rotundiventris* in the black thorax (perhaps secondary sexual), uniformly colored wings, and other minor color characters. It also differs in the position of the nervulus as figured by Kirby.

Female.—Length, 15.5 mm.; length of anterior wing, 16 mm.; length of antenna, 8 mm. Entire head shining, polished; anterior margin of labrum broadly rounded; anterior margin of clypeus broadly, arcuately emarginate, the lateral angles sharp; supraclypeal suture obsolete; middle fovea deep, rectangular in outline; ocellar depression cordate in outline but not sharply defined below; antenna; furrows complete; postocellar furrow wanting; postocellar line less than half as long as ocellocular; antennae long, filiform the third joint slightly longer than fourth, the following decreasing in length; pronotum, prescutum, scutum, and anterior part of scutellum polished; prescutum subgibbous, with a deep median furrow; scutellum pyramidal, the posterior part punctured; mesepisternum polished but also with large, distinct, separated punctures, the anterior margin sharply truncate, this truncation continues to the posterior ventral margin, and leaves a shelflike depression to the sternum which is prominent and armed with two teeth posteriorly; abdomen polished, cylindrical. longer than head and thorax; propodeal spiracle at about the middle of the lateral margin; sheath straight above, obliquely truncate apically, convex below; wings long and slender; interradius curved at almost a right angle and joining the radius slightly beyond the middle of the third cubital cell; third cubital longer on both radius and cubitus than the first and second combined, receiving the second recurrent a little beyond basal fourth; first recurrent at about the middle of second cubital; first discoidal cell elongate, the first recurrent shorter than the basal; nervulus half its length beyond basal. Black; clypeus, labrum, mandibles (except apices), and tegulae yellow; antennae black with fourth and following joints and apical part of third beneath, ferrugineous; abdomen brownish with a longitudinal median dorsal and lateral lines somewhat paler; propodeum dark brown with a yellowish median spot; legs yellowish, coxae black, posterior femora and tibiae rufous; wings uniformly yellowish; venation black, costa and stigma ferrugineous; tibiae and tarsi with short hair.

Type locality.—Kumaon, Ramgarh, 6,000 feet (about 1,818 meters), British India.

Described from one female collected August 21–26, 1918, by T. B. Fletcher.

Type.—Cat. No. 22610, U.S.N.M.

TENTHREDO BALABATEA, new species.

Judging from the descriptions, this species is probably more closely allied to (*Allantus*) *Tenthredo incognitus* (Bingham), but it may readily be distinguished from that species by the black thorax.

Male.—Length, 9 mm.; length of antenna, 4.5 mm. Labrum polished, broadly rounded apically; clypeus shining, with widely separated, setigerous punctures, the anterior margin deeply subsquarely emarginate, with broad rounded lobes; head with close (sometimes almost confluent) rather large punctures; middle fovea elongate more or less ellipitical in outline; antennal furrows not especially prominent; postocellar area well defined, rectangular in outline, twice as wide as long; postocellar line subequal with the ocellocupital line but hardly half as long as the ocellocular line; antennae thickening apically, the third joint as long as the fourth and fifth which are subequal; mesonotum shining, with distinct, rather close, well defined punctures; mesepisternum closely punctato-granular, opaque; scutellum gently convex; stigma straight below; obliquely truncate at base and apex; third cubital cell longer on both radius and cubitus than the second; interradius received at about middle of cell; second recurrent the length of second intercubitus from base of cell; abdomen shining; hypandrium narrowly truncate apically, short. Black; labrum, anterior femora and tibiae beneath, the intermediate femora apically beneath, yellowish; hind legs below trochanters, first sternite, and all of segments 3–6 inclusive rufous; wings brownish hyaline, somewhat darker anteriorly; venation except stigma black; stigma yellowish; head and thorax with rather long gray hair.

Type locality.—Dungagali, 8,000 feet (about 2,424 meters), Hazara District, British India.

Described from one male collected May 21–24, 1915, by T. B. Fletcher.

Type.—Cat. No. 22619, U.S.N.M.

TENTHREDELLA KUMAONENSIS, new species.

From *Tenthredella turneri* Rohwer this species may be separated by the black tergum and shorter third cubital cell.

Female.—Length, 10 mm. Labrum rather short, the anterior margin broadly rounded; clypeus long, the anterior margin broadly, rather shallowly, arcuately emarginate, lobes broad, rounded apically; supraclypeal area flat; middle fovea large, rather shallow, U-shaped in outline, raised in center; antennal furrows complete narrow; ocelli in an equilateral triangle; postocellar line about one-third as long as the ocellocular line; postocellar area flat, somewhat wider than long; head slightly receding behind eyes; antenna slender, filiform, as long as head and thorax, the third joint distinctly longer than fourth but shorter than fourth and fifth; mesonotum polished, with small well separated punctures which are sparser on scutellum; post-tergite (scutellum appendage) polished impunctate; mesepisternum shining, sparsely punctured above, but with rather close small punctures below; sheath broader at base, gradually and evenly rounding to an obtuse apex; second cubital but little shorter than the third, of the same width at base and apex, angulate where first recurrent joins the middle of the second abcissa of cubitus; third cubital two and one-half times as wide at apex as at base, receiving the second recurrent the length of second intercubitus from base; interradius strongly curved, joining the third cubital beyond the middle; nervulus at basal third. Black; band below antennae, clypeus, labrum, spot on mandible, cheeks, line on pronotum, tegulae, spot on mesepisternum, spot above hind coxa, sternites, and sheath sordid whitish; legs whitish, four anterior ones with a black line above from bases of femur (broader above), hind tibia except a small spot, and hind tarsi black; wings hyaline; venation black, except the reddish lower margin of stigma.

In one paratype the sheath is black and the sternites are marked with black; in another the hind femora are black above to near base.

Male.—Length, 9 mm. One specimen, which seems to be the male of this species, differs from the female as follows: Labrum longer; third and fourth antennal joints subequal; face entirely pale; spot on side and posterior lateral margin of pronotum, pale of mesosternum connected with that of mesepisternum, hind margin of mesepimeron, sordid-white; sternites except apical margins blackish; ventral margins of tergites yellowish; median spot on tergites three and four testaceous. Hypopygidium yellowish, narrowly rounded apically.

Type locality.—Ramgarh, Kumaon, British India.

Described from three females (one type) and one male collected August, 1918, at an altitude of 6,000 feet (about 1,818 meters) by T. B. Fletcher.

Type and allotype.—Cat. No. 22887, U.S.N.M.

Paratypes.—Returned to office of Imperial Entomologist of British India.

TENTHREDELLA SIABATAKA, new species.

Female.—Length, 9 mm. Labrum broadly rounded; clypeus rather broadly subsquarely emarginate apically, the lobes broad rounded; middle fovea elongate and extending nearly to anterior ocellus; anternnal furrows complete; postocellar furrow complete; postocellar area narrow, flat, more than twice as wide as long; head shinging, slightly receding behind eyes; antennae rather short, slightly thickened apically, the third but little shorter than fourth and fifth; mesonotum shining, with small, sparse punctures; apex of scutellum with larger punctures and with a median ridge; post-tergite (scutellum appendage) ridged medianally and with some large punctures near the ridge, otherwise shining; mesepisternum subopaque, coriaceous; sheath straight above, convex below, broadly rounded apically; stigma angulate at base beneath; second recurrent at about middle of cell and causing the cubitus to become angulate; third cubital about three times as wide at apex as at base; interradius curved received at about apical third. Black; spot on clypeus, labrum, mandibles except apices, cheeks, angles of pronotum, tegulae, spot on side of pronotum, spot above hind coxa, four anterior legs below coxae beneath, hind tibiae except apices, bases of hand tarsal joints, *yellowish;* abdominal segments two to five inclusive reddish; wings hyaline; venation black.

Type locality.—Ramgarh, Kumaon, British India.

Described from one female collected August, 1918, at an altitude of 6,000 feet (about 1,818 meters), by T. B. Fletcher.

Type.—Cat. No. 22889, U.S.N.M.

TENTHREDELLA NIAPA, new species.

This species seems to be allied to *Tenthredella casta* (Konow), but the markings of the abdomen are different.

Female.—Length, 10 mm. Labrum long, polished, obtusely pointed apically; clypeus long, the apical margin deeply arcuately emarginate, lobes broad, rounded apically; antennal furrows complete; ocelli in an equilateral triangle, the anterior one yellow, the lateral ones black; postocellar area flat, but little wider than long; head shining, hardly receding behind eyes; antennae rather short, slightly thicker apically, the third joint nearly as long as four plus five; mesonotum shining almost without punctures; post-tergite (scutellum appendage) smooth, without a median ridge and with only a few punctures; mesepisternum coriaceous; sheath straight above and below, apex rounded; venation usual. Yellowish (probably green in life); apices of mandibles, antennae beyond scape, circular sport above antennae and extending to occuput (except postocellar area), anterior dorsal margin of pronotum, prescutum (except lateral margins), scutum, narrow mark on mesepisternum, basal middle of all tergites, narrow line on femora (abbreviated on anterior pair) above, *black;* sides and sternum paler than dorsum; wings hyaline; venation black; costa and stigma yellowish.

Type locality.—Dungagali, Hazara District, British India.

Described from one female collected May, 1915, by T. B. Fletcher, at an altitude of 6,000 feet (about 1,818 meters).

Type.—Cat. No. 22890, U.S.N.M.

MACROPHYA LUCIDA, new species.

In Enslin's review[3] of the Palaearctic species of *Macrophya* this new species runs to *opposita* Smith, but the absence of dense punctures and differences in color will serve to separate it from that species.

Female.—Length, 9 mm. Anterior margin of the labrum broadly rounded; anterior margin of the clypeus deeply sub-squarely emarginate, the lobes broad, rounded apically; supraclypeal area flat, shining; antennal furrows broad, shallow, complete; median fovea broad, shallow and not sharply defined; frons shining, with only a few punctures laterally but medianly the punctures are more numerous; vertical and postocellar furrows well defined; postocellar area flat, fully twice as wide as long; postocellar line but little more than half as long as the ocellocular line; head not receding behind the eyes; vertex and orbits shining, very sparsely punctured; antennae as long as head and thorax, slightly thicker apically, third joint but little shorter than four plus five which are subequal; mesonotum shining, with small, well separated punctures; mesepisternum opaque,

[3] Deutsch. Ent. Zeit., 1910, p. 475

finely punctured, dorsally the punctures become larger; abdomen highly polished; sheath rather broad, straight above, convex below, rounded apically: stigma long, nearly parallel-sided, oblique apically; second cubital long, parallel-sided, receiving the recurrent a little before the middle; third cubital fully five times as wide at apex as at base, receiving the recurrent at basal third. Black, shining; two spots on clypeus, labrum, mandibles, spot on lower posterior orbit, small spot on inner superior orbit, narrow margin of pronotum, margin of tegulae, apical margin of fourth tergite (much wider laterally), *yellowish-white*; legs black, four anterior femora, tibiae and tarsi beneath, posterior tibiae beneath, yellowish-white; wings hyaline, venation black; head and thorax with long white hair.

Type locality.—Kumaoa, Ramgarh, British India.

Described from a single female collected at an altitude of 6,000 feet (about 1,818 meters), August, 1918, by T. B. Fletcher.

Type.—Cat. No. 22888, U. S. N. M.

CROMAPHYA, new genus.

Genotype.— *Cromaphya serricornis* Rohwer.

This genus belongs to the tribe Tenthredinini and allied to *Macrophya* Dahlbon and *Zalaquim* Rohwer, resembling them in the large metaepimeron, the flat front, etc., but may easily be distinguished from both of these as well as the other genera in the tribe by the serrate antennae. The noncarinate orbits and occiput, and the partly fused propodeum will separate it from *Paramacrophya* Forsius.

Clypeus emarginate; antenna probably nine-jointed (wanting beyond eight), the apices of the third and following joints produced so when seen from the side the flagellum is serrate, third antennal joint much longer than the fourth; inner margin of eyes strongly converging towards the clypeus; the distance between the eyes at the antennae slightly less than the length of the eye; malar space line-like; front as in *Macrophya;* posterior orbits narrower than the diameter of the eyes rounded; occiput and orbits not carinate; thorax much as in *Macrophya*; metaepimeron large, higher than the metaepisterum, rectangular in outline, the posterior part with a large oval-shaped area set off by a strong carina so as to form an oval basin; legs normal; hind coxae not especially large; tibial spurs long; hind basitarsus subequal in length with the following joints; claws cleft; basal plates not divided, but with a median longitudinal furrow; abdomen normal; wings as in *Macrophya* but the contraction of the anal cell is very short.

CROMAPHYA SERRICORNIS, new species.

Female.—Length, 10 mm. Labrum large, the anterior margin slightly emarginate; clypeus deeply subsquarely emarginate the lobes rounded, antennal furrows obsolete; postocellar areas defined laterally by furrows, not defined anteriorly; antennal joints strongly produced beneath at apex so when seen from the side they appear serrate; front with close, sometimes confluent punctures; prescutum anteriorly, with close fine punctures posteriorly nearly impunctate; scutum with scattered punctures which are closer along the notauli; scutellum with close, well-defined punctures; metascutum polished, mesepisternum with well defined, rather close punctures, when seen from the front angled below; propodeum polished except in middle; stigma rounded below; second cubital distinctly shorter than third; sheath rather narrow, concave above, rounded apically, convex beneath. Black; clypeus, labrum (except apex) spot on mandibles; scape, pedicellum, base of first flagellar joint, posterior margin of pronotum narrowly, tegulae (except a small spot), perapteron, large spot on anterior margin of mesepisternum, band on scutellum, and propodeum yellowish-white; first (beyond propodeum) four abdominal segments red; legs black; spot on coxae (anterior pair almost entirely), trochanters, apices of four anterior femora, posterior femora beneath, tibiae except a spot on apices of hind pair and a line on top of four anterior pair, tarsi except apices of joints and a line beneath of hind basitarsis *yellowish-white*. Wings dusky hyaline, to base of stigma and stigmella, beyond brownish; venation black.

Type locality.—Cherrapunji, Assam.

Described from one female collected at an altitude of 4,400 feet (about 1,333 meters) in October (2–8), 1914, by S. W. Kemp.

Type.—Indian Museum, $\frac{8371}{20}$.

Subfamily EMPRIINAE.

AMONOPHADNUS, new genus.

Genotype.—*Amonophadnus submetallicus* Rohwer.

Allied to *Monophadnus* and *Paracharactus*, but differs from them in the longer hind basitarsis, dentation of claws, venation, etc. *Senoclidea* and *Parazarca* have the long hind basitarsis and are closely allied, but have the claws different.

Belongs to Blennocampini. Clypeus truncate; malar space very narrow; eyes distinctly converging to clypeus, the distance between them at clypeus subequal with their length; orbits not carinate; antennae hairy, pedicellum longer than its apical width, third joint longer than fourth; nervulus less than its length from apex of cell; interradius and third intercubitus inclined at different angles; discoidellan cell present in both sexes; basitarsi longer than three following joints; claws long, heavy at base, with an erect inner tooth near middle; metaepimeron narrow; first tergal spiracle near base.

AMONOPHADNUS SUBMETALLICUS, new species.

Female.—Length, 7 mm. Shining. Middle fovea represented by a large shallow area which is open above; antennal furrows sharply defined, interrupted opposite crest; ocellar basin ovate-elliptical in outline, extending above the ocellus, rather well defined; postocellar line distinctly shorter than the osellocular line; postocellar furrow well defined, angulate; postocellar area gently convex, but little wider than long; antenna longer than head and thorax, slightly thickening apically, fourth and fifth joints subequal in length; stigma broadest at base, gradually tapering to apex; second and third abcissae of radius subequal; third cubital as long as the first and second combined; sheath narrow, parallel-sided, apex rounded. Submetallic bluish-black, abdomen more distinctly blue; antennae and legs, except trochanters and tibiae (anterior only posteriorly), which are yellowish-white, black; pubescence whitish, sparse; wings hyaline, iridescent; venation black.

Male.—Length, 5.5 mm. Hypopygidium truncate. Differs from description of female in having tibiae brownish.

Type locality.—Pulney Hills, South India.

Described from two females (one type) and one allotype male collected at an altitude of 3,600 feet (about 1,090 meters), May 10–31, 1917, by P. S. Nathan.

Type and allotype.—Cat. No. 22364, U.S.N.M.

Paratype returned to Government Entomologist of India.

ZASENOCLIA, new genus.

Genotype.—Senoclia albocoerulea Bingham (determined Rohwer).

This new genus is readily separated from *Senoclia* by the dentation of the tarsal claws and is probably more closely allied to *Senoclidea*, from which it differs in the following characters: Head flattened dorsally; pedicellum much longer than wide; petiole of anellan cell very short; antennal furrows interrupted; hind basitarsus longer than following joints, etc.

Belongs to Blennocampini. Anterior margin of clypeus slightly emarginate; malar space wanting; eyes large, prominent, very slightly converging to the clypeus; head flat above, the distance from top of eye to occiput but little shorter than the shortest diameter of eye; antennal furrows interrupted below ocelli; pedicellum nearly cylindrical, much longer than wide; interradius straight, joining the radius at an acute angle, and not inclined at same angle as the third intercubitus; anellan cell practically sessile; tarsal claws lobed basally, cleft apically.

ZASENOCELIA ALBOCOERULEA (Bingham).

Two females collected by R. C. McGregor, June, 1918, at Culasi, Panay, Philippine Islands, agree well with the original description.

In these the anterior margin of the clypeus is broadly, shallowly, arcuately emarginate; the frontal foveae are large; the interradius is interstitial with the third intercubitus; the second cubital is narrower below; and the apical part of the first abcissa of the anal vein forms a spur at the base of the lanceolate cell.

Genus SENOCLIA Cameron.

As far as can be determined with certainty, the genus *Senoclia* Cameron contains only two described species—*coerulea* Cameron and *cyanella* Cameron. The last-mentioned species was considered by Kirby to be a synonymon of *purpurata* Smith, but as the type localities are so widely separated it is desirable that the synonymy be confirmed. *Senoclia albocoerulea* Bingham does not belong to this genus but is the type of *Zasenoclia*. Other metallic blue Blennocampids have been described from the oriental region, but it is impossible to place them generically from the descriptions. Some few of them can, however, be placed in the related genus *Senoclidea* Rohwer. The species of *Senoclia* represented in the collection of the United States National Museum may be distinguished by the following key:

1. Exterior bases of tibiae whitish; wings basad of stigma nearly hyaline
diascoreae, new species.
Tibiae unicolorous black; wings uniformly violaceous or with a subhyaline area basad of basal vein in which case the base of wing is dark..................2
2. Female 11 mm.; male with wings uniformly violaceous; head more distincly punctured and with stronger antennal furrows.................*bilanga*, new species.
Female 9–10 mm.; male with apical three-fourths of median and submedian cell subhyaline..*coerulea* Cameron

SENOCLIA DIASCOREAE, new species.

The white at the bases of the tibiae and the hyaline basal part of wings easily distinguishes this species from other species of the genus.

Female.—Length, 11 mm. Clypeus flat, the apical margin truncate; supraclypeal area flat, triangular in outline; middle fovea large keystone-shaped in outline, the middle area convex, the handle of the "key" partially breaking through frontal crest; antennal furrows deep but partly interrupted opposite frontal crest; ocellar basin well defined, somewhat transversely elliptical in outline; postocellar furrow distinct, angulate, with a furrow from angulation to anterior ocellus; postocellar line distinctly shorter than ocellocular line; postocellar area sharply defined, convex, nearly twice as wide as long; third antennal joint distinctly longer than the fourth which is subequal with the fifth; nervulus one-fourth its length from basal; sheath broad, nearly parallel-sided, obtusely rounded apically. Metallic blue with a purplish tinge; antennae and legs, except a yellowish spot on exterior bases of tibiae, blackish; wings brownish, but entire area basad of basal and nervulus nearly hyaline; venation black.

Paratypes show that the convex area in middle fovea and the fovea itself may become somewhat elongated and be more spear-shaped.

Male.—Length, 10 mm. Hypopygidium truncate, with a very shallow arcuate emargination. Color and structure of female.

Type locality.—N. Malabar, Taliparamba, India.

Female type labeled "on pepper vine June '18;" allotype "July–Aug. '18," both collected by P. S. Nathan. Paratype male from same locality collected "16–26 IX '18," by Ramakrishna Ayyar. Paratype female Malabar Dt., Taliparamba, "30 IX–4 X 17" collected by Ramakrishna Ayyar. Paratype male and female from South Canara Dt., Kollur Ghat, 3,000 feet (about 909 meters), "18–21 IX–18." T. V. R., collector.

The letter which accompanied these specimens states that this species breeds "on a creeper, *Diascorea*."

Type, allotype, and paratypes.—Cat. No. 22363, U.S.N.M.

Paratypes returned to Government entomologist of India.

SENOCLIA BILANGA, new species.

This species is closely allied to *caerulea* Cameron, but may be distinguished by the characters used in the foregoing key. The female is very like Cameron's species, and the differences are comparative and hard to express. The male is, however, easily distinguished.

Female.—Length, 11 mm. Clypeus flat; supraclypeal area very slightly convex, triangular in outline; antennal furrows well defined, complete; middle fovea large, shallow, and with a median tubercle; ocellar basin deep, well defined, U-shaped, extending behind anterior ocellus, as a furrow, to the postocellar furrow; postocellar line distinctly shorter than the ocellocular line; postocellar furrow well defined, curved; postocellar area gently convex, about one-third wider than long; front, especially the ocellar area, with setiguous punctures; third and fourth antennal joints subequal, joints six and seven slightly wider than the preceding or following; sheath broad, straight above, obtuse apically, rounding to base; cerci short. Dark metallic blue, with a purplish tinge; antennae and legs black; wings deep violaceous.

Male.—Length, 9 mm. Hypopygidium truncate. Structure as in female.

Type locality.—Kollegal, 2,000 feet (about 606 meters), Coimbatore, S. India.

One female and one male collected August 1, 1917, by Ramakrishna Ayyar. One female paratype from Kallar, Nilgiris, collected by J. V. R., September 27, 1917.

Type and allotype.—Cat. No. 22362, U.S.N.M.

Paratype returned to Government entomologist of India.

Subfamily PHYMATOCERINAE.

TOMOSTETHUS (TOMOSTETHUS) TENUICORNIS, new species.

In the rather long, slender antennae this species differs from the other members of the genus. In color it is much like *hirticornis* Rohwer, but the legs are darker than they are in that species.

Female.—Length, 6.5 mm.; length of antennae, 4.75 mm. Clypeus long, the anterior margin very slightly emarginate, the lateral angles rounded; supraclypeal area triangular in outline, gently convex; middle fovea large, deep, nearly circular in outline, open below; antennal foveae deep, extending dorsally to a little above the level of the middle fovea; antennal furrows and pentagonal area obsolete; a line-like depressed area in front of anterior ocellus; postocellar line but little more than half as long as the ocellocular line; postocellar furrow poorly defined; vertical furrows deep, straight, complete; postocellar area one and one-third times as wide as long; antenna slender, slightly tapering apically, covered with short hair, the third joint only slightly longer than the fourth; stigma rounded below, truncate apically; third cubital cell very short, its length on cubitus subequal, on radius shorter than the third intercubitus; interradius curved, joining radius somewhat beyond middle; claws with an inner tooth near base; sheath concave above, convex below, rounded apically. Black; pronotum, mesonotum (except scutellar appendage), and upper part of mesepisternum rufous; tibiae dark piceous; wings hyaline, with a faint dusky tinge; venation dark brown.

Type locality.—Murree, 7,500 feet (about 2,272 meters), British India.

Described from a single female collected June, 1918, by Dutt and orwarded by the Imperial Entomologist of India.

Type.—Cat. No. 22542, U.S.N.M.

TOMOSTETHUS (TOMOSTETHUS) GRACILICORNIS, new species.

In general appearance more like *Tomostethus* (*Eutomostethus*) *assamensis* Rohwer, but the antennae are more slender and the femora yellow.

Female.—Length, 6 mm.; length of antenna, 3 mm. Anterior margin of clypeus truncate, the lateral angles rounded; supraclypeal area rectangular in outline, only gently convex; median fovea large, deep, rectangular; antennal foveae deep, extending well above the top of the median fovea; pentagonal area triangular in outline, enclosing the anterior ocellus, lateral walls rounded, ventral wall poorly defined; antennal furrows well defined; postocellar furrow poorly defined; vertical furrows deep, well defined, slightly curved; postocellar line one-fourth shorter than the ocellocular line; antenna slender, clothed with long hair, joints not well separated, third joint one-fourth longer than the fourth; stigma tapering from near base; third cubital longer on both radius and cubitus than the first and second combined; interradius curved, received at apical third; nervulus somewhat less than its length from end of cell; claws with a large erect inner tooth a little beyond middle; sheath slightly concave above, strongly convex beneath, rounded apically. Black, shining; legs below apices of coxae yellow; apical tarsal joint slightly infuscate; wings hyaline; venation black.

Male.—Length, 5 mm. Agrees in color and structure with female.

Type locality.—Shillong, British India.

Described from one female (type) and seven (one allotype) males collected June and July, 1918, by T. B. Fletcher at an altitude of 5,000 feet (about 1,515 meters). Forwarded by the Imperial Entomologist of India.

Type, allotype, and paratypes.—Cat. No. 22543, U.S.N.M.

Paratypes (males) returned to imperial entomologist of India.

Subfamily NEMATINAE.

HEMICHROA (HEMICHROA) ORIENTALIS, new species.

This species is closely allied to the European *H. crocea* (Geoffroy), but may be distinguished by the black hind legs and the shape of the sheath. *H. major* Rohwer the only other oriental species belonging to this genus is quite different.

Female.—Length, 7 mm.; length of antenna about 5 mm. Anterior margin of the clypeus with a deep U-shaped emargination, the lobes broad and rounded apically; supraclypeal foveae deep elongate, confluent with antennal foveae; supraclypeal area broadly triangular in outline, gently convex; middle fovea elongate rather well defined, breaking through the crest; ventrad of middle fovea is a small rounded tubercule; ocellar basin hexagonal in outline, rather well defined, especially so dorsally; a small nearly circular fovea below anterior ocellus; inter-antennal area parted by a deep furrow; postocellar line a trifle shorter than the ocellocular line; postocellar furrow present but not sharply defined; vertical furrows well defined, diverging posteriorly; anterior width of postocellar area not quite twice its median length; antenna tapering, the third and fourth joints subequal; stigma broadest at base gradually tapering to apex; interradius curved, received at about middle of cell; recurrentella about the length of intercubitella before intercubitella; sheath broad, straight above narrowly truncate at apex, tapering to broad base. Rufoferruginous; antennae, trophi, proepisternum; mesosternum, metapleurae, metascutellum, sheath and legs (except the apices of anterior femora and the tibiae beneath) black; wings brownish, clearer apically; venation black.

Type locality.—Kumaon, 6,000 feet (about 1,818 meters), Ramgark, British India.

Described from one female collected August, 1918, by T. B. Fletcher and forwarded by Imperial Entomologist of India.

Type.—Cat. No. 22393, U.S.N.M.

CROESUS ORIENTALIS, new species.

In size and appearance resembles *Croesus latitarsis* Norton.

Female.—Length, 8.5 mm.; length of antenna, 8.5 mm. Clypeus with a tranverse fold basally, the anterior margin with a deep, rather narrow U-shaped emargination, lobes very broad and rounded; supraclypeal area convex, trapezoidal in outline; supraclypeal foveae large deep; confluent with the antennal foveae; middle fovea elongate, deep; frontal crest prominent, unbroken; ocellar basin poorly defined; a distinct ridge from ocellar basin to near eye margin; postocellar furrow angulate anteriorly, well defined; postocellar line subequal with ocellocular line; vertical furrows deep well defined for half the length of postocellar area; postocellar area one and one third times wider anteriorly than its median length; front sculptured below the ocelli, the vertex and temples shining, impunctate; antenna long, strongly tapering, the third and fourth joints subequal; mesothorax smooth and shining, with scattered setigerous punctures; hind basitarsi similar to those of *C. varius;* sheath broad, straight above, obliquily truncate apically, rounded below and tapering to base; stigma long, gradually rounding to apex; recurrentella before intercubitella by about length of latter. Black with a decided bluish tinge to body; wings hyaline, dusky from beyond base of stigma, the duskiness is deeper below stigma, venation black, stigma dark brown.

Type locality.—Shillong, altitude 5,000 feet (about 1,515 meters), British India.

Described from one female collected in September by T. B. Fletcher and sent by Imperial Entomologist of India.

Type.—Cat. No. 22392, U.S.N.M.

BARNACLES OF THE SAN JUAN ISLANDS, WASHINGTON.

By Henry A. Pilsbry,
Of the Academy of Natural Sciences of Philadelphia.

The Cirripedes noted below were collected by Dr. Carl C. Engberg during 1918 and 1919, partly at Olga, in the Orcas group, the others at Friday Harbor.

Two species not found by Doctor Engberg have been reported from the San Juan Islands, without special locality—*Balanus balanus pugetensis* Pilsbry[1] and *Balanus rostratus heteropus* Pilsbry.[2] The list is doubtless otherwise incomplete, as it comprises no species of goose barnacles (*Lepas*), and no *Chthamali*, small, sessile barnacles living on shells, stones, and other barnacles, between tides. As these islands are now frequented by many students of zoology it is thought that a local list may prove useful and may lead to further study of the group, ecological and systematic.

Figures, descriptions, and references to the literature of barnacles may be found in United States National Museum Bulletins 60 and 93.

KEY TO SPECIES.

a.[1] Stalked barnacles.
- *b.*[1] Protected by five thin valves; usually attached to floating objects___*Lepas.*
- *b.*[2] Protected by many thick valves; attached to solid objects near low tide. *Mitella polymerus.*

a.[2] Sessile barnacles.
- *b.*[1] Compartments of the wall penetrated by longitudinal tubes.[3]
  - *c.*[1] Ribs on the inner side of the compartments more numerous than the septa between tubes in the base; tergum long.
    - *d.*[1] Tubes of wall without transverse septa. *Balanus balanus pugetensis.*
    - *d.*[2] Tubes of wall having transverse septa, at least above.[4] *Balanus rostratus heteropus.*
  - *c.*[2] Ribs on the inner side of compartments corresponding to septa between the tubes[5]; basis calcareous.
    - *d.*[1] Spur of the tergum wide at base, tapering distally, situated near middle of the basal margin; large barnacles, up to 100 mm. diameter. *Balanus nubilis.*

[1] Bull. U. S. Nat Mus. 93, p. 163.

[2] Idem, p. 142.

[3] These tubes can be seen by filing the outside, or breaking a compartment transversely. In eroded specimens the tubes are often laid open.

[4] To be seen by filing the outside.

[5] In old specimens of *Balanus nubilis* the interior is smooth.

d.[2] Width of tergum more than half its length, the spur short, near the basi-scutal angle; small barnacles.

e.[1] Three pits in the inner side of the scutum--------*Balanus glandula.*

e.[2] No middle pit in the scutum--------------------*Balanus crenatus.*

c.[3] Wall without regular internal ribs; basis membranous; tergum narrow and long, with long, slender spur------------------*Balanus cariosus.*

b.[2] Compartments of the wall without longitudinal tubes; tergum short, with a short spur.

c.[1] Scutum distinctly striate longitudinally; walls strongly ribbed. *Balanus engbergi.*

c.[2] Scutum weakly or not striate longitudinally.

d.[1] Spur of the tergum tapering, less than half as wide as the basal margin of tergum; upper part of the scutum thickened within. *Balanus hesperius laevidomus.*

d.[2] Spur very short and truncate, occupying half of the basal margin; scutum with three pits inside------------------*Balanus glandula.*

MITELLA POLYMERUS (Sowerby).

Plate 20, figs. 1, 2.

Piles of the dock at Olga (Cat. No. 53813, U.S.N.M.), and at the promontory, Deer Point, forming the eastern entry 'to Obstruction Pass. Abundant and typical. As this species was not figured in United States National Museum Bulletin 60 or other readily accessible work, photographs are here reproduced, natural size.

BALANUS NUBILIS Darwin.

Friday Harbor. In Puget Sound this species reaches its maximum size, far larger than Darwin's original specimens. In a group of four sent, the diameter is between 90 and 100 mm. (Cat. No. 53811, U.S.N.M.)

BALANUS CRENATUS Bruguiere.

Patelliform, columnar, and club-shaped specimens, the latter like the well-known club form of *Balanus balanoides.* Friday Harbor. (Cat. No. 53805, U.S.N.M., 30 specimens; Cat. No. 53806, U.S.N.M., 6 specimens; and Cat. No. 53808, U.S.N.M., 4 specimens.)

BALANUS GLANDULA Darwin.

Large examples up to 25 mm. long, similar to plate 43, figure 5, of Bulletin 93. Friday Harbor (25 specimens, Cat. No. 53810, U.S.N.M.)

BALANUS CARIOSUS (Pallas).

Plate 20, figs. 3. 6.

Friday Harbor. Very abundant (Cat. Nos. 53802, 53803, 53804, and 53807, U.S.N.M.). Old specimens are deeply eroded, cylindric, with rather thin walls at the base, not showing as many pores as in the conic typical form. A crowded, columnar form of small diameter is also abundant; length about 55; diameter, 5 to 15 mm. As this seems to be an unusual form elsewhere it is figured (pl. 20.

figs. 3, 6; Cat. No. 53812, U.S.N.M.). The young are not stellate, with strong corrugation and small orifice, but steep-walled with open orifice and walls but little corrugated. These unusual forms of *curiosus* are readily recognized by the shape and sculpture of the opercular valves.

BALANUS HESPERIUS LAEVIDOMUS Pilsbry.

Friday Harbor (Cat. No. 53809, U.S.N.M., 10 specimens). It is easily distinguished from the following species by the rather fragile walls, which are not ribbed.

BALANUS ENGBERGI, new species.

Plate 20, figs. 4, 5.

Type.—Cat. No. 53801, U.S.N.M., from Olga, Washington, collected by Dr. C. C. Engberg.

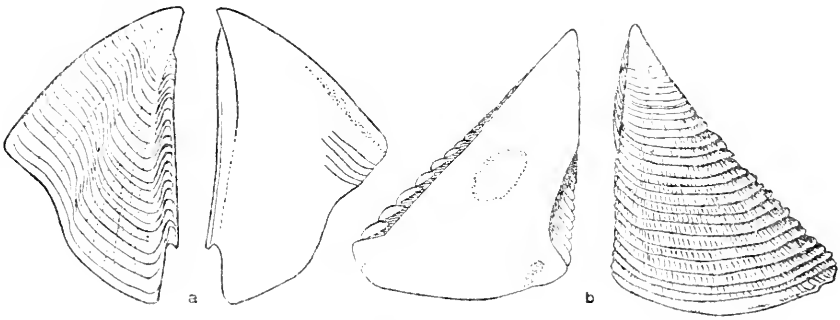


Fig. 1.—Balanus engbergi. External and internal views of the tergum, *a*, and of the scutum, *b*.

The barnacle is rather small, conic, grayish white, strongly ribbed, with a very small, shortly oval orifice, and partly covered with a very thin and pale cuticle, in large part fugacious. The compartments are not porose. The basis is calcareous, not porose. The opercular valves have the general shape of those of *Balanus crenatus*.

Greatest basal diameter of type, 14 mm.: altitude 7.3 mm.; length of orifice, 2.5 mm.

The scutum (fig. 1*b*) is shaped like that of *Balanus hesperius*. The tergal border is somewhat longer than the basal; the latter convex. The occludent border has a series of regular short, oblique ridges. The exterior is somewhat concave between the apex and base; quite convex between occludent and tergal margins. It is closely and regularly sculptured with high ribs, sloping downward; each alternate rib continued in the short ridges of the occludent edge. It is distinctly, finely, and closely striate from apex to base. Inside there is a rather strong articular ridge, but no adductor ridge. The pit of the adductor muscle and the very small pit of the lateral depressor are deeply sunken.

The tergum (fig. 1*a*) is thin, flat, having fine, transverse riblets and some weak radial striae. The short, obliquely truncate spur is fully half the basal width of the valve.

The compartments are very firmly united. The parieties have no tubes. The walls are thick, very deeply furrowed between the high ribs, which are unequal, two on each side usually being flat-topped, with narrow raised borders. The radii are narrow, not readily distinguishable. Internally there is a short sheath, overhanging deep cavities; the compartments below it coarsely folded like a heavy drapery and toward the base closely costate.

The basis is calcareous, solid, radially grooved inside.

The labrum, mandible, and maxillae (fig. 2*a*, *b*, *c*) are substantially as in *Balanus hesperius*. The palpi are also similar, but less profusely bristly.

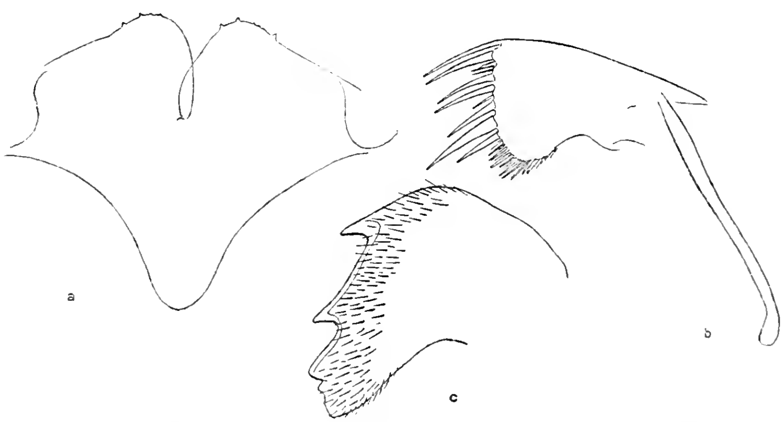


FIG. 2.—BALANUS ENGBERGI. *a*, LABRUM; *b*, MAXILLA; AND *c*, MANDIBLE.

The first cirrus has very unequal rami; the shorter, of 8 protuberant segments, a little more than one-third as long as the longer, which consists of at least 21 segments. Cirrus II has rami not very unequal, about 2 segments of the longer projecting beyond the shorter. In cirrus III the rami are equal. The posterior cirri have four pairs of spines on the segments, the lower pair very small. There are long posterior-distal spines, as in *Balanus hesperius*.

On the third cirrus there are a few excessively minute multifid scales distally on some segments, such as have been figured for *B. crenatus curviscutum* (Bull. 93, fig. 55*a*), but vertically placed, and not accompanied by small spinules.

Comparisons.—While this species is evidently related to *Balanus hesperius*, it differs conspicuously by the far wider spur of the tergum and by the distinct longitudinal striae of the scutum, which is plain inside. Externally it differs by the very strong ribs of the wall; but this is not usually a character of much constancy. *Balanus glandula* Darwin is most easily differentiated by its scutum, pitted below the adductor ridge, and not longitudinally striate externally. In *Balanus crenatus* the walls are conspicuously porose, and the scutum is not distinctly striate longitudinally. All of these species are of about the same size. While all occur on the San Juan Islands, they are not associated in any of the groups at hand, each forming its own colonies on separate objects. The specimens of *B. engbergi* were found on a board which had floated in. To what extent, if any, these species inhabit different zones in the San Juan Islands remains to be ascertained. In southern California *B. glandula* occurs at and above low tide. *B. crenatus*, on the eastern coast, is found below low tide.

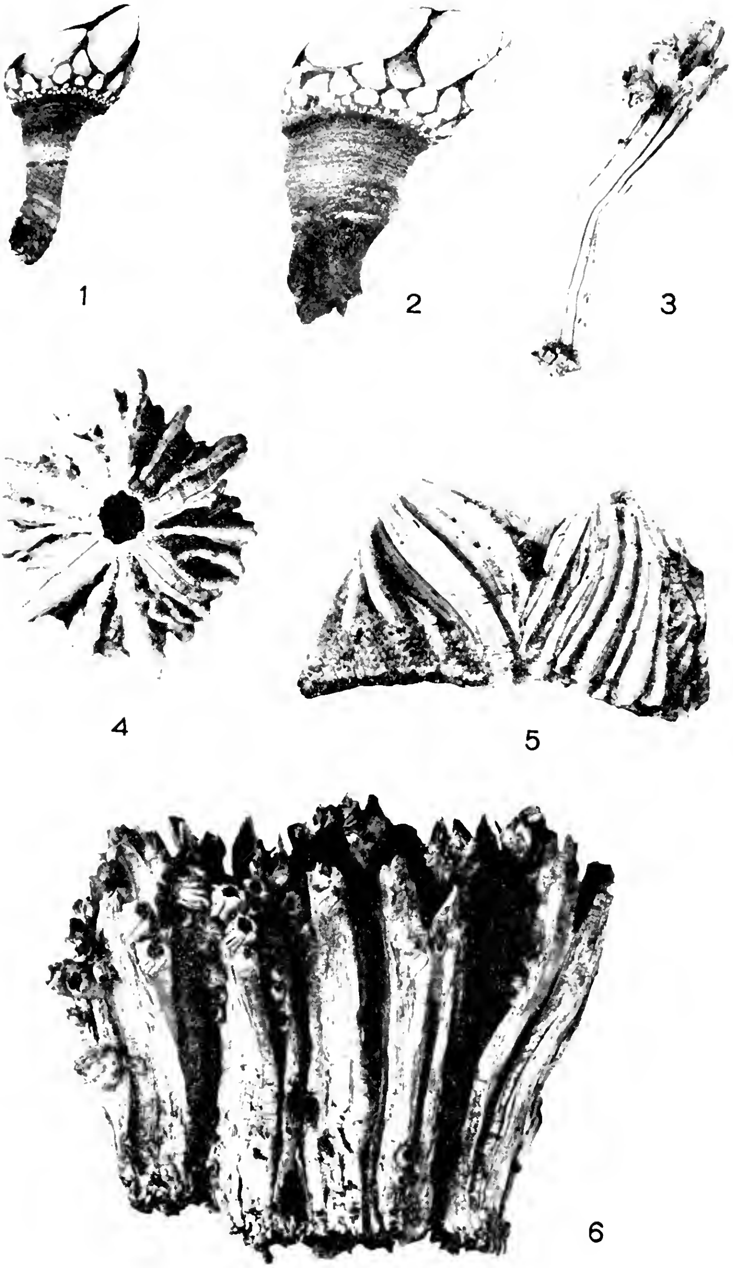
EXPLANATION OF PLATE 20.

FIG. 1, 2. *Mitella polymerus* (Sowerby). Olga. Natural size.

3. *Balanus cariosus* (Pallas). Friday Harbor. Slender individual from a close group. Natural size.

4, 5. *Balanus engbergi* new species. Olga. Top of the type and lateral view of two paratypes. ×3.

6. *Balanus cariosus* (Pallas). Friday Harbor. Part of a compact group. Natural size.



BARNACLES OF THE SAN JUAN ISLANDS.

FOR EXPLANATION OF PLATE SEE PAGE 115.

TERTIARY FOSSIL PLANTS FROM THE DOMINICAN REPUBLIC.

By Edward W. Berry,

Of the Johns Hopkins University, Baltimore, Maryland.

INTRODUCTION.

During the reconnaissance of the Dominican Republic, made during 1919 under the direction of T. Wayland Vaughan for the Dominican Government, fossil plants were collected at seven different localities. Most of this material is very poor, and determinable forms are confined to the five following of these localities:

At locality 8685 (D. C. 5) a brown sandy clay collected by C. W. Cooke and D. D. Condit furnished a specifically undeterminable *Inga*. At locality 8739 (D. C. 65) a gray friable sandstone furnished a specifically undeterminable *Melastomites* collected by D. D. Condit. At locality 8607 (C–21—19) C. W. Cooke collected *Calyptranthes domingensis*, new species, from a late Tertiary or Pleistocene clay, exposed in a bluff on Samaná Bay about 1½ miles east of Sanchez. The fourth locality, No. 8684 (D. C. 4), has furnished most of the determinable forms. This is a yellowish sandy clay exposed in a cut near the pier at Sanchez, and the collectors were C. W. Cooke and D. D. Condit. The fifth locality, about 1 mile west of Los Bancos, Azua Province, furnished the type of *Sophora cookei*.

The total number of forms identified is eleven, a much too small a number to give a correct idea of the botanical facies or of the geological age beyond the obvious facts that they indicate a tropical habitat and a Tertiary age. There are no traces of ferns or palms, and the majority of the forms, such as *Pisonia*, *Sophora*, *Sapindus*, *Calyptranthes*, *Bucida*, and *Bumelia*, are obviously strand types, as might well be true of the remainder. There are no traces of any of the typical plants of the Mangrove association, nor Lauraceae or Moraceae, all types normally present in tropical Tertiary floras.

The only previous record of fossil plants from the whole island, other than a reference to their presence by Gabb, is the determination by the writer of the genera *Inga*, *Nectandra*, and *Eugenia* in material collected by Miss C. J. Maury in the valley of Rio Yaque del Norte in connection with her work on the Mollusca of that region, and quoted by her in the discussion of the faunas.

LIST OF STATIONS AT WHICH DETERMINABLE FOSSIL PLANTS WERE COLLECTED.

8564 (D. C. 77A–19). Azua Province, Rio San Juan, about 1 mile west of Los Bancos. D. D. Condit, collector. May 21, 1919.

8607 (C–21–29). District of Samaná, bluff on Samaná Bay, about 1½ miles east of Sanchez. C. W. Cooke, collector. April 26, 1919.

8684 (D. C. 4). District of Samaná, cut in clay near pier at Sanchez, eastward-dipping beds, fossil plants and few mollusks. D. D. Condit and C. W. Cooke, collectors. April 1, 1919.

8685 (D. C. 5). District of Samaná. Beach 400 feet east of collection D. C. 4 (8684) Sanchez, mollusks and plants. D. D. Condit and C. W. Cooke, collectors. April 1, 1919.

8739 (D. C. 65). District of Monte Cristi, about 5½ miles up Gurabo River from Gurabo Adentro, fossils from below conglomerate. D. D. Condit, collector. May 9, 1919.

LIST OF FOSSIL PLANTS FROM THE DOMINICAN REPUBLIC.

Species.	Station.				
	8564	8607	8684	8685	8739
Poacites, species			×		
Pisonia conditi Berry, new species			×		
Inga sanchezensis Berry, new species			×		
Inga, species indeterminable				×	
Pithecolobium samanensis Berry, new species			×		
Sophora cookei Berry, new species	×				
Sapindus hispaniolana Berry, new species			×		
Calyptranthes domingensis Berry, new species		×			
Bucida sanchezensis Berry, new species			×		
Melastomites domingensis Berry, new species			×		
Melastomites species indeterminable					×
Bumelia reclinatafolia Berry, new species			×		
Guettardia cookei Berry, new species			×		

DESCRIPTIONS OF SPECIES.

Order GRAMINALES.

Family POACEAE.

Genus POACITES Brongniart.

POACITES, species.

Description.—The collection from Sanchez contains very abundant but fragmentary remains of what is evidently some grass or sedge, more probably the former. The remains are lax, linear in form, and range in width from 2 mm. to 3 mm., with a well-marked midvein and very faintly marked parallel lateral veins. They are of no botanical importance.

Although the name *Poacites* is one that has been applied indiscriminately to a variety of Paleozoic and Mesozoic objects of varied botanical affinity, it is so appropriate for fragments of grass foliage of uncertain relationship that I have ventured to use it in the present connection.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Order CHENOPODIALES.

Family NYCTAGINACEAE.

Genus PISONIA Linnaeus.

PISONIA CONDITI, new species.

Plate 21, fig. 1.

Description.—Leaves of small size, lanceolate, and slightly inequilateral in general outline, widest in the middle and equally pointed at the apex and base. Margins entire. Texture coriaceous. Length about 3.25 cm. Maximum width about 1.1 cm. Petiole very short and stout, only a millimeter or two in length. Midrib stout and prominent. Secondaries thin, immersed; five or six alternate camptodrome pairs diverge from the midrib at angles of about 45 degrees. These small leaves are characteristically inequilateral by having the basal margin flat on one side and curved on the other with the distal margin flat on the opposite side and curved on the other side. Named for the collector, D. D. Condit.

The genus *Pisonia* contains over a dozen fossil species from the Upper Cretaceous through the Tertiary in the Northern Hemisphere. In this country there are three species in the Wilcox Eocene, two in the lower Jackson, and a fifth in the Alum Bluff formation of Florida. None of these are especially close to the present form.

The existing species of *Pisonia* are numerous and occur chiefly in the Tropics, predominantly in the Western Hemisphere. The genus is still present in the flora of Santo Domingo.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35451, U.S.N.M.

Order ROSALES.

Family MIMOSACEAE.

Genus INGA Willdenow.

INGA SANCHEZENSIS, new species.

Plate 21, fig. 11.

Description.—Leaflets of fairly large size, ovate lanceolate and markedly inequilateral in outline, widest below the middle with an acuminate tip and an acute base. Margins entire. Texture subcoriaceous. Length about 9 cm. Maximum width about 3 cm. Petiolule missing. Midrib thin. Secondaries thin, camptodrome, of a considerably different aspect in the opposite halves of the lamina. Tertiaries mostly obsolete.

The present species is rather similar to *Inga oligocaenica* Berry [1] from the Culebra formation of Panama. Less than a score of fossil species are known, the genus being sparingly represented in the European Tertiary, although the modern species, which number over 200, are confined to the American Tropics. There are several species in the Antilles, but the majority of the recent forms are continental. Among modern forms that have come to my notice *Inga maritima* Bentham of Brazil is much like the present fossil species.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35452, U.S.N.M.

Genus PITHECOLOBIUM Martius.

PITHECOLOBIUM SAMANENSIS, new species.

Plate 21, fig. 2.

Description.—Leaflets broadly ovate and inequilateral in general outline, sessile, with a blunt apex and a broadly rounded base. Margins entire. Texture subcoriaceous. Length about 3.2 cm. Maximum width 1.8 cm. Midrib stout, curved. Secondaries thin, about 9 pairs diverge from the midrib at wide angles and fairly regular intervals, curve upward and are regularly camptodrome. Tertiaries comprise marginal loops and percurrent nervilles between the secondaries.

This leguminous leaflet is closely allied to the few fossil species that have been referred to this genus and to numerous existing species, as for example, the leaflets of *Pithecolobium unguis-cati* Linnaeus) Bentham, a tree widespread over the Antilles. More) than 100 existing species are known. They occur in both Tropics but perhaps three-fourths are American, many of them, such as the widely planted rain tree (*P. saman* Bentham), being large trees.

[1] Berry, E. W., U. S. Nat. Mus. Bull. 103, p. 32, pl. 16, fig. 2, 1919.

The fossil species heretofore recognized include two from the Wilcox Eocene, one from the Catahoula formation (Oligocene) of Louisiana, one from the supposed lower Miocene of Columbia, and two from the Pliocene of Bolivia. The present species is most suggestive of *P. oligocaenum* Berry,[2] from which it differs in its rounded base, its sessile habit, and more numerous secondaries.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35453, U.S.N.M.

Family PAPILIONACEAE.

Genus SOPHORA Linnaeus.

SOPHORA COOKEI, new species.

Plate 21, fig. 12.

Description.—Leaflets elliptical and slightly inequilateral in general outline with an equally rounded apex and base, the latter slightly the wider. Texture coriaceous. Length about 2.5 cm. Maximum width, at or below the middle, about 13.5 mm. Leaflets sessile. Midrib stout and prominent. Secondaries mediumly stout, five subopposite to alternate pairs diverge from the midrib at wide angles and form a wide camptodrome loop in the marginal region. Tertiaries obsolete. Named for C. W. Cooke.

This species is unfortunately based upon a single specimen, so that the complete characters and limits of variation can not be made out. It is exceedingly close to a number of previously described forms from the Tertiary of the southern United States as well as Europe, and to the leaflets of several existing species of the American tropics, as for example, *Sophora tomentosa* Linnaeus, a cosmopolitan tropical strand plant distributed through the agency of ocean currents by means of its buoyant seeds. The present species is similar to *Sophora henryensis* Berry[3] and to the smaller leaflets of the very abundant *Sophora wilcoxiana* Berry,[4] both species of the Wilcox Eocene. It is also similar to *Sophora claiborniana* Berry[5] of the Claiborne Eocene and to *Sophora europaea* Unger of the later Tertiary of Europe.[6]

There are about 25 existing species of shrubs and small trees referred to the genus Sophora, scattered in the warmer parts of both hemispheres and found on all tropical seashores.

Occurrence.—Locality No. 8564. Azua Province, Rio San Juan, 1 mile west of Los Bancos.

Holotype.—Cat. No. 35454, U.S.N.M.

[2] Berry, E. W., U. S. Geol. Surv. Prof. Paper 98M, p. 239, pl. 55, fig. 10, 1916.
[3] Berry, E. W., U. S. Geol. Surv. Prof. Paper 91, p. 243, pl. 52, fig. 2, 1919.
[4] Idem., p. 241, pl. 47, figs. 1–13.
[5] In press.
[6] Unger, F., Foss, Fl. v. Sotzka, p. 57, p. 42, figs. 1–5, 1850.

Order SAPINDALES.

Family SAPINDACEAE.

Genus SAPINDUS Linnaeus.

SAPINDUS HISPANIOLANA, new species.

Plate 21, fig. 3.

Description.—Leaflets of small size, ovate lanceolate in general outline with a broad abrutply pointed base and a much extended acuminate tip. Margins entire. Texture subcoriaceous. Length about 4.5 cm. Maximum width, in the lower half of the leaflet, about 1.3 cm. Petiolule missing or wanting. Midrib mediumly stought; straight. Secondaries thin, mostly immersed; numerous equally spaced camptodrome pairs diverge from the midrib at wide angles. Tertiaries obsolete.

These small leaflets appear to represent a new species of Sapindus. They are approximately equilateral and smaller than most of the fossil species but may be compared with *Sapindus georgiana* Berry[7] from the lower Jackson of Georgia, which, except for their somewhat narrower form, are exceedingly close to the present species. The existing species are numerous in the warmer parts of both hemispheres, including several species of soapberry of the Antillean beaches. Among these the present species is very similar to *S. marginatus* Willdenow of the Florida keys, which is a rare and little known form that may be present still in the Antilles. The fossil species are exceedingly numerous from the Upper Cretaceous through the Tertiary.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35455, U.S.N.M.

Order MYRTALES.

Family MYRTACEAE.

Genus CALYPTRANTHES Swartz.

CALYPTRANTHES DOMINGENSIS, new species.

Plate 21, figs. 9, 10.

Description.—Obovate subsessile leaves of small size and leathery texture, with a broadly rounded tip, widest above the middle, from which it tapers to a cuneate base. Margins entire, evenly rounded. Length about 2.5 cm. Maximum width about 1.6 cm. Midrib stout, prominent. Secondaries thin, immersed, numerous, and subparallel; they diverge from the midrib at wide angles, pursue a rather straight outward course, and are abruptly camptodrome

[7] Berry, E. W., U. S. Geol. Surv. Prof. Paper 84, p. 143, pl. 27, fig. 11, 1914.

in the marginal region. Tertiaries thin, subparallel, with secondarie with which they unite at acute angles.

This species has the characteristic venation of the genus, known in the fossil state only from the Wilcox Eocene of the United States[8] and the Gatun formation of the Canal Zone.[9] In form the present species approaches *Bumelia*, but the venation is decidedly different. A somewhat similar venation is displayed in the genus *Chrysophyllum* of the family Sapotaceae where, however, the normally pointed leaves are not typically, but occasionally obovate or retuse, and in which the venation is not identical with the fossil. The genus *Calyptranthes* contains about 70 existing species ranging from Mexico and the West Indies to southern Brazil and exclusively American except for certain doubtfully determined forms from the Fiji Islands, Africa, Mauritius, and Java. The present fossil species may be compared with the existing *Calypyranthes syzygium* (Linnaeus) Swartz, a shrub or small tree of Haiti and other islands of the Antilles.

Occurrence.—Locality No. 8607. Bluff on Samaná Bay, about 1½ miles east of Sanchez, District of Samaná.

Holotype.—Cat. No. 35456, U.S.N.M.

Family COMBRETACEAE.

Genus BUCIDA Linnaeus.

BUCIDA SANCHEZENSIS, new species.

Plate 21, fig. 8.

Description.—Leaves obovate in form, widest distad a short distance below the broadly rounded and slightly emarginate apex, narrowing rapidly to the narrowly cuneate or decurrent base. Margins entire. Texture coriaceous. Length about 5 cm. Maximum width about 3.75 cm. Petiole missing. Midrib stout and prominent. Secondaries ascending and camptodrome in the wider distal part of the leaf becoming flatter and straighter in the narrowed basal half of the leaf where their camptodrome endings become modified to form a pseudomarginal vein. Tertiaries obsolete.

This characteristic leaf appears to represent a Tertiary species of *Bucida*, a genus which is monotypic in the existing flora, its single living species being a strand and coastal marsh plant of the perimeters of the Caribbean and throughout the Antilles, and just reaching the tip of the Florida peninsula. The genus has not heretofore been recognized in the fossil state.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35457, U.S.N.M.

---

[8] Berry, E. W., U. S. Geol. Surv. Prof. Paper 91, p. 319, pl. 90, fig. 5, 1916.

[9] Berry, E. W., U. S. Nat. Mus. Bull. 103, p. 39, pl. 18, fig. 1, 1919.

Family MELASTOMATACEAE.

Genus MELASTOMITES Unger.

MELASTOMITES DOMINGENSIS, new species.

Plate 21, fig. 7.

Description.—The very fragmentary specimens representing the genus *Melastomites* do not really merit a specific name since they are too meager for any adequate diagnosis. Since, however, more representative material may be a long time in coming to light, and it is important to have a name of this form to use in discussion, and since also where a fossil form is certainly not a representative of one already described and which can be subsequently recognized there is no reason for using "species" instead of a real name.

Fragments indicate an ovate form pointed at both ends, with an entire margin, a prominent and stout curved midrib, stout acrodrome primaries, and less stout marginal acrodrome vein on either side which may be modified to slightly arch from end to end of the straight tertiaries extending outward from the lateral primaries. The latter are united with the midrib by thin, close-spaced, transverse-curved, inosculating tertiaries. The indicated size of these leaves is about 8 cm. in length and 3 cm. in maximum width.

A small fragment of a leaf of *Melastomites* of either this or an unknown species is contained in a collection made by D. D. Condit from a gray friable sandstone lying beneath a conglomerate 5½ miles up the Rio Gurabo from Gurabo Adentro (Loc. 8739).

The genus *Melastomites* was proposed by Unger [10] and contains several species in the Oligocene, Miocene, and Pliocene of Europe. A form referred to this genus from the Upper Cretaceous of Westphalia is probably Lauraceous. A single American species is known from the Wilcox Eocene,[11] and a second has been described recently from the Culebra formation of Panama.[12] The family is a large one in the existing flora, about 2,500 of the 3,000 species being found in the American Tropics.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35458, U.S.N.M.

---

[10] Unger, F., Gen. et sp. pl. foss., p. 480, 1850.
[11] Berry, E. W., U. S. Geol. Surv. Prof. Paper 91, p. 327, pl. 97, figs. 1-3, 1916.
[12] Berry, E. W., U. S. Nat. Mus. Bull. 103, p. 40, pl. 18, fig. 2, 1918.

Order EBENALES.

Family SAPOTACEAE.

Genus BUMELIA Swartz.

BUMELIA RECLINATAFOLIA, new species.

Plate 21, fig. 4.

Description.—Exceedingly coriaceous obovate leaves with slightly revolute margins, widest in the distal half, with a broadly rounded, sometimes slightly emarginate, apex and a gradually narrowed cuneate base. Length about 4.1 cm. Maximum width about 1.8 cm. Petiole short and very stout, about 2 mm. in length. Midrib stout and prominent, usually slightly curved. Secondaries immersed in the thick substance of the leaf.

With the exception that the secondaries are immersed in the leaf substance, this species is identical with the existing *Bumelia reclinata* Ventenat of the North American mainland. It is, however, almost equally close to several Antillean forms, as, for example, the Ants wood or Downward Plum (*Bumelia angustifolia* Nuttall).

The genus *Bumelia*, with over a score of existing species, is confined to the warmer parts of America, although present in Europe during the Tertiary. Its fossil species are numerous from the Upper Cretaceous onward, and represented in the Wilcox Eocene, Vicksburg and Alum Bluff formation.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35459, U.S.N.M.

Order RUBIALES.

Family RUBIACEAE.

Genus RUBIACEAE Endlicher.

GUETTARDA COOKEI, new species.

Plate 21, figs. 5, 6.

Description.—Leaves of small to medium size, elliptical in general outline, equally pointed at both ends, with full entire margins and subcoriaceous texture. Length ranging from 4 cm. to 6 cm. Maximum width, midway between apex and base, ranging from 2 cm. to 3 cm. Petiole missing. Midrib stout, straight, and prominent on the underside of the leaf. Secondaries numerous, fairly stout, prominent on the underside of the leaf; about nine subopposite to alternate pairs diverge from the midrib at fairly regular intervals and angles of about 60° to 70°; they are at first rather straight and then curve upward in a subparallel manner and are camptodrome. Tertiary system comprises intermediates between and subparallel with secondaries and numerous percurrent and well-marked nervilles.

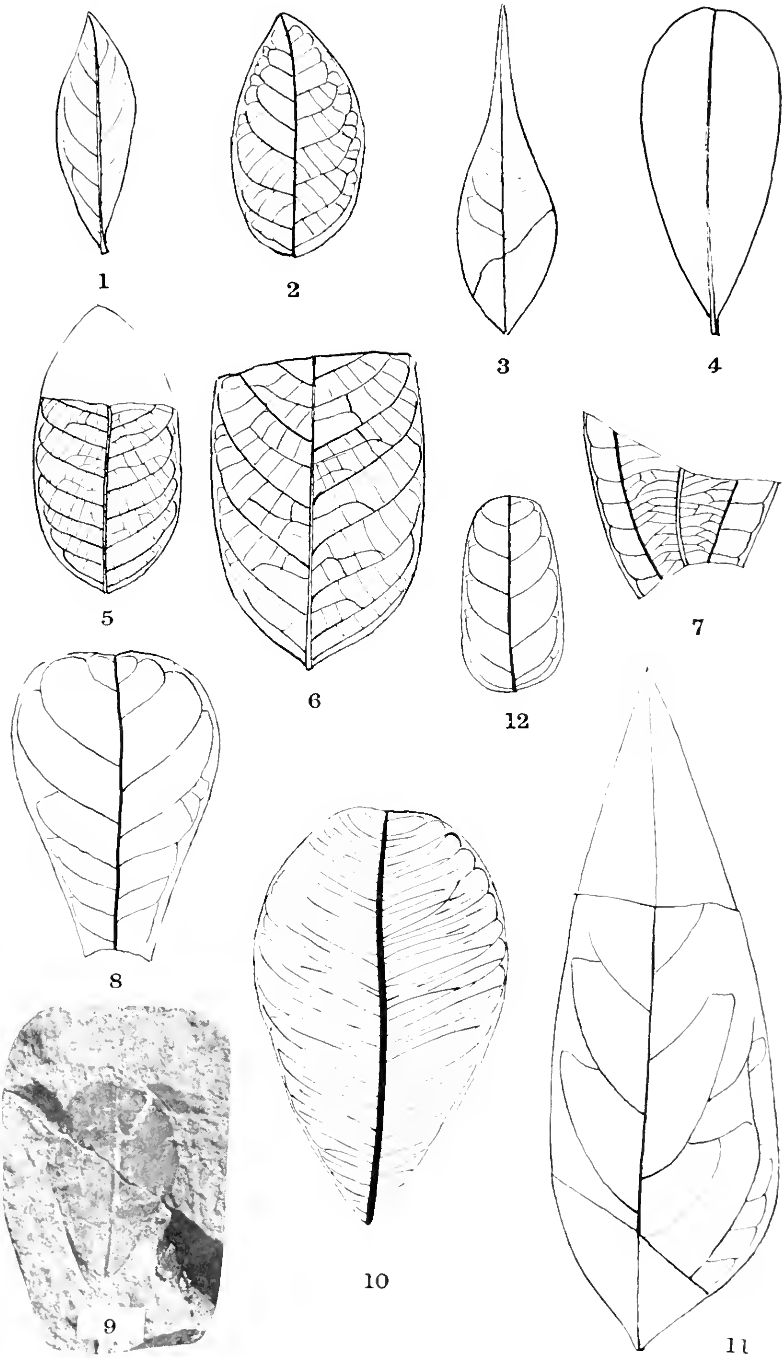
Only a single fossil species of *Guettarda* has, so far as I know, hitherto been recognized. This is a quite different form from the Wilcox Eocene of the Mississippi embayment region. The recent species number about 50 and are chiefly found in tropical America, one—a small coastal tree—reaching southern peninsular Florida (*Guettarda elliptica* Swartz), which has leaves much like those of the present fossil species. The genus is well represented at the present time in the Bahamas and throughout the Antilles.

Occurrence.—Locality No. 8684. Cut in clay near pier at Sanchez, District of Samaná.

Holotype.—Cat. No. 35460, U.S.N.M.

EXPLANATION OF PLATE 21.

FIG. 1. *Pisonia conditi* Berry, new species. Locality 8684.
2. *Pithecolobium samanensis* Berry, new species. Locality 8684.
3. *Sapindus hispaniolana* Berry, new species. Locality 8684.
4. *Bumelia reclinatafolia* Berry, new species. Locality 8684.
5, 6. *Guettarda cookei* Berry, new species. Locality 8684.
7. *Melastomites domingensis* Berry, new species. Locality 8684.
8. *Bucida sanchezensis* Berry, new species. Locality 8684.
9, 10. *Calyptranthes domingensis*, Berry, new species. Fig. 10 enlarged twice to show venation. Locality 8607.
11. *Inga sanchezensis* Berry, new species. Locality 8684.
12. *Sophora cookei* Berry, new species. Locality 8564.



TERTIARY FOSSIL PLANTS FROM THE DOMINICAN REPUBLIC.

FOR EXPLANATION OF PLATE SEE PAGE 127.

FIRST SUPPLEMENT TO "TYPE SPECIES OF THE GENERA OF ICHNEUMON-FLIES."[1]

By Henry L. Viereck,

Of the Bureau of Biological Survey, Washington.

At the end of 1919, seven years had elapsed since the writer concluded his review of the literature bearing upon the above subject. In the meantime new genera have been published and our knowledge of old genera has become more perfect, which is the reason the following list is so long. This supplement is presumed to be complete up to the end of 1919.

The following errata are noted in Bulletin 83:

Preface, line 5, change *being* to *bring*; line 9, change *State* to *States*.

Page 2, (*Absyrtus luteus* Holmgren)=(*Ichneumon*) *Absyrtus vicinator* (Thunberg), according to Roman 1912.

Acaenitellus Morley.
  Faun. Brit. Ind. Hym., vol. 3, 1913, p. 51.
  Type.—*A. polypori* Morley. (Monobasic.)

Acroricnus Ratzeburg. See (**Linocerus**, **Macrobatus**).

Actenonyx Foerster. See *Cteniscus similis* in Roman, 1914.

Aeolometis (Foerster) Dalla Torre. See (**Tachyporthus**), seen by Pfankuch, 1913, p. 182.

Aerophasmus Enderlein.
  Arch. Naturges., vol. 78 A, 1912, pp. 16–17.
  Type.—*A. exilis* Enderlein. (Monobasic.)

Aerophilopsis Viereck. See **Lytopylus**.
  Proc. U. S. Nat. Mus., vol. 44, 1913, p. 555.
  Type.—*Bassus* (*A.*) *erythrogaster* Viereck. (Monobasic.)

Agasthenopoda (Schmiedeknecht) Schmiedeknecht.
  Opusc. Ichn., fasc. 33, 1913, p. 2573.
  Type.—*A. australis* Schmiedeknecht. (Monobasic.)

Aglaojoppidea Viereck.
  Proc. U. S. Nat. Mus., vol. 46, 1913, p. 368.
  Type.—(*Trogus*) *A. fascipennis* (Cresson). (By original designation.)

Agrypon Foerster. See **Atrometus** Foerster.
  Type.—*Ophion flavcolatum* Gravenhorst. (By designation of Morley, 1913*a* p. 89; 1913*b*, p. 424.)

Aleirhogas Baker. Subgenus of **Aleiodes** Wesmael.
  Philippine Journ. Sci., vol. 12, 1917, p. 383. Five species.
  Type.—*Rhogas* (*A.*) *schultzei* Baker. (By present designation.)

[1] Bulletin 83, United States National Museum, 1914.

Allapanteles JEAN BRETHES.
Anal. Mus. Nac. Buenos Aires, vol. 27, 1915, p. 404.
Type.—*A. cecidiptae* JEAN BRETHES. (Monobasic.)

Allobracon GAHAN.
Proc. U. S. Nat. Mus., vol. 49, 1915, p. 94.
Type.—*Diachasma pilosipes* ASHMEAD. (Monobasic.)

Allocryptus VIERECK. Subgenus of **Agrothereutes** FOERSTER.
Conn. Geol. Nat. Hist. Surv., Bull. 22, 1917, p. 333.
Type.—*Agrothereutes* (*Allocryptus*) *hyslopi* VIERECK. (Monobasic.)

[**Alloplasta** (FOERSTER) WOLDSTEDT=? **Meniscus** SCHIODTE= (**Trichopimpla**)= **Amersibia** according to Rohwer, 1915*b*, 224.
Type.—(*Lissonota murina* GRAVENHORST)=(*Ichneumon*) *Meniscus piceator* (THUNBERG), according to Roman, 1912, p. 272.

Allotypus FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 65.

Amauromorpha ASHMEAD=**Eripternimorpha** VIERECK, according to Cushman, 1919, p. 528.

Ameloctonus (FOERSTER) ASHMEAD, see **Hyposoter.**

Amersibia (FOERSTER) SZEPLIGETI, good genus, according to Rohwer, 1915, p. 224. See **Alloplasta.**

Amorphota (FOERSTER) HOWARD=**Casinaria** Holmgren, according to Gahan, 1914, p. 155. See **Anempheres.**

Amyosoma VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 640.
Type.—*Amyosoma chilonis* VIERECK. (Monobasic.)

Anaglymnus ROMAN.
Ark. Zool., vol. 9, 1914, No. 2 (3, 4, 9), two species.
Type.—*Anaglymnus incisus* ROMAN. (By present designation.)

Analostania VIERECK.
Proc. Biol. Soc. Washington, vol. 29, 1916, p. 165.
Type.—*Analostania tenuipes* VIERECK. (Monobasic.)

Ancylocentrus FOERSTER=(**Euphoridea**), which see.

Anderis DAVIS=**Smicroplectrus** THOMSON, according to Roman, 1913*c*., p. 128. Page 11 under **Anempheres**, change reference to Proc. U. S. Nat. Mus., vol. 40, p. 188.

Angitia HOLMGREN.
Type.—*Limneria fenestralis* HOLMGREN, according to Morley 1913*b*, p. 496.

(**Anilasta** THOMSON)=? **Anilastus** (FOERSTER) DALLA TORRE. See **Hyposoter.**
Cross out lines starting with type and isogenotypic and substitute:
Type.—*Campoplex ebeninus* GRAVENHORST by designation of Morley 1913*b*, p. 493.

(**Anisitsia** VIERECK)=**Viereckiana** STRAND, which see.

Anisotacrus SCHMIEDEKNECHT.
Opusc. Ichn., fasc. 34, 1913, p. 2711.
Type.—*Epachthes tenellus* HOLMGREN. (Monobasic.)

(**Anomalon** JURINE)=**Diplazon** (NEES) GRAVENHORST.
Type.—*A. cerinops* GRAVENHORST, according to Morley, 1913*b*, p. 420.

Anomalon PANZER.=(**Nototrachys** MARSHALL, according to Rohwer, Gahan, and Cushman, 1915, p. 149).
Fauna Ins. German, Heft. 94, 1804, pl. 15.
Type.—*A. cruentatus* PANZER. (Monobasic.)

Anomopterus ROHWER, Psyche, vol. 21, 1914, pp. 80, 81.
Type.—*Anomopterus fasciipennis* ROHWER=(Monobasic.)

(**Antelca** MORLEY)=**Ichneumon** AUTHORS, according to Meade-Waldo and Morley.
Ann. Mag. Nat. Hist., 8 ser., vol. 14, 1914, p. 407.
Type.—(*Antelca rufa* CAMERON Ms.)=(*Ichneumon*) *Pterocormus*? *maculipleuralis* CAMERON.

Apatagium ENDERLEIN.
Stett. Ent. Zeit., vol. 73, 1912, p. 115. Three species.
Type.—*A. tristrigatum* ENDERLEIN. (By original designation.)
Apodesmia FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 65.
Apophua MORLEY.
Fauna Brit. Ind. Hym., vol. 3, 1913, p. 213. Two species.
Type.—*A. carinata* MORLEY. (By original designation.)
Archoprotus BRETHES.
Bol. Mus. Nacion., 1913, pp. 5, 6.
Type.—*A. porteri* BRETHES. (Monobasic.)
Arichelonus VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 641.
Type.—*Chelonus aculeatus* ASHMEAD. (Monobasic.)
Asphragis (FOERSTER) SCHMIEDEKNECHT. See (**Lampronota** HALIDAY.)
Aspigonus WESMAEL, VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 359.
Asternaulax VIERECK=**Helcostizus** (FOERSTER) DALLA TORRE, according to Rohwer, 1913, p. 185, and Roman, 1914, p. 23.
Astiphromma (FOERSTER) BRISCHKE. Change "By present designation" to "By designation of Morley 1913*b*. p. 516."
Atanycolimorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 557.
Type.—*A. winnemanae* VIERECK. (Monobasic.)
Atanycolus FOERSTER=**Coeloides** WESMAEL not AUTHORS, according to Roman 1912, p. 260.
Atopognathus CUSHMAN.
Proc. Ent. Soc. Wash., vol. 21, 1919, pp. 116, 117.
Type.—*A. collaris* CUSHMAN. (Monobasic.)
Atrometus FOERSTER=**Agrypon** FOERSTER, according to Morley 1913, p. 89.
Aulacites COCKERELL.
Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 102, 103, fig. 9.
Type.—*A. secundus* COCKERELL. (Monobasic.)
Aulonotus ASHMEAD=**Opius** WESMAEL, according to Gahan 1915, p. 65.
Austropimpla BRETHES.
Anal. Mus. Hist. Nat. Buenos Aires, vol. 24, 1913, p. 40.
Type.—*A. huebrichi* BRETHES. (Monobasic.)
Baeacis FOERSTER, VIERECK.
Pros. U. S. Nat. Mus., vol. 46, 1913, p. 359.
Baliena CAMERON=**Pseudeugalta** ASHMEAD, according to Morley, 1913*b*, p. 66.
Banchus FABRICIUS. See **Cidaphurus** (FOERSTER) WOLDSTEDT.
Type.—*Ichneumon volulatorius* LINNAEUS, according to Morley, 1913*b*, p. 253.
Barylypa FOERSTER, THOMSON, see **Erigorgus** (FOERSTER) BRISCHKE.
(**Bassus** AUTHORS)=**Diplazon** (NEES) GRAVENHORST.
(**Bassus** FALLEN)=**Diplazon** (NEES) GRAVENHORST.
Specim. Hym., 1813.
Type.—*Ichneumon laetatorius* FABRICIUS (By designation of Morley, Fauna Brit. Ind. Hym., vol. 3, 1913, p. 275.
Bathyglyptus SCHMIEDEKNECHT.
Opusc. Ich., vol. 35, 1913, p. 2802.
Biophthora FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 65.
Boloderma MORLEY.
Fauna Brit. Ind. Hym., vol. 3, 1913, p. 54.
Type.—*B. cadmus* MORLEY. (Monobasic.)
Brachycyrtus KRIECHBAUMER=(**Proterocryptus** ASHMEAD, which see).

Bracon FABRICIUS should read, **Bracon** JURINE, FABRICIUS, not Authors, etc., and the following reference should be added: Erl. Litt.-Ztg., vol. 1, 1801, p. 163.

(**Bracotritoma** CSIKI)=**Szepligetia** SCHULZ.

Rovartani Lapok, vol. 16, 1909, p. 13.

Presumably proposed too late to replace the preoccupied *Tritoma* SZEPLIGETI.

(**Brownius** ASHMEAD)=**Spinaria** BRULLE, according to Roman, 1913*a*, p. 43.

Bucheckerius SCHULZ=**Paniscus** SCHRANK, according to Morley, 1913.

Caenopimpla CAMERON=?**Neopimpla** ASHMEAD, according to Morley, 1913*b*, p. 408.

Calliephialtes ASHMEAD.

Type.—(*Pimpla xanthothorax* ASHMEAD)=(*Pimpla*) *C. grapholithae* (CRESSON), according to Cushman, 1915, p. 133.

Campoplex GRAVENHORST. See **Sinophorus**.

Camposcopus (FOERSTER) ROHWER.

Proc. U. S. Nat. Mus., vol. 49, 1915, p. 226.

Type.—*C. aclerivora* ROHWER. (Monobasic.)

Campothreptus FOERSTER, not DAVIS. No species as yet included, according to Cushman, 1919*b*.

Campothreptus DAVIS, not FOERSTER.=**Zagryphus** CUSHMAN. Davis regarded *Mesoleptus? nasutus* CRESSON and *Tryphon? nasutus* CRESSON as synonymous, consequently I hold that my choice of type of *Campothreptus* DAVIS can not be set aside.

Camptotypus KRIECHBAUMER. See **Hemipimpla**.

Casinaria HOLMGREN. See **Amorphota**.

Centistidea ROHWER.

Psyche, vol. 21, 1914, p. 81.

Type.—*C. ectoedemiae* ROHWER. (Monobasic.)

Cephalobaris KRYGER.

Ent. Medd., vol. 10, 1915, p. 243, fig.

Type.—*C. eskelundi* KRYGER.

Cephalobolus MORLEY.

Faun. Brit. Ind. Hym., vol. 3, 1913, p. 444.

Type.—*C. parvipes* MORLEY. (Monobasic.)

(**Ceratosoma** CRESSON).

Type.—*Agathis ornata* SAY.=(*C. fasciata* CRESSON), according to Gahan.

Chaoilta CAMERON=(**Platybracon** SZEPLIGETI), according to Roman, 1913.

Charitopimpla CAMERON=**Exeristes** FOERSTER, according to Morley, 1913*b*, p. 193.

Chelonus JURINE not PANZER.

Erl. Litt.-Ztg., vol. 1, 1801, p. 164.

Type.—*Ichneumon oculator* FABRICIUS. (Monobasic.)

Chilotrichia FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 65.

Christolimorpha VIERECK.

Proc. U. S. Nat. Mus., vol. 44, 1913, p. 564. Two species.

Type.—*C. plesius* VIERECK. (By original designation.)

Chrysocryptus CAMERON=**Leptocryptus** THOMSON, according to Roman, 1913*a*, p. 9.

Chrysopoctonus CUSHMAN.

Proc. U. S. Nat. Mus., vol. 55, 1919, pp. 518-520.

Type.—*Otacustes atriceps* ASHMEAD=(*Otacustes* ASHMEAD, not FOERSTER.)

Cidaphurus (FOERSTER) WOLDSTEDT=**Banchus** FABRICIUS, according to Morley, 1913*b*, p. 253.

Clotildea SZEPLIGETI.

Ann. Soc. Ent. Belg., vol. 58, 1914, p. 117.

Type.—*C. lucida* SZEPLIGETI. (Monobasic.)

Coccygodes SAUSSURE=(**Nadia**, which see).

Coccygomimus SAUSSURE=**Pimpla**, according to Morley, 1914*a*, p. 72.

Coelodontus ROMAN.
Zool. Bidrag. Fran Uppsala, vol. 1, 1912, p. 246.
Type.—*C. costator* Thunberg. (Monobasic.)

Coeloides WESMAEL=(**Atanycolus** FOERSTER, which see).

Coeloidimorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 558.
Type.—*Bracon (Melanobracon) webbi* VIERECK. (Monobasic.)

Coeloidina, new genus=**Coeloides** WESMAEL, part.
Type.—*Coeloides melanotus* WESMAEL. According to Roman, Zool. Beitrage Upsala, vol. 1, 1912, p. 260, *Bracon initiator* FABRICIUS is an *Atanycolus* FOERSTER. This being the case, *Atanycolus* FOERSTER becomes a synonym of *Coeloides* WESMAEL and *Coeloides melanotus* WESMAEL is left without a generic name. It is to supply this deficiency that the above name is proposed.

Coelopimpla BRETHES.
Anal. Mus. Nac. B. A., vol. 27, 1915, p. 402.
Type.—*C. amandci* BRETHES. (Monobasic.)

Colastomion BAKER.
Philippine Journ. Sci., vol. 12, 1917, pp. 283, 290, 291.
Type.—*C. abdominalis* BAKER. (Monobasic.)

Coleocentrus GRAVENHORST.
Type.—*Ichneumon excitator* PODA. (By designation of Morley, Faun. Brit. Ind., vol. 3, 1913, p. 147.)

Colpotrochia HOLMGREN=(**Inoresa** CAMERON).

(**Cosmiopimpla** CAMERON)=**Hemipimpla** SAUSSURE, according to Morley 1914*a*, p. 88, and Meade-Waldo and Morley, 1914, p. 408.

Cratocnema SZEPLIGETI.
Mitth. Mus. Zool., vol. 7, 1914, p. 184. Eight species.
Type.—Not designated.

Cremastus GRAVENHORST=(**Paurolexis** CAMERON) see (**Temelucha**) see **Zaleptopygus**. In 1913*b*, p. 498, Morley unnecessarily fixed *C. interruptor* GRAVENHORST as type of **Cremastus** GRAVENHORST.

Cryptanuridimorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 369.
Type.—*C. elegans* VIERECK. (Monobasic.)

Cryptodema MORLEY.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 312.
Type.—*C. anormis* MORLEY. (Monobasic.)

Cryptohelcostizus CUSHMAN.
Proc. U. S. Nat. Mus., vol. 55, 1919, p. 534.
Type.—*C. rufigaster* CUSHMAN. (Monobasic.)

Cryptoideus ASHMEAD, see (**Xylophruridea**).

Cryptonastes FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 65.

Cryptophion VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 370.
Type.—*C. strandi* VIERECK. (Monobasic.)

Cryptopterigimorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 371.
Type.—*C. tubulifera* VIERECK. (Monobasic.)

Crypturopsis ASHMEAD=(**Lymeon** ASHMEAD not FOERSTER) according to Cushman, 1919, p. 521.

(**Cryptus** FABRICIUS) preoccupied, according to Morice and Durrant.
Trans. Ent. Soc. Lond., 1915, p. 374=**Itamoplex** FOERSTER.

Ctenacme (FOERSTER) THOMSON=(**Pauroctenus**).
Type.—*Polyblastus scutellatus* THOMSON. (By designation of Morley, 1913*b* p. 335.)

Ctenotoma CAMERON=(**Macrogaster** BRULLE not **Macrogaster** THUNBERG, 1805.)

Cubocephalus RATZEBURG.

Type.—(*Cryptus fortipes* GRAVENHORST)=(*Ichneumon*) *Cubocephalus distinctor* (THUNBERG), according to Roman, 1912, p. 251.

Cyanocryptus CAMERON see (**Lamprocryptus**) (**Cyphanza** CAMERON) = **Monoblastus** HARTIG, according to Morley, 1913*b*, p. 331.

Cyrtobasis CUSHMAN.

Proc. Ent. Soc. Wash., vol. 21, 1919, pp. 114, 115.

Type.—*C. rogae* CUSHMAN. (Monobasic.)

(**Degithina** CAMERON) = **Ichneumon**, according to Meade-Waldo and Morley, 1914, p. 407.

(**Delaulax** CAMERON)=**Itoplectis**, according to Meade-Waldo and Morley, 1914, p. 410.

Page 42, change **Delcmerista** to **Delomerista**.

[**Delotomus** (FOERSTER) THOMSON]=**Acrotomus** HOLMGREN.

Page 43, change (**Deraidontus**) to (**Deraiodontus**).

Derocentrus CUSHMAN.

Proc. Ent. Soc. Wash., vol. 21, 1919, p. 113. Two species.

Type.—(*Coleocentrus*) *Nematopodius texanus* (ASHMEAD). (By original designation.)

Diachasma FOERSTER=**Opius** WESMAEL, according to Gahan, 1915.

Diachasmimorpha VIERECK=**Opius** WESMAEL, according to Gahan, 1915, p. 65.

Proc. U. S. Nat. Mus., vol. 44, 1913, p. 641.

Type.—*D. comperei* VIERECK. (Monobasic.)

Diaglyptidea VIERECK.

Proc. U. S. Nat. Mus., vol. 46, 1913, p. 371.

Type.—*D. roepkei* VIERECK. (Monobasic.)

Diaparsis (FOERSTER) DALLA TORRE.

Type.—*Ophion nutritor* FABRICIUS. (By designation of Morley, 1913*b*, p. 514).

Diapetimorpha VIERECK.

Proc. U. S. Nat. Mus., vol. 44, 1913, p. 564.

Type.—*Cryptus armatus* ASHMEAD=*C. ashmeadi* DALLA TORRE. (Monobasic.)

Dicaelotus WESMAEL. See (**Leptodemas**).

Digonocryptus VIERECK.

Proc. U. S. Nat. Mus., vol. 46, 1913, p. 373.

Type.—*D. bidens* VIERECK. (Monobasic.)

Dioctes (FOERSTER) SCHMIEDEKNECHT, see (**Enytus**). *D. trochanterata* MORLEY, designated as type by Morley, 1913*b*, p. 470, is untenable because not originally included.

Diplazon (NEES) GRAVENHORST=(**Anomalon** JURINE).

Diraphus WESMAEL=**Gnamptodon** HALIDAY, according to Gahan, 1915, p. 65.

Disophrys FOERSTER, VIERECK.

Proc. U. S. Nat. Mus., vol. 46, 1913, p. 367.

Echthromorpha HOLMGREN. *Cryptus intricatorius* FABRICIUS fixed as type by Morley, 1913*b*, p. 97, is untenable as a type had already been fixed for this genus.

Ectadiophatnus CAMERON.

Ind. For. Rec., vol. 4, 1913, p. 109.

Type.—*E. tachardiae* CAMERON. (Monobasic.)

Eiolo CAMERON.

Ann. Soc. Ent. Belg., vol. 56, 1912, p. 370.

Type.—*E. curvinervis* CAMERON. (Monobasic.)

Elasmosoma RUTHE=**Neoneurus** (HALIDAY) = MARSHALL, according to Morley, 1914, p. 93=(**Paramirax** ASHMEAD), which see.

Elphea CAMERON=? **Stenobracon**, which see.

Endasys (FOERSTER) ROMAN. See **Stylocryptus**.

Enytus CAMERON=**Dioctes** (FOERSTER).
Schmiedeknecht, according to Meade-Waldo and Morley, 1914, p. 409.

Ephialtes SCHRANK=(**Pimplidea** VIERECK, which see).
Fauna Boica, vol. 2, 1902, p. 316.
Type.—*Ichneumom compunctor* SCHRANK. (Monobasic.)

Ephonites CAMERON=**Eponites** MORLEY.

Epijoppa MORLEY.
Rev. Ich., pt. 4, vol. 4, 1915, pp. 7, 49. Eight species.
Type.—*Joppa verecunda* TOSQUINET. (By original designation.)

Epiopelmidea VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 374.
Type.—*E. erythrogaster* VIERECK=(*E. erythrogastra* VIERECK). (Monobasic.)

Epirhyssa CRESSON=?**Rhyssonota** KRIECHBAUMER.
Type.—*E. speciosa* CRESSON. (By designation of Morley, 1913*b*, p. 87.)

[**Epiurus** (FOERSTER) WOLDSTEDT]=**Scambus** HARTIG, according to Rohwer, 1915, p. 225.

Eremotyloides PERKINS.
Trans. Ent. Soc. London, 1914, p. 530.
Type.—*Eremotylus orbitalis* ASHMEAD.

Eriborus (FOERSTER) SCHMIEDEKNECHT=(**Erioborus** MORLEY, 1913, p. 469.)
Type.—*Campoplex perfidus* GRAVENHORST. (By original designation and monobasy.)

Erigorgus (FOERSTER) BRISCHKE.=**Barylypa** (FOERSTER) THOMSON, according to Rohwer, Gahan, and Cushman 1915.

Erigorgus SCHMIEDEKNECHT=? **Paranomalon** VIERECK see Rohwer, Gahan, and Cushman 1915.

Eriocoelinius VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 555.
Type.—*Coelinius longulus* ASHMEAD. (Monobasic.)

Eriostethus MORLEY.
Rev. Ich., pt. 3, 1914, pp. 34, 35.
Type.—*E. pulcherrimus* MORLEY. (Monobasic.)

Eriplanus (FOERSTER) VIERECK.
Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 340.
Type.—*Hemiteles* (*Eriplanus*) *metacomet* VIERECK. (Monobasic.)

Eripternimorpha VIERECK=**Amauromorpha** ASHMEAD, which see.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 645.
Type.—*E. schoenobii* VIERECK. (Monobasic.)

Eristernaulax VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 361.
Type.—*E. leucotaenia* VIERECK. (Monobasic.)

Eritrachynus SCHMIEDEKNECHT.
Opusc. Ich., fasc. 34, 1913, p. 2709. No species.
Fasc. 35, 1913, p. 2724. One species.
Type.—*E. asper* SCHMIEDEKNECHT. (Monobasic.)

Ethaemorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 565.
Type.—*Cryptus similis* CRESSON. (Monobasic.)

Ethelurgus (FOERSTER) VIERECK.
Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 340.
Type.—*Hemiteles* (*Ethelurgus*) *lonicerae* VIERECK. (Monobasic.)

Eudiospilus SZEPLIGETI.
Mitt. Mus. Zool. Berlin, vol. 7, 1914, p. 225. Two species.
Type.—Not designated.

Eulimneria Schmiedeknecht.
Type.—*Ichneumon albidus* Gmelin. (By designation of Morley, 1913*b*, p. 480.)
Euphoriana Gahan.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 433, pl. 39, fig. 1.
Type.—*E. uniformis* Gahan. (Monobasic.)
Euphoridea (Ashmead)=**Ancylocentrus** Foerster, Viereck.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 362.
Euryproctus Holmgren=(**Fovaya** Cameron, which see).
The type fixed by Morley 1913*b* (p. 320) is untenable as the type of this genus had already been fixed.
Eusphathius (Foerster.)=**Spathius** Nees.
Verh. naturh. ver. preuss. Rheinland, vol. 19, 1862, p. 236.
Eutrichopsis Foerster=**Opius** Wesmael, according to Gahan, 1915, p. 65.
Euurobracon Ashmead=(**Lissobracon** Cameron, which see)=(**Exobracon** Szepligeti, which see).
Evaniellus Enderlein. According to Brues, 1916, p. 720, this genus is based upon what "seems to be a very trivial character upon which to base a genus."
Exacrodus (Foerster) Morley.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 330.
Type.—*E. populans* Morley. (Monobasic.)
Exeristes (Foerster) Schmiedeknecht. See (**Charitopimpla**).
Exetastes Gravenhorst. The type of this genus having been fixed by Westwood in 1840, Morley's type designation of 1913*b*, p. 243, is uncalled for.
(**Exobracon** Szepligeti)=**Euurobracon** Ashmead, according to Cameron, 1910, p. 20 and Roman 1913*a*, p. 45.
(**Exochilum** Wesmael)=**Therion** Curtis, according to Rohwer, Gahan, and Cushman, 1915, p. 149.
(**Fenenias** Cameron)=(**Mesostenoideus** Ashmead) according to Meade-Waldo and Morley 1914, p. 410.
(**Foenus** Fabricius)=**Gasteruption** Latreille, see Morice and Durrant 1915, p. 386.
(**Fovaya** Cameron)=**Euryproctus** Holmgren, according to Morley 1913*b*, p. 320.
(**Gabunia** Kriechbaumer)=**Nadia** Tosquinet, according to Krieger, Zeit. f. Hym. Dip., vol. 4, 1904, p. 172.
Gasteruption Latreille=? **Foenus** Fabricius, which see.
Gelis Thunberg=(**Pezomachus** Gravenhorst).
Giraudia (Foerster) Ashmead.
The type of this genus (*Cryptus congruens* Gravenhorst)=*Ichneumon gyratorius* Thunberg, according to Roman 1912, p. 259.
Glyptopimpla Morley.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 209.
Type.—*G. prima* Morley. (Monobasic.)
Gnamptodon Haliday. See **Diraphus** Wesmael.
Gnathonophorus (Schmiedeknecht) Schmiedeknecht.
Opusc. Ich., fasc. 33, 1913, pp. 2574, 2575).
Type.—*G. moricei* Schmiedeknecht. (Monobasic.)
Gnesia (Foerster) Rohwer.
Proc. U. S. Nat. Mus., vol. 49, 1915, p. 220.
Type.—*G. caliroae* Rohwer. (Monobasic.)
Goryphus Holmgren see (**Melcha** Cameron).
(**Gunomeria** Schmiedeknecht)=**Hadrodactylus** Foerster, according to Roman, Ent. Tidsk., 1917, p. 278.
Gyroneuronella Baker.
Philippine Journ. Sci., vol. 12, 1917, pp. 284, 320.
Type.—*G. kokujewii* Baker. (Monobasic.)

Habrodemus (SCHMIEDEKNECHT) SCHMIEDEKNECHT.
Opusc. Ich., fasc. 35, 1913, p. 2799; 1914, p. 2842.
Type.—*Mesoleius elongatus* BRISCHKE. (Monobasic.)

(**Hambergiella** ROMAN)=**Mengersenia** SCHMIEDEKNECHT, according to Roman 1913*c*, p. 132.

Helcostizidea ROHWER.
Proc. Ent. Soc. Wash., vol. 15, 1914 (1913), p. 185. Two species.
Type.—*Cubocephalus atrocoxalis* ASHMEAD. (By original designation.)

Helcostizus (FOERSTER) DALLA TORRE. See **Asternaulax**.

[**Helictes** (HALIDAY) CURTIS]=**Megastylus** SCHIODTE, according to Morley, 1913*b*, p. 341.

Hemigyroneuron BAKER.
Philippine Journ. Sci., vol. 12, 1917, pp. 284, 322, 323. Two species.
Type.—*H. speciosus* BAKER. (By original designation.)

Hemipimpla SAUSSURE=(**Camptoytpus** KRIECHBAUMER) according to Roman 1913*a*, p. 12. See (**Odontopimpla** CAMERON.) The synonomy under this genus, established by Schulz, 1911, p. 27, was endorsed by Morley 1914*a*, 88.
Type.—*H. caffra* SAUSSURE. (By designation of Morley 1913*b*, p. 186).

Homalomma (FOERSTER) ROHWER.
Proc. U. S. Nat. Mus., vol. 49, 1915, p. 218. Three species.
Type.—*H. caliroae* ROHWER. (By original designation.)

(**Homocidus** MORLEY) MORLEY 1913*b*, p. 282, fixed *Bassus tarsatorius* PANZER as the type of this synonym, but this choice is untenable owing to my choice of the preceding year.

Hoploplatystylus SCHMIEDEKNECHT.
Tidjschr. Ent., vol. 55, 1912, p. 47.
Type.—*H. smits-van-burgsti*, SCHMIEDEKNECHT. (Monobasic.)

Hymenobosmina DALLA TORRE. See (**Neobosmina**).

Hymenopharsalia MORLEY=(**Pharsalia** CRESSON, preoccupied,)=(**Parophionellus** BRUES and RICHARDSON.)
Rev. Ichn., vol. 2, 1913, p. 98.

[**Hypamblys** (FOERSTER) THOMSON]=**Syndipnus**, which see.

Hyperacmus HOLMGREN=(**Nothaima** CAMERON).

Hypocynodus FOERSTER.=**Opius** WESMAEL, according to Gahan, 1915.

Hypolabis FOERSTER.=**Opius** WESMAEL, according to Gahan, 1915.

Hyposoter (FOERSTER) VIERECK=**Hypothereutes** (FOERSTER) ASHMEAD, **Ischnoscopus** (FOERSTER) ASHMEAD, **Ameloctonus** (FOERSTER) ASHMEAD, and **Anilastus** (FOERSTER) DALLA TORRE, according to Gahan, 1914, p. 156.

Hypothereutes (FOERSTER) ASHMEAD. See **Hyposoter** (FOERSTER) VIERECK.

Hypsicera LATREILLE. See (**Plesioexochus**).

Hysterobolus VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 559.
Type.—*H. mallochi* VIERECK. (Monobasic.)

Ichneumon LINNAEUS. See Morice and Durrant, 1915, p. 388.

Ichneutipterus VACHAL.
Rev. d' Ent., 1907, p. 123.
Type.—*Sigalphus* (?) *ichneutipterus* VACHAL. (Monobasic.)

Idemun, page 75 change to **Idemum** (FOERSTER) VIERECK.
Bull. 22, Conn. Geol. and Nat. Hist. Surv., 1917, p. 340.
Type.—*Hemiteles* (*Idemum*) *crassiformis* VIERECK. (Monobasic.)

Idiolispa (FOERSTER) SCHMIEDEKNECHT.=**Phaedrophadnus**, which see.

(**Inoresa** CAMERON)=**Colpotrochia** HOLMGREN, according to Morley, 1913*b*, p. 305.

Isadelphus (FOERSTER) ROMAN. See Cushman, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 526.

[**Ischnoscopus** (FOERSTER) ASHMEAD]. See **Hyposoter**.
Ischnurgops (FOERSTER) ROMAN. See **Panargyrops, Leptocryptus**.
Iseropus (FOERSTER) WOLDSTEDT=**Scambus**, according to Rohwer, 1915, p. 225.
Isomecus KRIECHBAUMER.
Prof. Staatsgym Pola, 1895, p. 11.
Itamoplex (FOERSTER) ASHMEAD=(**Cryptus** FABRICIUS, preoccupied).
Itoplectis (FOERSTER) WOLDSTEDT. See **Delaulax**.
Type.—*Ichneumon maculator* FABRICIUS. (By designation of Morley 1913*b*, p. 169.)
Joppocryptus VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 374.
Type.—*J. egregius* VIERECK. (Monobasic.)
Labroctonus (FOERSTER) DAVIS,=?**Lapaphras**, which see. Morley's selection of type for this genus, namely *Ichneumon scotopterus* GRAVENHORST, 1913*b*, p. 327, is untenable because of my choice of the preceding year.
Lamprocryptidea VIERECK
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 376.
Type.—*L. magnifica* VIERECK. (Monobasic.)
(**Lamprocrytus** CAMERON)=**Cyanocryptus**, according to Brues, 1917.
Lamprocrytpus SCHMIEDEKNECHT, to the Gen. Ins. reference add the year 1909.
(**Lapaphras** CAMERON)=**Labrossyta** FOERSTER, according to Morley, 1912, 1913.
(**Leptocryptus** THOMSON) see **Chrysocryptus**.
Leptodemus (FOERSTER) CAMERON=**Dicaelotus** according to Meade-Waldo and Morley, 1914, p. 409.
Leptoperilissus (SCHMIEDEKNECHT) SCHMIEDEKNECHT.
Opusc. Ichn., fasc. 33, 1913, pp. 2577, 2578.
Type.—*L. oraniensis* SCHMIEDEKNECHT. (Monobasic.)
(**Letosha** CAMERON)=**Megastylus** SCHIODTE according to Morley, 1913*b*, p. 341.
(**Leptotermas** MEADE-WALDO, and MORLEY) Morley, 1914, p. 409=**Leptodemus**.
(**Liganira** WALKER.)=**Microgaster**, according to Walker, 1860, p. 308.
Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 308.
Type.—*Microgaster detractus* WALKER. (Monobasic.)
Judging from Walker's remarks under this reference, **Liganira** was erroneously established at an earlier date.
(**Limneria** HOLMGREN.) Morley's choice, 1913*b*, p. 480, of type for this genus, namely *Ichneumon albidus* GMELIN, is untenable, owing to my choice of the preceding year. Owing to the fact that Morley's choice of a type for *Olesicampe* (FOERSTER) Dalla Torre antedates my choice and is different, therefore (*Limneria* HOLMGREN) is not isogenotypic with *Olesicampe* (FOERSTER) Dalla Torre.
(**Linoceras** TASCHENBURG)=**Acroricnus**, which see. The type of this genus (*Cryptus macrobates* GRAVENHORST)=*Ichneumon stylator* THUNBERG, according to Roman, 1912, p. 281.
Liobracon SZEPLIGETI.
Type.—*Syngaster macula* BRULLE=(*Liboracon singularis* SZEPLIGETI), according to Szepligeti, 1904.
Liomorpha SZEPLIGETI.
Mitt. Mus. Zool. Berlin, vol. 7, 1914, p. 155.
Type.—*L. nigrirostris* SZEPLIGETI. (Monobasic.)
Lissarcha CAMERON.
Soc. Ent., vol. 27, 1912, p. 95.
Type.—*L. flavomaculata* CAMERON.
(**Lissobracon** CAMERON)=**Euurobracon** ASHMEAD, according to Roman, 1913*a*, p. 45.
Lissonota GRAVENHORST.
Type.—*L. sulphurifera* GRAVENHORST. [By designation of Morley, 1913*b*, p. 224.]

Lissotheronia CAMERON=(**Pimpla**) AUTHORS according to Meade-Waldo and Morley, 1914, p. 408.

Lorenzoa DE STEFANI, 1909.
Marcellia, vol. 8, pp. 15, 16.
Type.—*L. solani* DE STEFANI. (Monobasic.)

Loxoneurus (SCHMIEDEKNECHT) SCHMIEDEKNECHT.
Opusc. Ich., fasc. 34, 1913, p. 2711, no species; fasc. 35, p. 2752.
Type.—*L. thuringiacus* SCHMIEDEKNECHT. (Monobasic.)

Lycogonalos BISCHOFF.
Arch. Naturges., vol. 79 A, 1913, p. 155.
Type.—*L. flavicincta* BISCHOFF. (Monobasic.)

Lymeon (FOERSTER) ASHMEAD. See **Crypturopsis**.

Lytacra FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 65.

Lytarmes CAMERON, MORLEY.
Rev. Ichn., vol. 2, 1913, p. 21, Characters.

(**Lytopylus** VIERECK) not FOERSTER=**Aerophilopsis** VIERECK.
A. azygos VIERECK, the so-called genotype of *Lytopylus* FOERSTER was included under the latter genus by mistake.

(**Macrobatus** HOLMGREN)=**Acrorhicnus**, according to Roman, 1912, p. 281.
Type.—(*Cryptus macrobates* GRAVENHORST)=*Ichneumon stylator* THUNBERG.
Isogenotypic with *Linoceras* TASCHENBERG.

(**Macrogaster** BRULLE)=**Ctenotoma** CAMERON, according to Morley, 1913*b*, p. 25.

Macroneuroides VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 363.
Type.—*M. erythropleura* VIERECK. (Monobasic.)

Macrostomionella BAKER.
Philippine Journ. Sci., vol. 12, 1917, pp. 283, 294, 295. Two species.
Type.—*M. philippinensis* BAKER. (By original designation.)

Macrus GRAVENHORST=**Coleocentrus**, according to Morley 1913*b*, p. 47.

Magnibucca MORLEY.
Rev. Ichn., vol. 2, 1913, p. 79.
Type.—*M. testacea* MORLEY. (Monobasic.)

Matara HOLMGREN, BRETHES (Characters).
Anal. Mus. Nacional Buenos Aires, vol. 11, 1904, p. 335.

Medophron (FOERSTER) BRISCHKE.
Type.—(*M. niger* BRISCHKE)=(*Phygadeuon*) *Medophron afflictor* GRAVENHORST, according to Roman, 1914, p. 25.

Megastylus SCHIODTE=(**Letosha** CAMERON), which see.

(**Melcha** CAMERON)=**Goryphus** HOLMGREN, according to Meade-Waldo and Morley 1914, p. 410.

Mengersenia SCHMIEDEKNECHT.=(**Hambergiella** ROMAN), according to Roman, 1913*c*, p. 132.

Meniscus SCHIODTE, see **Alloplasta** and **Amersibia**.

Meropaches (SCHMIEDEKNECHT) SCHMIEDEKNECHT.
Opusc. Ichn., fasc. 34, 1913, pp. 2668, 2705, 2706·
Type.—*M. bulsanensis* SCHMIEDEKNECHT (Monobasic.)

Mesochorus GRAVENHORST. (*M. thoracicus* GRAVENHORST)=*M. giberius* THUNBERG, according to Roman, 1912 p. 258.

Mesostenimorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 566.
Type.—*Cryptus nebraskensis* ASHMEAD. (Monobasic.)

(**Mesostenoideus** ASHMEAD)=(**Fenenias**), which see.

Mesostenus GRAVENHORST=(**Umlima**), which see.

Mesotages FOERSTER?=**Hedylus**, according to Gahan, 1915, p. 65.

Metacoelus (FOERSTER) HOLMGREN.
Ofvers Vet.-Akad. Forh., vol. 30, pt. 4, 1873, p. 61.
Isogenotypic with [*Polyclistis* (FOERSTER) THOMSON].
Metanomalon MORLEY.
Rev. Ichn., vol. 2, 1913, p. 58.
Type.—*M. poliendum* MORLEY. (Monobasic.)
Meteorus HALIDAY=(**Saprotichus** HOLMGREN.)
Metopius PANZER=(**Peltastes**), which see. The species, namely *Ichneumon micratorius* FABRICIUS, chosen as type for this genus, by Morley 1913*b*, p. 265, is untenable because of my choice of the preceding year.
[**Microplex** (FOERSTER) ROMAN] **Aclastus**=(FOERSTER) ASHMEAD.
Microrhogas SZEPLIGETI. Preoccupied by Cameron, 1910.
Voy. Alluaud Hym., 1915, p. 183.
Type.—*M. ocellaris* SZEPLIGETI.
Monoblastus HARTIG=(**Cyphanza** CAMERON), which see.
Type.—*Ichneumon neustriae* SCHRANK (by designation of Morley 1913*b*, p. 33), should the only species originally included prove to be untenable then Morley's choice may be tenable.
Monocoila ROMAN, Characters by Roman 1915, p. 13.
Monogonocryptus VIERECK.
Proc. U. S. Nat. Mus. vol. 46, 1913, p. 376.
Type.—*M. diversicolor* VIERECK. (Monobasic.)
Myersia VIERECK. CUSHMAN.
Proc. U. S. Nat. Mus., vol. 55, 1919, pp. 521, 522.
Myrmicomorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 566.
Type.—*Pezomachus* (*Myrmicomorpha*) *perniciosa* VIERECK. (Monobasic.)
Neliopisthus THOMSON=(**Polysphinctomorpha** ASHMEAD, which see.)
Neoacampis SZEPLIGETI Mitt. Mus. Zool. Berl., vol. 7, 1914, p. 210.
Type.—*N. gracilipes* SZEPLIGETI (Monobasic.)
(**Neobosmina** CAMERON)=**Hymenobosmina** DALLA TORRE, according to Morley 1913*b* p. 438.
Neocremastus CUSHMAN.
Proc. U. S. Nat. Mus., vol. 53, 1917, pp. 504, 509.
Type.—*Porizon stigmaterus* CRESSON. (Monobasic.)
Neodiospilus SZEPLIGETI.
Mitth. Mus. Zool. Berl., vol. 7, 1914, p. 224. Two species.
Type.—Not designated.
Neodoryctes SZEPLIGETI.
Mitth. Mus. Zool. Berl., vol. 7, 1914, p. 199. Six species.
Type.—Not designated.
Neogreenia VIERECK.
Proc. Biol. Soc., vol. 29, 1916, p. 169. Additional matter.
Neohelcon SZEPLIGETI.
Voeltzkow Reise Ost-Afr., vol. 3, 1913, p. 427.
Type.—*N. braconinus* SZEPLIGETI. (Monobasic.)
Neoneurus (HALIDAY) MARSHALL. See **Elasmosoma**.
Neopimpla ASHMEAD. See **Caenopimpla**.
Neopius GAHAN.
Proc. U. S. Nat. Mus., vol. 53, 1917, p. 203.
Type.—*N. carinaticeps* GAHAN. (Monobasic.)
Neorhyssalus BAKER.
Philippine Journ. Sci., vol. 12, 1917, pp. 282, 286, 287.
Type.—*N. compositus* BAKER. (Monobasic.)
Nesanomalon MORLEY.
Rev. Ichn., vol. 2, 1913, p. 56.
Type.—*N. dimidiatum* Morley. (Monobasic.)

Nesaulax Roman.
Ark. Zool., vol. 8, 1913, pp. 11–12.
Type.—*Ipobracon (Nesaulax) flagellaris* Roman. (Monobasic.)

Neuraulax Roman.
Ark. Zool., vol. 8, 1913, p. 4.
Type.—*N. semperi* Roman. (Monobasic.)

Nonnus Cresson=(**Ophionocryptus**, which see.) Meade-Waldo and Morley, 1914, p. 409, claim that this genus is closely related to **Nematopodius** Gravenhorst.

Nosopea Foerster=**Opius** Wesmael, according to Gahan 1915, p. 65.

Nothaima Cameron=**Hyperacmus** Holmgren, according to Morley 1913*b*, p. 308.

(**Nototrachys** Marshall)=**Anomalon**, which see.

Nudinella Szepligeti.
Mitt. Mus. Zool. Berl., vol. 7, 1914, p. 157.
Type.—*N. gracilis* Szepligeti. (Monobasic.)

Odontopimpla (Cameron)=**Hemipimpla** Saussure, according to Morley 1914*a*, p. 100, and Meade-Waldo and Morley 1914, p. 408.

Ogkosoma Haupt.=**Paxylomma** according to Strand 1914, p. 31.
Mitt. Ent. Ges. Halle, vols. 5–7, 1913, pp. 52, 53.
Type.—*O. schwarzi* Haupt. (Monobasic.)

Olesicampe (Foerster) Dalla Torre.
Type.—*Ichneumon fulviventris* Gmelin. (By designation of Morley 1913*b*, p. 478.) This designation invalidates mine of the succeeding year.

(**Ophiodes** Hartig.)=**Ophiogastra** Ashmead.

Ophionellus Westwood. See **Hymenopharsalia** Morley.

(**Ophionocryptus** Schmiedeknecht)=**Nonnus** Cresson, which see.

Opiellus Ashmead=**Opius** Wesmael according to Gahan 1915, p. 65.

Opius Wesmael. See **Allotypus**, **Apodesmia**, **Aulonotus**, **Biophthora**, **Biosteres**, **Chilotrichia**, **Cryptonastes**, **Desmatophorus**, **Desmiostoma**, **Diachasma**, **Diachasmimorpha**, **Eutrichopsis**, **Hypocynodus**, **Hypolabis**, **Lytacra**, **Nosopoea**, **Opiellus**, **Phaedrotoma**, **Rhabdospilus**, **Stenospilus**, **Therobolus**, **Trichopius**, **Trigonospilus**, and **Utetes**.

Orientospilus Morley.
Type.—*O. individuus* Morley. (By designation of Morley 1913*b*, p. 378.)

(**Orientotheronia** Morley)=**Theronia**, according to Morley 1914*a*, p. 44.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 146. Three species.
Type.—*O. rufescens* Morley. (By original designation.)

Orthocryptus Viereck.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 567.
Type.—*Cryptus monticola* Ashmead=*C. sanderi* Dalla Torre. (Monobasic.)

Orthopelma Taschenberg.
Type.—(*Hemiteles luteolator* Gravenhorst)=*Ichneumon mediator* Thunberg, according to Roman, p. 267, 1912.

Otacustes Ashmead. See **Chrysopoctonus** Cushman.

[**Panargyrops** (Foerster) Schmiedeknecht.] See Cushman. Proc. U. S. Nat. Mus., vol. 55, 1919, p. 528, who uses this genus instead of *Ischnurgops*, but without giving a reason for his action.

Paniscus Schrank. See Bucheckerius.
Type.—(*Ichneumon luteus* Rossi)=*Paniscus testaceus* Gravenhorst. (Monobasic.)

Parabates (Foerster) Dalla Torre.
Type.—*P. nigricarpus* Thomson. (By designation of Enderlein.) Ent. Zeit. Stett., vol. 73, 1912, p. 106. This designation invalidates the designation of both Morley 1913*b*, p. 357, and myself 1914, p. 110.

Paracanidia Viereck. See (**Prosmoridea** Cushman).

Paragyroneuron Baker.
Philippine Journ. Sci., vol. 12, 1917, pp. 284, 318.
Type.—*P. bicolor* Baker. (Monobasic.)

(**Paramirax** Ashmead)=**Elasmosoma** Ruthe.

Proc. Ent. Soc. Wash., vol. 3, 1895, p. 281.

Type.—*P. schwarzi* Ashmead. (Monobasic.)

Paraneura Morley.

Rev. Ichn., vol. 2, 1913, pp. 22, 23. Two species.

Type.—*Apechoneura* (*Paraneura*) *nigricornis* Mocsary. (By present designation.)

Parania Morley.

Rev. Ichn., vol. 2, 1913, p. 97.

Type.—*P. nototrachoides* Morley. (Monobasic.)

Paranomalon Viereck.=**Erigorgus** Schmiedeknecht, not (Foerster) Brischke, according to Rohwer, Gahan, and Cushman 1915.

Parapambolus Dahl.

Beitr. Naturdenkmalpfl., vol. 3, 1912, p. 555.

Type.—*P. rufigaster* Dahl. (Monobasic.)

Parca Morley.

Rev. Ichn., vol. 2, 1913, p. 133.

Type.—*P. ocularia* Morley. (Monobasic.)

(**Paropheltes** Cameron)=**Paniscus** Schrank, according to Morley 1913*b*, p. 347.

(**Parophionellus** Brues and Richardson.)

Bull. Amer. Mus. Nat. Hist., vol. 32, p. 495 (Oct. 7), 1913=(**Pharsalia** Cresson not Thomson)=**Hymenopharsalia** Morley.

(**Pauroctenus** Cameron)=**Ctenacme** Foerster, according to Morley 1913*b*, p. 335.

(**Paurolexis** Cameron)=**Cremastus** Gravenhorst, according to Morley 1913*b*, p. 498.

Pectenella Morley.

Ichn. Britt., vol. 5, 1915, p. 173.

Type.—*Angitia latungula* Thomson (Monobasic.)

Perilissus (Foerster) Holmgren=(**Spanotecnus** Foerster, which see.)

Type.—*Mesoleptus limitaris* (Gravenhorst)=*Ichneumon naevius* (Gmelin), according to Pfankuch, 1906, p. 91.

The type, namely *P. filicornis* (Gravenhorst), chosen by Morley 1913*b*, p. 314, is untenable owing to my choice of the preceding year.

(**Pezomachus** Gravenhorst)=**Gelis** Thunberg, which see.

(**Phaedrophadnus** Cameron)=**Idiolispa** Foerster, according to Meade-Waldo and Morley, 1914, p. 410.

Phaedrotoma Foerster=**Opius** Wesmael, according to Gahan 1915, p. 65.

Phaenolabrorychus Viereck.

Proc. U. S. Nat. Mus., vol. 46, 1913, p. 379.

Type.—*P. anisitsi* Viereck. (Monobasic.)

Phaestacoenites Smits van Burgst.

Ber. Ned. Ent. Ver., vol. 3, 1913, p. 363.

Type.—*P. demeyerei* Smits van Burgst. (Monobasic.)

(**Phanaulax** Cameron, Tijdschr. Ent., 1910)=**Stenobracon**, which see.

(**Phanaulax** Cameron, Soc. Ent., 1910)=**?Stenobracon**, which see.

(**Pharsalia** Cresson, preoccupied)=**Hymenopharsalia** Morley, according to Morley 1913*a*, p. 97.

Photocryptus Viereck.

Proc. U. S. Nat. Mus., vol. 46, 1913, p. 379.

Type.—*P. photomorphus* Viereck. (Monobasic.)

Photoptera Viereck.

Proc. U. S. Nat. Mus., vol. 46, 1913, p. 380.

Type.—*P. erythronota* Viereck. (Monobasic.)

Phytodiaetoides Morley.

Faun. Brit. Ind. Hym., vol. 3, 1913, p. 221.

Type.—*P. megaera* Morley. (Monobasic.)

(**Phytodiaetus** Morley, emendation)=**Phytodietus** Gravenhorst.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 218. Two species.
Type.—*P. coryphaeus* Gravenhorst. (By original designation.)

(**Pimpla** Fabricius) Morley's choice of type for this synonym, 1913*b*, p. 151, namely *P. instigator* Fabricius is uncalled for.

(**Pimplidea** Viereck)=**Ephialtes** Schrank, according to Cushman and Rohwer 1919, p. 188. See also (**Lissotheronia**) and (**Coccygomimus**).

Platybracon Szepligeti=subgenus of **Chaoilta** Cameron, according to Roman 1913*a*, p. 46.

(**Plesioexochus** Cameron)=**Polyclistus** according to Morley 1914.

(**Poecilocrytus** Cameron)=**Poecilopimpla** Morley, which see.

Poeciloeryptus [sic] Cameron=?**Poecilopimpla** Morley.
Proc. Linn. Soc. New South Wales, vol. 36, 1913, p. 335.

Poecilopimpla Morley=**Poecilocryptus** Cameron 1901, not Kriechbaumer 1901.
Rev. Ichn., part 3, 1914, pp. 35, 36.

Polyaenidea Viereck.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 381.
Type.—*P. pretiosa* Viereck. (Monobasic.)

[**Polycinetis** (Foerster) Woldstedt]=**Xenoschesis** (Foerster) Jemiller, according to Cushman 1915, p. 139.

[**Polyclistis** (Foerster) Thomson]=(**Plesioexochus** Cameron, which see.)
Morley's choice of a type for this genus 1913*b*, p. 298, namely *Ichneumon mansuetor* Gravenhorst is uncalled for owing to my choice of the preceding year.

Polycyrtidea Viereck.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 382.
Type.—*P. gracilis* Viereck. (Monobasic.)

Polycyrtimorpha Viereck.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 383.
Type.—*P. amoenus* Viereck. (Monobasic.)

Polycyrtus Spinola, Viereck.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 384.

Polysphincta Gravenhorst. Morley's choice of type for this genus, 1913*b*, p. 205, namely *Ichneumon percontatorius* Muller is uncalled for.

(**Polysphinctomorpha** Ashmead)=**Neliopisthus** Thomson, according to Cushman 1919*b*.

Porizon Fallen, Cushman.
Proc. U. S. Nat. Mus., vol. 53, 1917, p. 503.
Morley's choice of type for this genus 1913*b*, p. 512, namely *P. hostilis* Gravenhorst is also uncalled for.

Promethes (Foerster) Woldstedt=(**Sussaba** Cameron), which see.

Promicrogaster Brues and Richardson.
Bull. Amer. Mus. Nat. Hist., vol. 32, 1913, p. 499.
Type.—*P. terebrator* Brues and Richardson. (Monobasic.)

(**Prosmoridea** Cushman)=**Paracanidia** Viereck.
Proc. Ent. Soc. Wash., vol. 17, 1915, p. 141.
Type.—*Prosmorus elongatus* Davis. (Monobasic.)

Prosthodocis Enderlein.
Stettin Ent. Zeit., vol. 73, 1912, pp. 141, 142. Two species.
Type.—*Paniscus antefurcalis* Szepligeti. (By original designation.)

(**Proterocryptus** Ashmead)=**Brachycyrtus** Kriechbaumer, according to Roman 1915, p. 5. See Cushman, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 543.

Pseuderipternoides Viereck.
Bull. 22, Conn. Geol. Nat. Hist. Surv., 1917, pp. 268, 269.
Type.—*Limneria porrecta* (Cresson). (Monobasic.)

Pseuderipternus Viereck.
Bull. 22, Conn. Geol. Nat. Hist. Surv., 1917, pp. 268, 269.

Pseuderipternus CUSHMAN.
Proc. U. S. Nat. Mus., vol. 53, 1917, pp. 504-506.
Type.—*Podogaster radiolatus* PROVANCHER. (Monobasic.)
Pseudeugalta ASHMEAD=(**Baliena** CAMERON), which see.
Pseudogyroneuron BAKER.
Philippine Journ. Sci., vol. 12, 1917, pp. 284, 316.
Type.—*P. mindanaensis* BAKER. (Monobasic.)
Pseudohelcon SZEPLIGETI.
Mitth. Mus. Zool. Berlin, vol. 7, 1914, p. 223.
Type.—*P. tessmanni* SZEPLIGETI. (Monobasic.)
Pseudorhyssa MERRILL.
Trans. Amer. Ent. Soc., vol. 41, 1915, p. 150.
Type.—*P. sternata* MERRILL. (Monobasic.)
Psiloparia VIERECK=?**Apechoneura** KRIECHBAUMER.
Ent. News, vol. 31, 1920, pp. 17-19.
Type.—*P. maculata* VIERECK. (Monobasic.)
Pterocormus FOERSTER.=(**Degithina** and **Antelca**), which see.
Rhabdospilus FOERSTER.=**Opius** WESMAEL, according to Gahan 1915.
Rhadinocera (FOERSTER) VIERECK.
Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 340.
Type.—*Hemiteles (Rhadinocera) algonquinus* VIERECK. (Monobasic.)
Rhogadopsis BRETHES.
Anal. Mus. Hist. Nat. Buenos Aires, vol. 24, 1913, pp. 44, 45.
Type.—*R. miniacea* BRETHES. (Monobasic.)
Rhogasella BAKER.
Philippine Journ. Sci., vol. 12, 1917, pp. 283, 311, 312. Two species.
Type.—*R. straminea* BAKER. (By original designation.)
Rhopalospathius CAMERON.
Ann. Soc. Ent. Belgique, vol. 56, 1912, p. 368. Two species, namely *R. auranteiceps* and *R. erythrathorax*.
Type.—Not designated.
(**Rhynchothyreus** ASHMEAD)=**Hybophanes** (FOERSTER) SCHMIEDEKNECHT, according to Cushman, 1919.
Rhyssonota KRIECHBAUMER=(**Epirhyssa** CRESSON), according to Morley, 1913*b*, p. 97.
Rinamba CAMERON.
Ann. Soc. Ent. Belgique, vol. 56, 1912, p. 375.
Type.—*R. opacicollis* CAMERON. (Monobasic.)
Ritzemabosia (SMITS VAN BURGST), SCHMIEDEKNECHT.
Tijdschr. Ent., vol. 55, 1912, p. 269; Opusc. Ich., fasc. 34, 1913, p. 2711; Tunisian Hym., 1913, pp. 13, 36, 37.
Type.—*R. meridionalis* SMITS VAN BURGST. (Monobasic.)
(**Saprotichus** HOLMGREN)=**Meteorus**, according to Szepligeti, 1904, p. 177; Roman, 1910, p. 132.
Sauterellus ENDERLEIN.
Stettin. Ent. Zeit., vol. 73, 1912, pp. 112, 113.
Type.—*S. pianiscutellatus* ENDERLEIN. (Monobasic.)
Scallama CAMERON.
Type.—*S. trilineata* CAMERON. (By designation of Morley, 1913*b*, p. 263.)
Scambus HARTIG. See **Epiurus** and **Iseropus**.
Schlettereriella SZEPLIGETI. Under this genus change **Prenobolus** to **Psenobolus**.
Scolobatina ROMAN.
Ark. Zool., vol. 9, 1915, p. 4.
Type.—*S. ruficeps* ROMAN. (Monobasic.)
Scopophthalmus SZEPLIGETI.
Voy. Alluad. Hym., 1915, p. 183.
Type.—*S. jeanneli* SZEPLIGETI.

Sellcornuta Morley.

Faun. Brit. India. Hym., vol. 3, 1913, p. 310.

Type.—*S. albicalcar* Morley. (Monobasic.)

Shirakia Viereck.

Proc. U. S. Nat. Mus., vol. 44, 1913, p. 643.

Type.—*S. schoenobii* Viereck. (Monobasic.)

(**Sinophorus** Ashmead) not Foerster=**Campoplex** Gravenhorst.

Type.—[*Limneria* (*Sinophorus*) *canarsiae* Ashmead]=*Campoplex teratis* Weed. A comparison of the types of these two species revealed their identity.

Sinophorus (Foerster) Schmiedeknecht.

Opusc. Ichn., 1908, p. 1649.

Type.—*S. thuringiacus* Schmiedeknecht. (By designation of Morley, 1913, p. 477.

Smicroplectrus Thomson. See **Anderis** (**Spanotecnus** Thomson)=**Udenia** Foerster according to Roman, 1914, p. 30.

Spanotecnus (Foerster) Thomson.

According to Pfankuch 1906, p. 32, *Ichneumon filicornis* Gravenhorst is a **Perilissus** Foerster.

Spathius Nees. See (**Stenophasmus**).

Spilanomalon Morley.

Rev. Ichn., vol. 2, 1913, p. 89.

Type.—*Anomalon elegans* Cresson. (Monobasic.)

Spinaria Brulle. See (**Brownius**).

[**Stauropodoctonus** Morley 1913*b*, p. 375] emendation=**Stauropoctonus** Brauns.

Stenobracon Szepligeti=(**Phanaulax**)=?**Elphea**, according to Roman, 1913*b*, p. 22.

(**Stenophasmus** Smith)=**Spathius** Nees, according to Szepligeti, 1905, p. 39.

Stenospilus Foerster=**Opius** Wesmael, according to Gahan, 1915, p. 66.

Stephaniscus Kieffer=(**Schlettereriella** Szepligeti), according to Enderlein, 1912, p. 3.

Stephanus Jurine, Panzer, Fn. Ins. Germ., vol. 76, 1800, p. 13.

Sterotrichus (Forester) (Schmiedeknecht)=**Xylonomus** Gravenhorst, according to Roman, 1912, p. 256.

Type.—*Xylonomus pilicornis* Gravenhorst=*X. fuligator* (Thunberg), according to Roman, 1912, p. 256.

Stilbopoides Rohwer.

Proc. Ent. Soc. Wash., vol. 15, 1913, p. 183. Two species.

Type.—*S. maculiventris* Rohwer. (By original designation.)

Stirostoma Cameron.

Ann. Soc. Ent. Belg., vol. 56, 1912, p. 376.

Type.—*S. longicornis* Cameron. (Monobasic.)

(**Sussaba** Cameron)=**Promethes** Foerster, according to Morley, 1913*b*, p. 287.

Syndipnus Foerster=(**Hypamblys**).

Talimeda Cameron.

Ann. Soc. Ent. Belg., vol. 56, 1912, p. 382.

Type.—*T. pallidiceps* Cameron. (Monobasic.)

Tarytia Cameron.

Type.—*T. basimacula* Cameron. (By designation of Morley, 1913, p. 503.)

Tegona Morley.

Faun. Brit. Ind. Hym., vol. 3, 1913, p. 251.

Type.—*T. rufipes* Morley. (Monobasic.)

[**Temelucha** (Foerster) Ashmead]=**Cremastus** Gravenhorst, according to Cushman, 1917, pp. 509, 510.

Tetragonalys Morley.

Rev. Ich., vol. 2, 1913, p. 132.

Two species, namely *T. barbarica* Morley and *T. pagana* Morley.

Type.—Not yet designated.

Therion Curtis=(**Exochilum** Wesmael), according to Rohwer, Gahan, and Cushman, 1915, p. 149.

Therobolus FOERSTER=**Opius** WESMAEL, according to Gahan, 1915, p. 66.
Theronia HOLMGREN=(**Orientotheronia** MORLEY, which see.)
Thymarimorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 384.
Type.—*T. platygastra* VIERECK, (Monobasic).
Torbda CAMERON.
Type.— *T. geniculata* CAMERON. (By designation of Morley, 1913*b*, p. 61.)
Torocampus (SCHMIEDEKNECHT) SCHMIEDEKNECHT.
Opusc. Ichn., fasc. 35, 1913, p. 2797; 1914, p. 2820.
Type.—*Tryphon eques* SCHMIEDEKNECHT. (Monobasic.)
Trachagathis VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 366.
Type.—*T. taeniogaster* VIERECK. (Monobasic.)
Trichiothecus CAMERON.
Type.—[*T. ruficeps* CAMERON]=*Hemipimpla rugosa* (DE GEER), according to Schulz, 1912, p. 97.
Trichomma WESMAEL, according to Morley, 1913*b*, p. 428. This was published in volume 25 of Bull. Acad. Sci. Belg., and *Ichneumon enicator* ROSSI is the genotype.
(**Trichopimpla** CAMERON.)=**Alloplasta**, according to Morley, 1913*b*, p. 222.
Triclistus (FOERSTER) HOLMGREN.
Type.—*Exochus podagricus* GRAVENHORST. (By designation of Morley, 1913*b*, p. 300.)
Trigonospilus ASHMEAD=? **Opius** WESMAEL, according to Gahan, 1915, p. 66.
Trissevania KIEFFER.
Voyage Alluaud Hym., vol. 1, 1913, p. 33.
Type.—*T. anemotis* KIEFFER. (Monobasic.)
Tryphon FALLEN. Morley's 1913 choice of *Tryphon signator* GRAVENHORST as type of this genus is uncalled for owing to the valid choice made by Curtis in 1832, p. 399.
Tylocomnus HOLMGREN=(**Trachyderma** GRAVENHORST) preoccupied.
Tymmophorus SCHMIEDEKNECHT.
Opusc. Ichn., fasc. vol 34, 1913, pp. 2709, 2714, 2715.
Type.—*T. lacustris* SCHMIEDEKNECHT. (Monobasic.)
Udenia (FOERSTER) KRIECHBAUMER=(**Spanotecnus** THOMSON), according to Roman. 1914, p. 30=**Perilissus** FOERSTER, according to Pfankuch, 1906, p. 91.
Type.—[*Udenia herrichii* (FOERSTER) KRIECHBAUMER]=*Ichneumon rufoniger* GRAVENHORST, according to Roman, 1914.
(**Umlima** CAMERON)=**Mesostenus**, according to Morley, 1916.
Utetes FOERSTER.=**Opius** WESMAEL, according to Gahan, 1915, p. 66.
Vendolus ROMAN.
Ark. Zool., vol. 9, No. 2, 1914, p. 35.
Type.—*V. stilpninus* ROMAN. (Monobasic.)
Viereckiana STRAND.=(**Anisitsia** VIERECK), preoccupied.
Arch. Naturg., vol. 80, 1914, p. 163.
Vipiellus ROMAN.
Ark. Zool., vol. 9, 1915, p. 8.
Type.—*Vipio (Vipiellus) mjobergi* ROMAN (Monobasic).
?**Westmaelia** at the foot of page 152, Bull. 83, U. S. Nat. Mus., 1914, should be changed to ?**Wesmaelia**.
Xanipelma TSCHEK.=**Xaniopelma**, according to Authors.
Xanthexochus MORLEY.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 292.
Type.—*X. scutellatus* MORLEY. (Monobasic.)
Xanthocampoplex MORLEY.
Faun. Brit. Ind. Hym., vol. 3, 1913, p. 445.
Type.—*X. orientalis* MORLEY. (Monobasic.)
Xanthopimpla SAUSSURE.
Type.—*Pimpla punctata* FABRICIUS, according to Morley, 1913*b*, p. 108.

Xenoschesis (FOERSTER) JEMILLER=[**Polycinetis** (FOERSTER) WOLDSTEDT], according to Cushman, 1915.

Xylonomus GRAVENHORST, see (**Sterotrichus**) Morley's 1913*b*, p. 76, choice of type for this genus, namely *Ichneumon praecatorius* FABRICIUS is uncalled for owing to the designation by Curtis, 1831.

(**Xylophruridea** VIERECK)=**Cryptoideus** ASHMEAD, according to Cushman, 1919.

Zadiolcogaster VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 366.
Type.—*Z. anomus* VIERECK. (Monobasic.)

Zaglyptomorpha VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 385.
Type.—*Z. attenuata* VIERECK. (Monobasic.)

Zagryphus CUSHMAN=(**Campothreptus** DAVIS, not FOERSTER.)
Proc. U. S. Nat. Mus., vol. 56, 1919, pp. 376, 378.
Type.—*Mesoleptus? nasutus* CRESSON. (Monobasic.)

Zaleptopygus VIERECK=subgenus of **Cremastus** GRAVENHORST, according to Cushman, 1917, pp. 509, 510.

Zamastrus VIERECK.
Proc. U. S. Nat. Mus., vol. 46, 1913, p. 385.
Type.—*Z. photopsis* VIERECK. (Monobasic.)

Zamicrotoridea VIERECK.
Bull. 22, Conn. Geol. Nat. Hist. Surv., 1917, p. 340.
Type.—*Hemiteles* (*Zamicrotoridea*) *orbiformis* VIERECK. (Monobasic.)

Zaparaphylax VIERECK.
Proc. U. S. Nat. Mus., vol. 44, 1913, p. 647.
Type.—*Z. perinae* VIERECK. (Monobasic.)

Zaplethocornia (SCHMIEDEKNECHT) SCHMIEDEKNECHT.
Opusc. Ichn., fasc. 33, 1913, p. 2597.
Type.—(*Trematopygus*) *Z. procurator* GRAVENHORST. (Monobasic.)

(**Zarhynchus** ASHMEAD)=**Hybophanes** (FOERSTER) SCHMIEDEKNECHT, according to Cushman 1919.

Zoophthorus (FOERSTER) VIERECK.
Bull. 22, Conn. Geol. Nat. Hist. Surv., 1917, p. 340.
Type.—*Hemiteles* (*Zoophthorus*) *nigricaniformis* VIERECK. (Monobasic.)

Page 158, change **Adelius** FABRICIUS to **Adelius** HALIDAY; change the first **Melanodolius** to **Mclanodolius**; change **Parizonidea** to **Porizonidea**.

BIBLIOGRAPHY OF ARTICLES REFERRED TO BY MEANS OF CITATION OF AUTHOR, YEAR OF PUBLICATION, AND PAGE, IN THE CONTEXT.

BRUES, C. T.
1916. Three new species of Evaniidae. Bull. Amer. Mus. Nat. Hist., vol. 35, pp. 717-720.

CAMERON, P.
1910. On some Asiatic species of the Subfamilies Braconinae and Exothecinae in the Royal Berlin Museum. Soc. Ent., vol. 25, pp. 11-12, 14-16, 19-20, 22-23, 25, 26.

CURTIS, J.
1832 Brit. Ent., vol. 9, p. 399.

CUSHMAN, R. A.
1915. Descriptions of New Ichneumonidae and taxonomic notes. Proc. Ent. Soc. Wash., vol. 17, pp. 132-142.
1917. A Revision of Hymenopterous Insects of the Tribe Cremastini of America North of Mexico. Proc. U. S. Nat. Mus., vol. 53, pp. 503-551.
1919. Descriptions of New North American Ichneumon-flies. Proc. U. S. Nat. Mus., vol. 55, pp. 517-543.

CUSHMAN, R. A., and ROHWER, S. A.

1919*a*. The Genus *Ephialtes*, first proposed by Schrank. Proc. Ent. Soc. Wash., vol. 20, pp. 186-188.

1919*b*. Notes on certain genera of Ichneumon flies, with descriptions of a new genus and four new species. Proc. U. S. Nat. Mus., vol. 56, pp. 373-382.

ENDERLEIN, G.

1912. Zur Kenntnis der Spathiinen und einiger verwandter gruppen. Arch. Naturg. Berlin, vol. 78, Abt. A., Heft 2, pp. 1-37.

GAHAN, A. B.

1914. Descriptions of New genera and species, with notes on Parasitic Hymenoptera. Proc. U. S. Nat. Mus., vol. 48, pp. 155-168.

1915. A Revision of the North American Ichneumon flies of the subfamily Opiinae. Proc. U. S. Nat. Mus., vol. 49, pp. 63-95.

MEADE-WALDO, G., and MORLEY, C.

1914. Notes and Synonomy of Hymenoptera in the Collection of the British Museum.

Ann. and Mag. Nat. Hist., London, vol. 14, pp. 402-410.

MORICE, F. D., and DURRANT, JNO. HARTLEY.

1915. The Authorship and First Publication of the "Jurineau" Genera of Hymenoptera. Trans. Ent. Soc. Lond., pp. 339-436.

MORLEY, C.

1913*a*. A Revision of the Ichneumonidae. Part 2. Tribes Rhyssides, Echthromorphides, Anomalonides, and Paniscides. London, pp. i to xi, 1-140.

1913*b*. The Fauna of British India. Vol. 3. Ichneumonidae: i Ichneumones deltoidei. London, pp. i-xxxvi, 1-531.

1914*a*. A Revision of the Ichneumonidae, Part 3, London, pp. i-ix, 1-148.

1914*b*. Synonomy of *Neoneurus halidaii* Marsh., with *Elasmosoma berolinense*, Ruthe.

PFANKUCH, K.

1906. Die Typen der Gravenhorstschen Gattungen *Mesoleptus* und *Tryphon*.

Ichneumonol. Europaea, vol. 2, pp. 1-213. Zeitschr. Syst. Hymenopt. Dipt. Jahrg., vol. 6, pp. 17-32, 81-96.

1913. Aus der Ichneumonologie (Hym.), Deutsch. Ent. Zeitschr., pp. 176-183.

ROHWER, S. A.

1913. Descriptions of New Parasitic Hymenoptera. Proc. Ent. Soc. Wash., vol. 15, pp. 180-188.

1915. Descriptions of New Species of Hymenoptera. Proc. U. S. Nat. Mus., vol. 49, pp. 205-249.

ROHWER, S. A., GAHAN, A. B. and CUSHMAN, R. A.

1915. Some Generic Corrections in the Ophioninae. Proc. Ent. Soc. Wash., vol. 17, pp. 149-150.

ROMAN, A.

1910. Notizen zur Schlupfwespen Sammlung des Schweidischen Reichsmuseums. Ent. Tidskr. Stockholm, vol. 31, pp. 109-196.

1912. Die Ichneumonidentypen C. P. Thunbergs. Zool. Beitrage, Uppsala, vol. 1, pp. 229-293.

1913*a*. Philippinische Schlupfwespen aus dem Schwedischen Reichsmuseum I. Arkiv. Zool., vol. 8, No. 15, pp. 1-51.

1913*b*. Philippinische Schlupfwespen aus dem Schwedischen Reichsmuseum II. Arkiv. Zool., vol. 8, No. 24, pp. 1-22.

1913*c*. Arktiska Ichneumonideri Skandinavien. Ent. Tidskrift, pp. 105-132.

1914. Beitrage zur schwedischen Ichneumonidenfauna. Ark. Zool. Stockholm, vol. 9, No. 2, pp. 1-40.

1915. Results of Dr. E. Mjoberges Swedish Scientific Expeditions to Australia 1910-1913. 1. Schlupfwespen. Ark. Zool., vol. 9, pp. 1-18.

Schulz, W. A.
1911. Zweihundert Alte Hymenopteren. Zool. Annal., vol. 4, pp. 1-220.
1912. Aelteste und Alte Hymenopteren Skandinavischer Autoren. Berlin Entomol. Zeitschrift, vol. 57, pp. 52-102.
Strand, E.
1914. Bemerkungen über Paxylommatinae. Ent. Mitt. Berl., vol. 3, pp. 27-31.
Szepligeti, Gy. V.
1904. Hymenoptera. Fam. Braconidae. Gen. Ins., fasc. 22*b*., pp. 79-353.
1905. Exotische Braconiden aus dem aethiopischen, orientalischen und Australischen Regionen. Ann. hist. nat. Mus. Nat. Hung., vol. 3, pp. 25-55.
Viereck, H. L.
1914. Types Species of the Genera of Ichneumon Flies. Bull. 83, U. S. Nat. Mus., pp. i-v, 1-186.
Walker, F.
1860. Characters of some apparently undescribed Ceylon Insects. Ann. Mag. Nat. Hist., ser. 3, vol. 5, pp. 304-311.

ADDENDA.

Acanthodoryctes Turner.
Ann. Nat. Hist., vol. 1, 1918, p. 55. Two species.
Type.—*Iphiaulax morleyi* Froggatt. (By original designation.)

Amesospilus Enderlein.
Beitr. Landf. Sudwestafrik., vol. 1, 1918, p. 222.
Type.—*A. herero* Enderlein.
(Monobasic.)

Aplomiana Strand=**(H)aplomus** Szepligeti not Erichson.
Int. Ent. Zs. Guben., vol. 10, 1916, p. 137.

Archihymen Enderlein.
Beit. Landf. Sudwestafrik., vol. 1, 1918, p. 197.

Austrohelcon Turner.
Ann. Nat. Hist., vol. 2, 1918, p. 166. Two species.

Bicryptella Strand=**Cryptella** Szepligeti not Webb and Berthoumieu.
Int. Ent. Zs. Guben., vol. 10, 1916, p. 137.

Calohelcon Turner.
Ann. Nat. Hist., vol. 2, 1918, p. 165.
Type.—*C. obscuripennis* Turner. (Monobasic.)

Coelopimpla Jean Brethes.
Anal. Mus. Nac. B. A., vol. 27, 1916 (1915), p. 402.
Type.—*C. Amadei* Brethes. (Monobasic.)

(**Coelostephanus** Kieffer)=**Gymnoscelus** according to Turner.
Ann. Nat. Hist., vol. 2, 1918, p. 173.

Cryptella Szepligeti=**Bicryptella** Strand.
Have failed to find out the place of publication of this and the following presumably preoccupied names of Szepligeti that were changed by Strand in 1916.

Dinocryptiella Strand=**Dinocryptus** Szepligeti not Cameron.
Int. Ent. Zs. Guben., vol. 10, 1916, p. 137.

Ecthropis Brethes.
Revist. Chilena, vol. 20, 1916, p. 86.
Type.—*E. porteri* Brethes. (Monobasic.)

Elasmosoma Bengtsson.
Lund. Univ. Arsskr. N. F. Avd., pt. 2, vol. 14, 1918, pp. 1-47.

Electrofoenus Cockerell.
Amer. Journ. Sci., vol. 44, 1917, p. 364.
Type.—*E. gracilipes* Cockerell. (Monobasic.)

Glyptichneumon Habermehl.
Zeitschr. Wiss. Ins'biol., vol. 13, 1917, p. 114.
Type.—*G. phaeogenoides* Habermehl. (Monobasic.)

Gymnoscelus. See (**Coelostephanus** Kieffer).

H)aplomus Szepligeti=**Aplomiana** Strand.

Hypselogastrina ENDERLEIN.
Beitr. Landf. Sudwestafrik., vol. 1, 1918, p. 217.
Two species.
Hyptiogastrites COCKERELL.
Ann. Ent. Soc. Amer., vol. 10, 1917, p. 19.
Type.—*H. electrina* Cockerell. (Monobasic.)
Lissonotopsis HABERMEHL.
Zeitschr. Wiss. Ins'biol., vol. 13, 1917, pp. 234, 306.
Type.—*L. rufa* Habermehl. (Monobasic.)
Macrogrotea BRETHES.
Revist. Chilena., vol. 20, 1916, p. 84.
Type.—*Pimpla gayi* Spinoza. (Monobasic.)
Megalohelcon TURNER.
Ann. Nat. Hist., vol. 2, 1918, pp. 163, 164.
Type.—*M. torresensis* Turner. (Monobasic.)
Mesocryptus SZEPLIGETI=**Pseudomesocryptus** STRAND.
Neoneurus BENGTSSON.
Lund. Univ. Arsskr. N. F. Avd., pt. 2, vol. 14, 1918, pp. 1, 47.
Pachysoma SZEPLIGETI=**Pachysomoides** STRAND.
Pachysomoides STRAND=**Pachysoma** SZEPLIGETI not MACLEAY.
Int. Ent. Zs. Guben., vol. 10, 1916, p. 137.
Phylacter BENGTSSON.
Lund. Univ. Arsskr. N. F. Avd., pt. 2, vol. 14, pp. 1, 47.
Platyagathis TURNER.
Trans. Ent. Soc. Lond., 1918, pp. 113, 114.
Type.—*P. leaena* TURNER. (Monobasic.)
Pleurodontoplax ENDERLEIN.
Beitr. Landf. Sudwestafrik., vol. 1, 1918, p. 228. Three species.
Polysphinctopsis HABERMEHL.
Zeitschr. wiss. Ins'biol., vol. 13, 1917, p. 167.
Type.—*P. eximia* SCHMIEDEKNECHT. (Monobasic.)
Protofoenus COCKERELL.
Ann. Ent. Soc. Amer., vol. 10, 1917, p. 19.
Type.—*P. swinhoei* Cockerell. (Monobasic.)
Pseudomesocryptus STRAND=**Mesocryptus** SZEPLIGETI not Thomson.
Intern. ent. Zs., vol. 10, 1916, p. 137.
Pseudopimpla HABERMEHL.
Zeitschr. Wiss. Ins'biol., vol. 13, 1917, pp. 164, 165.
Type.—*P. algerica* HABERMEHL. (Monobasic.)
Scammatonotum ENDERLEIN.
Beitr. Landf. Sudwestafrik., vol. 1, 1918, p. 231.
Type.—*S. herero* ENDERLEIN. (Monobasic.)
Scenopathus ENDERLEIN.
Beitr. Landf. Sudwestafrik., vol. 1, 1918, p. 215.
Type.—*S. ferrugineus* ENDERLEIN. (Monobasic.)
Skiapus MORLEY.
Ann. S. Afr. Mus., vol. 17, 1917, p. 220.
Type.—*S. coalescens* MORLEY. (Monobasic.)
Stigmatobracon TURNER.
Trans. Ent. Soc. Lond., 1918, p. 91. Four species.
Sycosoter PICARD and LICHTENSTEIN.
Bull. Soc. Ent. Fr., 1917, p. 285.
Type.—*S. lavagnei* Picard and Lichtenstein.
Trichiohelcon TURNER.
Ann. Nat. Hist., vol. 2, 1918, p. 168.
Type.—*Iphiaulax phoracanthae* Froggatt. (Monobasic.)

NEW SPECIES OF NORTH AMERICAN CLERID BEETLES OF THE GENUS AULICUS.

By Charles Schaeffer,

Of the Museum of the Brooklyn Institute of Arts and Sciences.

Three species of *Aulicus* are at the present time recorded from the United States. These are: *A. nero* Spinola, *monticola* Gorham, and *femoralis* Schaeffer. The first two were originally described from Mexico and the last from Arizona. Of these *nero* was first recorded from the United States by Dr. George H. Horn[1] from specimens collected by William S. Gabb in the coast range of southern California. Later Horn[2] and Wolcott[3] have recorded the species from Texas, New Mexico, Arizona, and Lower California, thus giving *nero* a wide distribution in the southwestern United States. I have seen specimens from these additional localities, and after a close study of them am convinced that several distinct species were confused as *Aulicus nero*.

In the typical species of the genus the claws are simple in both sexes, but in certain species some or all of the claws are toothed or cleft in the male and simple in the female. Such species do not differ otherwise from typical *Aulicus*, and I do not think it advisable to separate them generically on a character which is possessed by one sex alone and which also varies in the number of claws affected in the different species. An aberrant species (*antennatus*), described below, differs from typical *Aulicus* in the form of the two or three antennal joints preceding the three-jointed club, and as below stated, appears to be intermediate between the genera *Aulicus* and *Xenoclerus*.

In the males the intermediate antennal joints are usually shorter and stouter and the club larger than in the females, and the fifth ventral abdominal segment is usually more or less deeply arcuate-emarginate at apex in the former, but truncate in the female.

Some species are more variable in color than others. In all the species the blue markings of the elytra are similar and consist of a sutural vitta, a median and an apical fascia; the rest red or yellow. Of the blue markings the median elytral fascia is especially variable

[1] Trans. Amer. Ent. Soc., vol. 2, 1868, p. 134.
[2] Proc. California Acad. Sci., ser. 2, vol. 4, 1894, p. 331.
[3] Field Mus. of Nat. Hist., Zool. Ser., vol. 7, 1910, p. 365.

and in some specimens of *dentipes* is reduced to a small, rounded spot on each side near suture, while in the type of *nero*, as indicated in the original description, it is entirely absent. The sutural vitta above the median fascia, however, varies much less and differs in form and width in several species, offering a good character for their separation. In some species the blue humeral spot is always present, in others absent, and in one, *femoralis*, may be present or absent. In the females, generally, the blue markings of the elytra are heavier and the coloration of the ventral segments is darker than in the males.

The form of prothorax is similar in all the species and nearly as in our robust species of *Clerus*, but with a much stronger subapical impression, which is very strong at sides and more feeble at middle. The pubescence of the upper side is never very dense and is easily lost. The elytra punctuation seems to be rather constant, but the rugosities between the punctures may vary in the more sparsely punctate forms. The punctuation of the under surface is never dense and is variable even in specimens of the same species.

The species are apparently rare and poorly represented in collections, and without the assistance of the material in other collections very little could have been accomplished. I have studied 92 specimens which are preserved in the following collections and for the loan of which and gift specimens I am greatly indebted to Dr. A. Fenyes, Mr. Warren Knaus, Mr. Charles Liebeck, Dr. E. C. Van Dyke, Prof. H. F. Wickham, American Museum of Natural History (through Dr. F. E Lutz), Academy of Sciences of Philadelphia (through Dr. Henry Skinner), Brooklyn Museum, University of Kansas (through Mr. C. P. Alexander), Massachusetts Agricultural College (through Dr. H. T. Fernald), and the United States National Museum.

Most of the species can be readily separated in the males by good structural characters, but the females are more difficult to distinguish, and I have used coloration largely in the following table. The measurements of the length of the specimens are from the apical margin of prothorax to the apex of the elytra. Four of the six species of the genus included in Wolcott's synoptic table,[4] but which apparently do not occur in the United States, are omitted

TABLE OF NORTH AMERICAN SPECIES OF AULICUS.

1. Head red, prothorax bluish-black at middle, red at sides........................2
   Head and prothorax entirely black or bluish black...............................3
2. Body below and legs black or bluish-black, except the fifth ventral segment, which is red at sides and apex; blue sutural vitta above the median fascia small, sometimes obsolete near base and always much narrower than the red humeral space; claws of male simple; fifth ventral segment of male scarcely emarginate; last dorsal segment subtruncate at apex in the male and broadly rounded in the female....................................*monticola* Gorham.

[4] Can. Ent., 1910, p. 245.

Body below and femora in about basal half or more red, last ventral segment sometimes more or less black; blue sutural vitta above the median fascia always broad and generally as wide or wider than the red humeral space, nearly parallel, at most feebly dilated towards base; males with the inner claw of anterior tarsi toothed and intermediate tarsi more or less distinctly so; posterior claws simple; fifth ventral segment of male moderately deeply arcuate-emarginate; last dorsal segment at apex emarginate at middle in the male, broadly rounded in the female.......................................*femoralis* Schaefter.

3. Antennae with joints six to eight in the male, or seven and eight in the female, triangularly dilated and intermediate in size between the preceding joints and the club, more strongly pronounced in the male than in the female............8

Antennal club abruptly three-jointed.......................................4

4. Sutural vitta above the submedian fascia broadly arcuately dilated near base, subcordiform.......................................5

Sutural vitta never broadly, arcuately dilated near base, the sides subparallel or gradually diverging toward base.......................................6

5. Palpi red; under side bluish-black, except the first three or four ventral segments, which are reddish; legs black or piceous, femora more or less reddish; last ventral segment of male deeply arcuate-emarginate; last dorsal segment of male at apex deeply emarginate at middle; outer claws of the first and second pair and the inner claws of the posterior tarsi distinctly cleft in the male; small species about 6.5 mm.......................................*fissipes*, new species.

Palpi black or piceous; underside and legs bluish-black, ventral segments sometimes narrowly reddish at sides; fifth ventral segment of male broadly emarginate at apex; last dorsal segment subtriangularly emarginate at apex in the male and truncate in the female; claws in both sexes simple; large species, about 8–10 mm.
nigriventris, new species.

6. Large species about 10 mm. long; form rather elongate; blue sutural vitta above the median facia broad and wider than the red humural space; underside and legs bluish-black, ventral segments at sides and fifth at apex largely red, fifth ventral segment of male at apex broadly arcuate-emarginate, and last dorsal feebly emarginate.......................................*nero* Spinola.

Smaller species about 8 mm. long or less; form rather robust; all the claws, or the inner claw of anterior and middle tarsi of male toothed.......................7

7. Elytra densely and relatively coarsely punctate; blue sutural vitta above the median fascia as wide or wider than the red humeral space; humeri with a black spot; body below metallic blue; ventral segments red, but sometimes at sides more or less black; fifth ventral segment in the male deeply arcuate-emarginate at apex; last dorsal segment in the male emarginate at middle and broadly rounded in the female; male with inner claw of anterior and middle tarsi more or less distinctly dentate, posterior claws simple..............*femoralis* Schaeffer.

Elytra relatively sparsely punctate, the punctures well separated; sutural vitta above the median fascia narrow, not as wide as the red humeral space; humeri without black spot; body below blue or bluish-black; all ventral segments at sides and last at apex red; fifth ventral and last dorsal segment of the male scarcely emarginate, last dorsal segment of the female emarginate at apex; all the claws of the male cleft, with the inner tooth shorter than the outer.
dentipes, new species.

8. Body below and legs entirely metallic blue; sutural vitta above the median fascia as wide or wider than the red humeral space; humeral spot absent; fifth ventral segment rather deeply arcuate-emarginate and last dorsal segment rounded at apex in the male, the latter in the female narrowly, subtriangularly emarginate at apex. The inner claw of the front tarsi toothed in the male.
antennatus, new species.

AULICUS MONTICOLA Gorham.

Aulicus monticola GORHAM, Biol. Cent.-Amer., Col., vol. 3, pt. 2, 1882, p. 146, pl. 8, fig. 18.—SCHENKLING, Deutsche Ent. Zeitschrift, 1907, p. 306.—WOLCOTT, Field Mus. Nat. Hist., Zool. Ser., 1910, p. 364; Canad. Entom., vol 42, 1910, p. 245.

Head red, rather sparsely punctate, below with a black median spot, palpi black; antennae black, first joint below and the two following often more or less reddish. Prothorax red with a black median vitta extending along apex and base; surface sparsely punctate. Elytra rather densely and coarsely punctate, intervals between the punctures more or less rugose; median fascia in form of a transversely oval spot; sutural vitta above the median fascia, narrow, either parallel or narrowing obliquely to the scutellum, scarcely attaining the base; dark humeral spot absent. Body beneath and legs black, last ventral segment red, penultimate segment red at sides and black at middle; ventral segments rather sparsely punctate. Claws simple in both sexes. Fifth ventral segment of male feebly emarginate, last dorsal segment subtruncate at apex in the male and broadly rounded in the female; length 8.5–13.5 mm. Alpine, Texas (Wickham); Mexico (Dugès).

I have seen about eighteen specimens of this species from Texas and Mexico, and though the markings are variable, they are less so than in most of the other species.

Generally a species of medium size: the largest measurements above were taken from a Mexican specimen in the collection of the United States National Museum. It is an easily recognizable species.

AULICUS FEMORALIS Schaeffer.

Aulicus femoralis SCHAEFFER, Journ. N. Y. Ent. Soc., vol. 25, 1917, p. 132.

Head red, coarsely and closely punctate; palpi black or piceous rarely reddish; the outer joints of antennae black or piceous, but the club of the male often pale. Prothorax black at middle, apex and base, red at sides; surface moderately punctate, punctures rather coarse. Elytra closely and coarsely punctate, intervals between the punctures rugose; basal part of sutural vitta broad, as wide or wider than the red humeral space, sometimes gradually widening towards base; median vitta more or less constricted at middle and wider laterally and in heavily marked specimens nearly uniting laterally with the apical blue spot; black humeral spot sometimes absent. Underside and all the femora largely red, except apex of the latter and tibiae and tarsi black; fifth ventral segment occasionally more or less blackish and in the male rather deeply arcuate-emarginate at apex, in the female truncate. Last dorsal segment at apex emarginate at middle in the male, broadly rounded in the female. The inner claw of anterior tarsi of the male distinctly dentate, of the middle tarsi less distinctly so, posterior claws simple. Length 6–8 mm.

Arizona: Nogales (Nunenmacher); Santa Rita Mountains, (Wickham); Chiricahua Mountains, (Owen); Coyote Mountains, (Lutz); Tucson, (Horn coll.).

This species is the only one which differs very much in the coloration of head, prothorax, and underside. Specimens taken with the typical form by Doctor Lutz have the head and prothorax above and below, also the mesosternum, metasternum, and all the femora bluish-black; the ventral segments in these are either red or red with black spots at sides; otherwise they do not differ from the typical form.

AULICUS FISSIPES, new species.

Male.—Head black, moderately coarsely punctate, punctures more dense anteriorly and posteriorly than at middle; palpi and antennae pale reddish. Prothorax black, sides moderately arcuate; surface rather sparsely punctate with moderately large punctures; anterior constriction as usual more feeble at middle than at sides. Elytra with moderate, not closely placed punctures, pubescence short and sparse; intervals between these punctures scarcely rugose: common blue sutural vitta broadly, arcuately dilated around the scutellum, narrowing behind to the median fascia but absent between the latter and the apical blue spot; median fascia subtriangular, broadest laterally and narrowing toward suture, anterior margin of this fascia very oblique; apical blue spot divided narrowly for half its length by the red suture. Underside obscure metallic-green; abdomen red, last ventral segment black at middle and deeply, arcuately emarginate at apex; ventral segments rather sparsely punctate; femora red, apically black; tibiae black, but anterior and intermediate pair reddish at apex; tarsi black, the inner claws of the front and middle tarsi and outer claws of hind tarsi distinctly cleft. Last dorsal segment at apex emarginate at middle.

Female.—Palpi pale reddish; antennal joints less stout and the three-jointed club black; elytra more rugose than in the male and the blue median vitta more fully developed, reaching to the lateral margin and about as wide at suture as near lateral margin, anterior margin of vitta laterally strongly angulate, posterior margin less strongly; posterior femora largely black and fourth and fifth ventral segment black; sides red; all the claws simple. Length 6.5 mm.

Type.—Cat. No. 23083, U.S.N.M.

Tucson, Arizona (type, male); San Jose del Cabo, Lower California (female).

Of this species I have seen only two specimens of which the type, preserved in the United States National Museum, was collected on August 24, 1913, by W. D. Pierce on cotton, and the allotype is in the Brooklyn Museum.

The shape of the median fascia in the fully colored female is different from any of the other species which, with the more slender form, entirely pale palpi, basally arcuately dilated sutural vitta, and the inner claws of the male distinctly cleft should make this an easily recognizable species. Occasionally specimens of typical *femoralis* have the palpi more or less reddish and the basal part of the sutural vitta gradually dilated toward base but these differ, besides the more robust form, in having the head, sides of prothorax and the entire underside red.

AULICUS NIGRIVENTRIS, new species.

Head black, coarsely and moderately closely punctate, denser at sides and apex; palpi black; antennae black, the first three or four joints reddish, basal joint black above. Prothorax black, rather sparsely punctate, punctures coarse. Elytra moderately closely punctate; intervals between the punctures more or less rugose; black humeral spot present; sutural vitta towards base rather strongly arcuately dilated; median fascia broad and generally arcuate laterally; underside and legs black with metallic blue tint; ventral segments either entirely bluish-black or very narrowly margined at sides with red; fifth ventral segment of male broadly emarginate at apex and last dorsal segment subtriangularly emarginate, in the female truncate, all the claws of both sexes simple. Length, 8–10 mm.

Mexico (Van Zwaluwenburg); Torreon, Coahuila, Mexico (McKinney and Loftin); Chiricahua Mouutains, Arizona (Owen).

Type and allotype.—Cat. No. 23084, U.S.N.M.

Described from fifteen specimens, as follows: Type a male from Mexico without definite locality and allotype from Torreon, Coahuila, Mexico, June 28, 1918 (McKinney and Loftin) in United States National Museum; paratypes from Mexico (Van Zwaluwenburg) in collections of the Massachusetts Agricultural College, the Brooklyn Museum, and Mr. Chapin, and from the Chiricahua Mountains, Arizona, in the collection of Dr. E. C. Van Dyke.

A large robust species, which varies very little in elytral maculation, though the elytral sculpture is perhaps more variable than in any of our other species. The subcordiform basal part of the sutural vitta is very pronounced and separates this species readily from the other, except *fissipes*, which is a much smaller and less robust insect, with pale palpi, differently colored abdomen, and the male with one claw of all the tarsi distinctly cleft.

AULICUS NERO Spinola.

Aulicus nero Spinola, Essay monogr. sur les Clerites, vol. 1, 1844, p. 330, pl. 27, fig. 5.—Chenu, Encycl. d Hist. Nat. Col., vol. 2, 1860, p. 180.—Schenkling, Bull. Mus. Paris, vol. 8, 1902, p. 325.—Horn, Trans. Amer. Ent. Soc., vol. 2, 1868, p. 134; Proc. California Acad. Sci., ser. 2, vol. 4, 1894, p. 331.—Wolcott, Field Mus. Chicago, Zool. Series, vol. 7, 1910, p. 364.

Head black, coarsely and densely punctuate; palpi black; antennae, including the club, pale, or the outer joints, or only the club, black.

Prothorax black, coarsely and moderately closely punctate. Elytra rather coarsely rugose, punctuation scarcely evident; basal part of sutural vitta broad, of nearly equal width and wider than the red humeral space; humeri without black spot; median vitta normally broad and subtruncate laterally, but becoming much reduced by the extension of the red humeral and postmedian spaces. Underside and legs black, ventral segments at sides and fifth at apex largely red; the latter moderately arcuate-emarginate in the male and all the claws simple. Last dorsal segment at apex at most feebly emarginate. Length, 10 mm. California (Wm. S. Gabb).

Of this species I have seen only five specimens, all males, three from the collection of Dr. George H. Horn and two from Mr. Charles Liebeck, which all came undoubtedly from the same lot, and were, according to Doctor Horn, collected in the coast region of southern California or Lower California.

The specimens do not agree exactly with Spinola's description of the type, in which the median fascia of the elytra is absent, with only the suture and apex blue, the ventral segments red. However, he describes and figures a variation with median fascia, and with this the above specimens agree fairly, and better in form, size, and markings than any other species known to me. Mr. Sigmund Schenkling, who has seen the type and other specimens in the Paris Museum, mentions also the variability of the elytral maculation of this species. There is a possibility that more than one species are included under that name in the Paris Museum; but judging from the variation of the elytral fascia in the five specimens before me, it is possible that specimens occur with the fascia entirely absent. The extent of the red color on the ventral segments is also variable in the few specimens, and specimens may occur in which the black fasciae on the ventral segments are considerably reduced or entirely absent. In consideration of all this I feel more inclined to accept Doctor Horn's identification of these specimens than to give them a new name.

This is one of the few large species of the genus and of more elongate and slender form than *nigriventris*, the only other large species with black head and prothorax, from which the form of the basal part of the sutural vitta, the absence of the black humeral spot, the ventral segments largely red at sides, etc., will separate it. The sides of prothorax are broadly rounded in *nigriventris*, in *nero* more feebly. The punctuation of the elytra in *nero* is feeble, almost absent, but the surface is more or less and rather coarsely rugose.

AULICUS DENTIPES, new species.

Head black, coarsely and moderately closely punctate; palpi black; antennae with the first four or five joints reddish, the outer black. Prothorax black, moderately punctate. Elytra not densely punctate, surface between the punctures more or less distinctly rugose; black humeral spot absent; sutural vitta narrow, smaller than the red humeral space; blue median vitta moderate and more or less arcuate laterally. Body below and legs black, ventral segments at sides and fifth at apex largely red. Fifth ventral and last dorsal segment of the male scarcely emarginate, last dorsal of the female emarginate at apex. All the claws of the male cleft, the inner tooth shorter than the outer, of the female simple. Length, 5.5 mm.

San Diego (Schwarz) and Alpine (Wickham), Texas; Luna (Wickham) and Water Canon (Snow), New Mexico; San Bernardino Ranch (Snow) and Chircahua Mountains (Owen), Arizona; San Diego (Orcutt), California.

Type, allotype, and two paratypes.—Cat. No. 23085, U. S. N. M.

The type, a male, and a female allotype from San Diego, Texas, in the United States National Museum, paratypes in collections of Prof. W. F. Wickham, American Entomological Society, University of Kansas, and Brooklyn Museum.

This is the most widely distributed species of the genus, of which I have seen about thirty specimens. I have also a specimen which possibly was collected in Mexico. It is one of our smallest species, measuring from 5.5 to 8 mm. and of the same form as *femoralis* and *nigriventris*. The blue median fascia is never very strong and reduced in some specimens to a small rounded spot on each elytron near suture, and the sutural vitta does not reach the scutellum in some specimens. The sculpture of the elytra is in some specimens more coarsely rugose than in others, though the punctuation is always rather sparse. The males are readily separated from the other species by having all the claws toothed, or rather cleft, and the females, besides the coloration and markings, by the distinctly emarginate apex of the last dorsal segment. This latter character is rather unusual and is present only in the female of *antennatus*, which differs in antennal and other characters from *dentipes*.

AULICUS ANTENNATUS, new species.

Male.—Head black, rather closely and coarsely punctate; palpi black; antennae black, the first joint below and the second and third reddish; joints three and four rather elongate and subparallel, five slightly dilated, six to ten subtriangularly dilated but joints nine and ten much larger than any of the preceding joints, joint eleven longer than ten, oval, pointed near apex. Prothorax bluish-black, rather sparsely punctate. Elytra sparsely and not coarsely punctate, surface between the punctures more or less rugose; basal part of sutural vitta nearly parallel to suture and wider than the red humeral space; median vitta moderately large, arcuate laterally. Body beneath and legs entirely bluish black, fifth ventral segment rather deeply arcuate-emarginate and last dorsal rounded at apex; the inner claw of the front tarsi distinctly toothed. Length, 6.5 mm.

Female.—Similar to the male except that the blue markings are heavier on the elytra, only the seventh and eighth antennal joints dilated, and the last dorsal segment narrowly but rather deeply emarginate at apex. Length, 6.5 mm.

Palm Spring, California (Fenyes).

Of this very distinct species I have seen only two specimens. The male (type) is in the collection of Professor Wickham and the female (allotype) in the collection of the Brooklyn Museum.

By the structure of the antennae this is rather an aberrant species. The form and also number of the antennal joints is considered important from the generic point of view, and I was at one time inclined to propose a new genus for this species. However, it seems that a number of genera in this family are founded on too slight characters and that a critical revision of the genera of the Cleridae is very much needed and for the present prefer to leave it in this genus.

This species can perhaps be equally well placed as an aberrant member of the genus *Xenoclerus*, which is in all its characters an *Aulicus* but with a five-jointed antennal club and smooth, not pubescent, elytra.

NOTES AND DESCRIPTIONS OF NEOTROPICAL SAWFLIES OF THE SUBFAMILY PERREYIINAE.

By S. A. Rohwer,

Custodian of Hymenoptera, United States National Museum.

In endeavoring to determine some species of the subfamily Perreyiinae considerable difficulty was experienced in placing the various species into the genera recognized by Konow and Schrottky. The more the matter of the genera was considered the more evident it became that the present keys were unsatisfactory and the more convinced the writer became that a satisfactory solution could not be brought about by the study of the literature and the few specimens available. It did seem, however, that if the new forms were to be described it would be necessary to express in a definite manner just what conception was placed on the various genera. To do this the following key, which includes all the Neotropical genera placed by Konow in his tribe Perreyides, has been prepared. Specimens of all of the genera have not been examined and with the exception of *Paraperreyia* Schrottky the genotypes of none have been studied, so it is not certain that all of these genera belong to the subfamily as here limited. This is especially true of *Camptoprium* Spinola, which is described as having long, filiform palpi, the maxillary having six joints and the labial four joints. The long normal jointed palpi make it necessary to refer this genus to the Perreyiinae with doubt, because in all species where the palpi have been examined they are found to be short and with the number of joints reduced. That the separation of *Perreyia* and *Paraperreyia* given by Schrottky (and it is practically the same as that given by Konow for *Perreyia* and *Brachytoma*) is at least open to verification is evidenced by the association of sexes in *Lophyroides tropicus* as given by Cameron.[1] The male of *tropicus*, because of its ramose antennae, would belong to *Perreyia*, while the female, because of the short joints of the flagellum, would go to *Paraperreyia*. Since the genera are not sufficiently well understood, it has been deemed advisable to place the species in genera already described rather than adding new generic names. It is to be noted that the work of Cameron on this group was perhaps

[1] Biol. Centr.-Amer. Hym., vol. 1, 1883, p. 61.

27177—21—Proc.N.M.vol.59——11

more carefully done than that of any other author, and I feel that I have only expanded on the beginning made by him.

In this paper I have listed all of the species in the National Collection and all of the species I have recently studied. Some of the material was borrowed from other museums on the condition that the types be returned. The disposition of the type material is given after each description.

KEY TO GENERA.

1. Antennae with 10 or 11 joints....................2
   Antennae with 12 or more joints....................4
2. Body cylindrical, elongate oval; second intercubitus wanting, therefore only three cubital cells; antennae in male with 11 joints; first flagellar joint elongate, the others dilated at apex; palpi short, the maxillary 4 jointed.... *Tristegus* Konow.
   Body robust, oval; second intercubitus present, therefore with four cubital cells..3
3. Antennae with 10 or 11 joints of nearly equal size; a single joint of the flagellum narrowed at base and dilated apically; hind part of pronotum more or less swollen.................... *Camptoprium* Spinola.
   Antennae of male 10 jointed, of female 10–11 jointed; a single joint of flagellum is conical in the female and funnel-shaped in the male; joints of female sometimes compressed.................... *Decameria* Lepeletier.
4. Maxillary palpi 4 jointed, labial palpi 3 jointed; antennae of male biramose, of female serrate; second recurrent usually received in second cubital cell, but sometimes interstitial or at extreme base of third cubital cell. *Lophyroides* Cameron.
   Maxillary palpi 5 jointed, labial palpi 3 jointed; antennae simple with well-defined joints in both sexes; second recurrent received by the third cubital cell.................... *Heteroperreyia* Schrottky.
   Maxillary palpi 2 jointed, labial palpi 1 jointed; antennae simple with well-defined joints in both sexes; second recurrent usually received by the second cubital, but sometimes interstitial or received at base of third cubital. *Perreyia* Brullé.

Genus TRISTEGUS Konow.

This genus was described by Konow and is known only in the male. The antenna is simple; the head small; and both recurrents are received by the second cubital cell.

Genus CAMPTOPRIUM Spinola.

No species which could be placed in this genus is available, but, as previously suggested, there are certain characters which would indicate that it is not properly placed in the Perreyiinae. The following notes from the original description may be useful: Palpi filiform, the maxillary 6-jointed, the labial 4-jointed; third antennal joint of male longer than fourth and fifth combined; second and third cubital cells each receiving a recurrent vein; head transverse as wide as thorax.

Genus DECAMERIA Lepeletier.

I have followed previous authors in accrediting this genus to Lepeletier; but inasmuch as there is some doubt as to the correctness of this, I have not followed my usual custom and named the subfamily after it, even though it would thus be considerably older than *Perreyia.* Kirby (1882) was the first author to place a species in the genus. The definition of the genus given in the above key is that of Konow, but as far as it goes it agrees with Cameron. The following characters may be added: Palpi short, the maxillary 3-jointed, the labial 1-jointed; third cubital cell receiving the second recurrent close to its base.

DECAMERIA RUFIVENTRIS Cameron.

A single female collected April 21, 1916, at Mount Poas, Costa Rica, by A. Alfaro is in the United States National Museum.

Genus LOPHYROIDES Cameron.

Syn. *Paraperreyia* SCHROTTKY.

Konow, without giving reasons or stating that he knew the genotype of *Perreyia,* sunk *Lophyroides* Cameron as a synonym of *Perreyia.* Whether he was justified in this or not can only be determined by a study of authentic specimens of *P. lepida* Brullé. Until such a comparison can be made I prefer to consider *Lophyroides* Cameron as good genus and use *Perreyia* in the sense which Cameron did.

Judging from the specimens studied, it would seem that it may be possible to divide this genus into two groups on characters found on the antennae. In some species the female has the third joint very greatly lengthened, while in others it is but little longer than the following joint. The value of such characters can, however, only be determined by examination of a number of species and specimens.

LOPHYORIDES GRANDIS (Schrottky).

A female from Sapucay, Paraguay, collected October 12, 1902, agrees so well with the original description that, even though the flagellum is wanting and the length is only 11 mm., there can be but little doubt that it is not Schrottky's species.

LOPHYORIDES MELANGASTRA, new species.

In color seems to be more closely allied to *Brachytoma chalybeata* Moscary, but differs from the description of that species in number of antennal joints, pale mesosternum, dark prescutum and scutum. It does not agree sufficiently well with the descriptions of the males to be likely to be female of any described male.

Female.—Length, 11 mm.; length of anterior wing, 13 mm.; length of antenna, 5 mm. Labrum longer than the clypeus, the anterior margin narrowly rounded; clypeus flat, transverse, the anterior margin truncate; supraclypeal area, broad, trapezoidal in outline, gently convex; distance between eyes at the clypeus only a trifle greater than the length of an eye; middle fovea obsolete; in front of anterior ocellus is a shining, triangularly-shaped depressed area, below which is a narrow depressed area which is triangular and nearer the clypeus on the median line; antennal furrows complete, angular at about middle of frons; postocellar line subequal with ocellocular line, but shorter than the ocelloccipital line; lateral ocelli below the supraorbital line; antennae 12-jointed, longer than head and thorax, first flagellar joint as long as second and third combined, joints two to five diminishing in length, the remaining subequal, with width and length subequal; stigma broadest near base; third cubital slightly longer on radius but shorter on cubitus than second; second recurrent received very near the apex of the second cubital cell; thorax and abdomen shining, polished practically without hair. Black with a faint bluish tinge; sides of prescutum, tegulae, pronotum, mesepisternum, mesosternum, most ol mesepimeron, four anterior coxae, anterior trochanters and femora rufous; underside of anterior tibiae ferrugineous; wings uniformly deep brown with a faint bluish reflection; venation black.

Type locality.—British Guiana.

Described from one female collected in 1908 by J. Rodway.

Type.—In the British Museum of Natural History, London.

LOPHYROIDES MELANOPYGA (Konow).

A single female collected by W. F. H. Rosenberg at Chauchamayo, Peru, agrees perfectly with the original description. The antennae are wanting beyond the seventh joint.

LOPHYROIDES DORSUARIA (Konow).

A single female from Santa Catharine, Brazil, received by the British Museum from the Crowley bequest.

LOPHYORIDES MODESTA, new species.

Apparantly allied to *melanoptera* Perty but is smaller and the thorax is entirely black. The dark wings will distinguish it from *cordoviensis* Norton and the darker legs from *pica* Westwood and *flavipes* Konow.

Male.—Length, 6 mm.; length of anterior wing, 6 mm.; length of antenna, 2.5 mm. Labrum shorter than the clypeus, partly hidden by long whitish hair; clypeus rather short, flat, truncate apically, the surface with separate setigerous punctures; supraclypeal area very gently convex; distance between the eyes at the clypeus distinctly greater than the length of an eye; middle fovea obsolete; a narrow furrow below anterior ocellus; antennal furrows complete; postocellar furrow present, straight; postocellar area strongly convex, twice as long as wide, parted medianly; postocellar line distinctly longer than either the ocellocular or ocelloccipital line; antennae 16-jointed, the third joint nearly as long as four plus five, with only a single apical projection; head and thorax polished and with short gray hair; stigma widest near base; third cubital on radius a little more than half and on cubitus half the length of second; second recurrent interstitial with second intercubitus; hypopygidium broadly truncate with rounded lateral angles. Black; anterior femora and tibiae and intermediate tibiae beneath piceous; wings uniformly dark brown; venation black.

Type locality.—Balzapamba, Equador.

Described from a single male collected by R. Haensch.

Type.—In the Deutschen Entomologischen Museums, Berlin.

LOPHYROIDES FULVA (Moscary).

Five males from two different but indecipherable localities in Peru are assigned to this species. They differ from the brief description given by Moscary in having at least a part of the thorax piceous, but as there is considerable variation in the specimens before me it is not considered advisable to treat these as a different species. In one specimen the clypeus as well as the labrum is yellow, in the others the clypeus is mostly black.

Genus HETEROPERREYIA Schrottky.

I do not know the genotype of this genus and have placed the following species in it largely because of the venation. The original description of the genus makes no mention of the palpi, so I have taken this character from the species here described.

HETEROPERREYIA COSTATA, new species.

In color and general appearance is, judging from the descriptions, more closely allied to *Brachytoma melanopyga* Knoow, but may be distinguished from that species by the yellowish wings, entirely black head, pale tarsi, etc. It is not unlikely that this will prove to be the female of *Brachytoma nigriceps* Westwood, but it differs from the description of that species in the entirely black antennae, black labrum, and uniformly pale thorax.

Female.—Length, 10.5 mm.; length of anterior wing, 10.5 mm. Labrum short rounded apically; clypeus flat, with sparse setigerous punctures, anterior margin broadly, shallowly arcuately emarginate; supralclypeal area strongly raised almost tuberculiform; frontal crest very prominent, slightly broken medianly; middle fovea very large, deep, ellipical; lateral ocelli on low tubercules and directed laterally; postocellar line distinctly shorter than ocellocular line and subequal with the ocelloccipital line; antennal furrows complete; postocellar furrow curved; malar space distinct; antenna longer than the head and thorax, 18-jointed, flagellar joints narrowed at base beneath, the first one-fourth longer than second, the following diminishing in length to eight where they become subequal in length; thorax and abdomen shining; stigma broadest at basal third; third intercubitus opposite end of stigma; third cubital longer than first and second on the radius and distinctly longer than the second on cubitus, receiving second recurrent at basal sixth. Rufo-testaceous; head, apical five tergites and apical sternite black; maxillary palpi testaceous; color of thorax rufo-testaceous of abdomen more yellowish; legs color of thorax; wings yellowish hyaline, dusky beyond end of stigma; venation brown darker apically; costa and stigma yellowish; head and thorax with short blackish hair.

In the paratype the antennae are 17-jointed, the thorax and abdomen are the same color and the black at the apex of the abdomen is indented medianly with yellow; the third cubital is somewhat shorter.

Type locality.—Sao Paulo, Brazil.

Described from one female type collected November 20, 1912, by G. E. Bryant, and one female paratype labeled "Brazil, Coll. Konow."[2]

Type.—In the British Musuem of Natural History, London.

Paratype.—In the Deutschen Entomologischen Museums, Berlin.

Genus PERREYIA Brullé.

It is possible that I am wrong in using this genus as restricted by Cameron, but this can only be decided by a study of genotypes. The species placed in this genus can be divided into smaller groups by characters on the antenna. One of these groups (the one to which *compta* Norton belongs) has a close resemblance to *Decameria* and it may be found advisable to place it nearer to it.

PERREYIA COMPTA Norton.

A single male collected by Frederick Knab at Cordoba, Mexico, June 14, is in the United States National Museum.

PERREYIA UNICOLOR, new species.

Should easily be distinguished by small size, and entirely pale head.

Male.—Length, 5.5 mm.; length of anterior wing, 5.5 mm.; length of antenna, 3.5 mm. Slender, apex of abdomen narrowed; head rather small, strongly receding behind eyes; labrum as long as clypeus, emarginate apically; clypeus, short, flat, truncate apically; supraclypeal area very gently convex; distance between the eyes at the clypeus distinctly greater than the length of an eye; a distinct depression below anterior ocellus so frons look to have two low rounded protruberances; antennal furrows complete, though poorly defined behind ocelli; postocellar furrow obsolete; postocellar line distinctly

[2] Since the above was written I have seen a single female (metatype) from Sao Paulo, Brazil, collected August, 1905. This was sent by H. Luederwaldt, of Museu Paulista, and the specimen returned to that museum. This specimen has 18-jointed antenna and the third cubital cell is short as in the paratype.

shorter than the ocellocular line, subequal with the ocelloccipital line; lateral ocelli tangent to the supraorbital line; antenna a little longer than the head and thorax, 15-jointed, third joint distinctly longer than fourth but not as long as four plus five, intermediate joints somewhat longer than wide, conical in outline; head and thorax polished, without hair; third cubital longer on both radius and cubitus than the second; second recurrent received in third cubital near base; hypopygidium narrow, obtusely rounded apically. Rufous; antennae brownish; obscure brownish spots on pronotum and mesoscutum; legs yellowish; wings uniformly pale brownish; venation pale brown, costa and stigma darker.

In paratype the second recurrent is interstitial with second intercubitus.

Type locality.—Mapir, Bolivia.

Described from two males.

Type.—In the Deutschen Entomologischen Museums, Berlin.

Paratype.—Cat. No. 22590, U.S.N.M.

TERTIARY FOSSIL PLANTS FROM COSTA RICA.

By Edward W. Berry,

Of the Johns Hopkins University, Baltimore, Maryland.

The present contribution is devoted to a small florule collected from the Tertiary of Costa Rica by Dr. Wendell P. Woodring in March, 1917, while in the employ of the Sinclair Oil Company, and now deposited in the United States National Museum.

The collection was made at the northeast border of Talamanca Valley on the west fork of Sheroli Creek, about one-half mile above the forks, there being a waterfall and conglomerate precipice about 100 feet high at the latter locality. In more general terms, the locality is on the southeastern frontier of Costa Rica along the left scarp of the Sixaola Valley, about 30 miles from the Caribbean.

The section at the plant locality comprises a thick basal steeply inclined series of marine fossiliferous shales with thin intercalated sandstones, which have been called the Uscari shales. Overlying these unconformably is a thinner series of sandstones and shales from which the fossil plants were collected, and these beds are overlain unconformably by a conglomerate (the Suretka conglomerate).

The Mollusca collected from the Uscari shales have not yet been studied, so that the lower limit of age of the deposit can not be stated. The flora itself is too small to throw any light on this point, as it is of a type that might well occur in the American Tropics at any horizon between the Oligocene and the Recent. Only one of the species, and that somewhat doubtfully, has been recorded from the Canal Zone, namely, *Hieronymia lehmanni* Engelhardt, of the Caimito formation, which is considered as of Upper Oligocene age. This same species was described originally from Loja, Ecuador, from a locality of unknown age, which I have considered as probably lower Miocene. Two other of the Costa Rican fossil plants have an outside distribution, having been described originally from Santa Ana in the Rio Magdalena Valley, Colombia, also from an unknown, probably Miocene, Tertiary horizon. The age of the Costa Rican plants is undoubtedly Miocene, and I would not be surprised if future work would show that it is younger rather than older Miocene.

At the present time the Caribbean coast is a region of swamps and coastal lagoons, with a heavy rainfall and dense forest cover. At Port Limon rain falls 265 days each year, and the annual rainfall amounts to about 170 inches. The existing flora is essentially the same as that of Panama, with a few Antillean and many South American elements. The virgin forests of the valleys, with their tall trees, many lianas, and epiphytes, have been called by Polakowsky the Hylaea association. It has much in common with Brazil, the Guianas, Venezuela, and Colombia and little with that of Ecuador and the Andean uplands or with that of Mexico and Guatemala. Above 8,000 feet the flora consists of a mixture of peculiar species and those common to the Central American uplands to the north.

The fossil florule—it is not extensive enough to merit the term flora—consists of 12 recognizable species. These comprise a *Heliconia*, two species of pepper (*Piperites*), a fig, an *Anona*, an *Inga*, a *Hieronymia*, a *Büttneria*, and three *Lauraceae*. The collection contains no palms, nor ferns, nor distinctively coastal types. While these peculiarities are believed to be due entirely to accidents of preservation and discovery, the assemblage does not indicate a strand flora but a noncoastal valley flora. It is perhaps needless to remark that it is a typically tropical assemblage, essentially South American in its facies. In addition to the named forms, which represent ten genera, nine families, and nine orders, the collection contains linear parallel-veined monocotyledonous leaves, fragments of undeterminable dicotyledonous genera, and a leafspot fungus. The scarcity of Leguminosae is remarkable, this alliance being represented by a single species of *Inga*—a genus still abundant in the region. The relative abundance of Lauraceae is also worthy of notice.

Class MONOCOTYLEDONAE.

Order PIPERALES.

Family MUSACEAE.

Genus HELICONIA Linnaeus.

HELICONIA, species.

The collection contains small fragments of a large leaf, which undoubtedly represents a Costa Rican Tertiary species of *Heliconia*. The venation is characteristic, but the material is unfortunately inadequate for specific description.

The genus *Heliconia* is exclusively American in the present-day flora, with between 30 and 40 species widely distributed in the American Tropics from the Antilles to Brazil. It is exceedingly common in Central America and the lower Montaña region of Peru and Bolivia, where I have observed it, and probably elsewhere throughout northern South America. *Heliconia* has not previously been recognized in the fossil state, but I have a species as yet unpublished from the late Tertiary of eastern Bolivia, and *Musophyllum elegans* described by Engelhardt from the Tertiary of Santa Ana, Colombia, is present in material collected by C. F. Bowen at Betijaque, Venezuela. The genus *Musophyllum* was founded by Goeppert in 1854 for fossil Musaceae from the Island of Java, and a number of European and American species have subsequently been described. Fossil forms are liable to be confused with the genera *Canna* and *Geonoma* and their allies, but undoubtedly the bulk of the fossil species actually represent the banana. There is no evidence that the existing cultivated species which flourish so prodigiosuly in the American Tropics were ever indigenous in the Western Hemisphere, and I can see no reason for not substituting *Heliconia* for *Musophyllum* in the Tertiary record of tropical America.

Class DICOTYLEDONAE.

Order PIPERALES.

Family PIPERACEAE.

Genus PIPERITES Goeppert.

PIPERITES CORDATUS, new species.

Plate 22, fig. 1.

Description.—Leaves of medium size, approximately equilateral, cordate in general outline, with an acuminate tip, and a not deeply cordate base. Margins entire, full, and evenly rounded. Texture subcoriaceous. Length, about 10 cm. Maximum width, in the lower half of the leaf, about 8 cm. Petiole stout, expanded proximad, about 4.5 cm. long. Primaries seven, from the top of the petiole, diverging at acute angles, all curved including the midrib, stout, prominent on the lower surface of the leaf, acrodrome. Secondaries thin but well marked, arching along the margins and internally mostly transversely percurrent.

This is an exceediugly well-marked species of Piperaceae which finds many similar forms among existing tropical American species of *Piper* and related genera. Since its generic affinity can not be positively demonstrated, it is referred to the genus *Piperites* proposed by Goeppert for fossil leaves of the plants of this family.

This ancient and specifically abundant family has hitherto furnished but few fossil species, its past rarity being thought to be a matter of lack of preservation or discovery, since its extensive modern distribution would seem to indicate that its ancient history was extensive. The fossil species comprise three from the Tertiary of Java, one from the Tertiary of Sumatra, one from the Tertiary of Australia, a sixth from the Upper Cretaceous of the Mississippi embayment region, and a seventh from the Denver formation (basal Eocene) of Colorado. It is apparent that the family has been present in America since Upper Cretaceous times, and the hosts of modern species of the American Tropics would seem to indicate a vigorous evolving Tertiary series of forms. The two species from the Tertiary of Costa Rica are the first later Tertiary forms found in this hemisphere, and I might add that collections made from the high Andes in Bolivia contained a variety and great abundance of leaves of fossil peppers.

Comparisons have been instituted with the leaves of various Menispermaceae, Tiliaceae, Leguminosae, Dioscoreaceae, etc., which suggested analogies with these fossils, and they are found to be clearly referable to the Piperaceae.

Holotype.—Cat. No. 35461, U.S.N.M.

PIPERITES QUINQUECOSTATUS, new species.

Plate 22, fig. 2.

Description.—Leaves of smaller size than in *Piperites cordatus* Berry, cordate in general outline, with an acuminate tip and a more deeply cordate base. Margins entire, full, and evenly rounded. Texture subcoriaceous. Length, about 7 cm. Maximum width, in the lower part of the leaf, about 6.25 cm. Petiole missing. Midrib stouter than the lateral primaries which are two on each side. All are fairly prominent on the under side of the leaf. The lateral primaries are not acrodrome as in the preceding species but join a branch from the upper secondaries. Secondaries thin but well marked, camptodrome. Tertiaries thin forming an open mesh.

The salient features of this species are well shown in the accompanying illustration. It is clearly distinct from the preceding and is less common in the collection. It also may be closely matched by several existing American species.

Holotype—Cat. No. 35462, U.S.N.M.

Order URTICALES.

Family MORACEAE.

Genus FICUS Linnaeus.

FICUS TALAMANCANA. new species,

Plate 23.

Description.—Leaves elliptical in general outline, with an apiculate acuminate tip and a decurrent base, of relatively large size but shorter and wider than the associated leaves of *Anona costaricana.* Margins entire and full. Texture subcoriaceous. Length, ranging from 14 cm. to 16 cm. Maximum width, in the median region, ranging from 5.5 cm. to 7 cm. Petiole stout. Midrib very stout, prominent on the under surface, relatively narrow on the upper surface. Secondaries 8 or 9 subopposite to alternate pairs, diverging from the midrib at wide angles of about 75° to 80°, curving regularly but slightly, and camptodrome in the marginal region. Tertiaries thin, forming an open, prevailingly quadrangular areolation, partly consisting of percurrent nervilles.

These leaves are slightly inequilateral and are readily distinguished from the associated fossil leaves by their general outline, shorter wider form, and apiculate tip. This large-leafed form is the only *Ficus* in the collection and may be readily matched among the very numerous existing species of this genus.

Cotypes.—Cat. Nos. 35463, 35464, U.S.N.M.

Order RANALES.

Family ANONACEAE.

Genus ANONA Linnaeus.

ANONA COSTARICANA, new species.

Plate 24.

Description.—Leaves of large size, somewhat inequilateral and elliptical in general outline, with a bluntly pointed apex and a full wide, eventually somewhat decurrent, base. Margins full, entire, slightly undulate. Texture subcoriaceous. Length, about 17.5 cm. Maximum width, in the median part of leaf, about 6 cm. Petiole short and stout. Midrib stout, curved, channeled above and prominent below. Secondaries stout, about 10 alternate pairs diverge from the midrib at wide angles (55° to 80°), ascending in full even curves and camptodrome in the marginal region. Tertiaries thin forming an open polygonal mesh.

This is an exceedingly well-marked species, comparable to a considerable number of existing American species, among which may be mentioned *A. lutescens* Safford of southern Mexico and Guatemala, *A. jahnii* Safford of Colombia and Venezuela, *A. paludosa* Aublet of French Guiana, *A. marcgravii* Martius of Venezuela to Brazil, *A. montana* Macfadyen of the Antilles, *A. sphaerocarpa* Splitgerder of Panama, and the allied *Raimondia quinduenis* (Humboldt, Bonplant and Kunth) Safford of Colombia and Ecuador.

None of the previously known fossil forms are as large as this species except certain forms from the Wilcox Eocene of the Mississippi embayment. Among these *A. ampla* Berry [1] resembles the Costa Rican species and shows the same open areolation.

Holotype.—Cat. No. 35465, U.S.N.M.

[1] Berry, E. W., U. S. Geol. Surv. Prof. Paper 91, p. 217, pls. 39, 40, 1916.

Order ROSALES.

Family MIMOSACEAE.

Genus INGA Willdenow.

INGA SHEROLIENSIS, new species.

Plate 25, fig. 2.

Description.—Leaflets ovate and somewhat falcate, markedly inequilateral in outline, particularly proximad. Apex acute. Margins entire. Texture subcoriaceous. Length, about 6.5 cm. Maximum width, about 2.25 cm. Petiolule stout, about 6 mm. in length. Midrib curved, stout, and prominent. Secondaries thin, numerous, subparallel, and camptodrome. Tertiaries subparallel with secondaries, close set, connected by fine cross nervilles to form a close areolation.

This is a well-marked species of *Inga*, clearly differentiated from previously described fossil forms but showing considerable resemblance, particularly in the venation, to *Inga reissi* described by Engelhardt [2] from the Tertiary (probably Miocene) of Santa Ana in Colombia. The latter is, however, a somewhat more ovate and more nearly equilateral leaflet.

Several existing species show close similarities to the fossil.

Holotype.—Cat. No. 35466, U.S.N.M.

Order GERANIALES.

Family EUPHORBIACEAE.

Genus HIERONYMIA Allen.

HIERONYMIA LEHMANNI Engelhardt (?).

Hieronymia lehmanni Engelhardt, Uber neue Tertiärpflanzen Süd-Amerikas, Abh. Senck. Naturf. Gesell., vol. 19, p. 11, pl. 2, figs. 1, 2, 1895.—Berry, U. S. Nat. Mus., Bull. 103, p. 36, pl. 16, fig. 3, 1918.

Description.—Leaves broadly elliptical or somewhat deltoid and inequilateral in outline, with a shortly acuminate tip and broadly rounded full lower lateral margins and a very wide, somewhat obliquely truncated base. Length, about 12 cm. Maximum width, in the lower half of the leaf, about 10 cm. Margins entire, full, and rounded. Texture thin but coriaceous. Midrib stout, curved, prominent on the lower surface of the leaf. Secondaries stout, 10 or 11 irregularly spaced pairs, prominent on the lower surface of the leaf; they diverge from the midrib at wide angles which become more acute in the apical part of the leaf; those on the narrower side are more ascending and somewhat straighter than those on the wide side; all are conspicuously camptodrome at some distance from the margin.

[2] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 36, pl. 8, figs. 1, 2; pl. 9, fig. 8, 1895.

Tertiaries thin, mostly percurrent. Areolation of small, isodiametric polygonal meshes well marked on the under side of the leaf.

This rather large leaf is unfortunately represented by fragmentary material just as it was to the southward in the Canal Zone. In some respects its characters suggest a broad *Ficus*, but it seems clearly identical with the species described by Engelhardt in 1895 from the Tertiary of Ecuador. I have, however, queried the determination because of the broken character of the material, although it is somewhat more complete than that from Panama and includes the terminal half of a leaf.

This species was described from the coal-bearing series of the Loja basin in the southern Ecuadorian Andes and was subsequently provisionally identified from the Caimito formation of Panama.

The genus *Hieronymia* comprises about a dozen existing species of shrubs and trees confined to tropical America and rather widely distributed from Mexico to Brazil as well as in the West Indies and is still represented in Central America.

Order MALVALES.

Family STERCULIACEAE.

Genus BÜTTNERIA Linnaeus.

BÜTTNERIA CINNAMOMIFOLIA Engelhardt (?).

Büttneria cinnamomifolia Engelhardt, Abh. Senck. Naturf. Gesell., vol. 19, p. 32, pl. 7, fig. 9, 1895.

Description.—Leaves ovate in general outline, widest below the middle and with an acute apex and base, the latter slightly wider than the former. Margins entire, evenly rounded. Length, about 8.25 cm. Maximum width, about 4 cm. Petiole stout, about 1.5 cm. in length. Midrib stout, prominent. Basal pair of secondaries transformed into pseudoprimaries which diverge from the midrib at an acute angle at the top of the petiole and curve upward subparallel with the lateral margins, joining the normal secondaries about two-thirds of the distance to the apex of the leaf. Normal secondaries 3 pairs in the upper third of the leaf; they diverge from the midrib at a wide angle and are abruptly camptodrome. Tertiaries percurrent within and camptodrome outside the area inclosed by the basal secondaries. Areolation prevailingly quadrangular.

This species was described from the Tertiary (probably Miocene) of Santa Ana, Colombia, and compared with the existing *Buettneria elliptica* Pohl, *B. affinis* Pohl, and *B. laevigata* Schott. Fragments showing the characteristic areolation are contained in the present collection, but as no reasonably complete specimens have been found the identification is queried.

The genus contains about three score existing species of herbaceous or shrubby, mostly climbing, plants largely confined to tropical America but found also in Madagascar, the southeastern Asiatic region, and Malayanasia.

Order THYMELEALES.

Family LAURACEAE.

Genus GOEPPERTIA Nees.

GOEPPERTIA TERTIARIA, new species.

Plate 25, fig. 1.

Description.—Leaves of medium size, elliptical oval in general outline, widest below the middle, with an acute tip and a rounded base. Margins entire, full and evenly rounded. Texture coriaceous. Length, about 12 cm. Maximum width, about 5.75 cm. Petiole missing. Primaries 3, supra basilar, all prominent on the lower surface, midrib stoutest; the laterals diverge from the midrib about 5 mm. above its base at acute angles of about 25°, curving upward. Secondaries comprise a few camptodrome pairs in the tip of the leaf, several broadly curved ascending ones from the outer side of the lateral primaries and an opposite pair from near the base of the midrib. The tertiaries are thin and percurrent or inosculate midway between primaries or secondaries and primaries. Aerolation forms a fine polygonal lauraceous mesh.

This leaf is of a type that has uniformly been referred to the genus *Cinnamomum* except in a few instances in Engelhardt's work upon South American fossil plants. I know of no certain characters for distinguishing certain forms of *Goeppertia* or *Cryptocarya* from *Cinnamomum* and am therefore inconsistent in not adhering to custom. It is a problem which paleobotanists will be obliged to face sooner or later in connection with a great many fossil species which have been referred to *Cinnamomum.* I am influenced by the large number of species of the almost exclusively tropical American tribe Cryptocaryeae which have leaves of the *Cinnamomum* type; in fact, the modern *Cinnamomum camphora* Nees has leaves very much like the present fossil species. It does not have the characters of *Strychnos* nor of the many American Melastomataceae, but is very similar to various species of *Goeppertia*, a genus with numerous species of tropical America, to which region it is confined, and which is sometimes, as by Pax in Engler and Prantl, made a subgenus of *Aydendron* Nees. With the exception of a species from the Chattian of Bohemia, the only fossil forms that have been heretofore recognized comprise one from Colombia and two from southern Chile, and all probably of lower Miocene age.

Holotype.—Cat. No. 35467, U.S.N.M.

Genus NECTANDRA Roland.

NECTANDRA AREOLATA Engelhardt.

Plate 27.

Nectandra areolata ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 29, pl. 6, figs. 1, 2, 1895.

Description.—Leaves of large size, elliptical, acute in general outline, widest in the middle and equally pointed at both ends. Margin entire, slightly undulate. Texture coriaceous. Length, about 18 cm. Maximum width, about 7.5 cm. Petiole short and stout, about 1 cm. in length. Midrib stout and prominent on the lower side of the leaf. Secondaries stout proximad, becoming thin distad, prominent on the lower surface of the leaf; eight to ten somewhat irregularly spaced pairs diverge from the midrib at angles of 45° or more and curve regularly upward, ending in camptodrome arches along the margin. Tertiaries well marked, percurrent. Areolation polygonal.

This species was described by Engelhardt from the Tertiary (probably Miocene) of Santa Ana, Colombia, and compared with the existing *Nectandra gardneri* Meissner. It was based upon rather imperfect type material, more complete specimens being present in the Costa Rica collection. In the account of the Colombian fossil plants, as well as in much of Engelhardt's paleobotanical work, there is an unwarranted differentiation of specific types, and it seems extremely likely that two additional nominal species which this author described from the same outcrop at Santa Ana, Colombia, should be united with his *Nectandra areolata*. These are *Nectandra Reissi* Engelhardt [3] and *Persea coriacea* Engelhardt.[4] Judging by the illustrations of these forms they are not to be differentiated, but as I have only actual specimens of the first I hesitate to go beyond suggesting such a change, which would, of course, require that the aggregate go by the name *coriacea*, which has priority of position in Engelhardt's discussion.

NECTANDRA WOODRINGI, new species.

Plate 26, fig. 1.

Description.—Leaves broadly lanceolate in general outline, widest midway between the apex and the base, narrowing upward to the acuminate tip and downward to the acute base. Margins entire, slightly undulate. Texture coriaceous. Length, about 15.5 cm. Maximum width, about 4.5 cm. Petiole short and stout. Midrib stout, curved, prominent on the lower surface of the leaf. Second-

[3] Englehardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 28, pl. 6, fig. 7, 1895.

[4] Idem., p. 26, pl. 6, figs. 3, 4.

aries stout, prominent; seven or eight alternate pairs diverge from the midrib at angles of about 45°, sweep upward in long ascending curves, and are camptodrome in the marginal region. Tertiaries comprise arches along the margins and prevailingly percurrent veins between the secondaries.

This exceedingly well-marked species is named for the collector, Dr. Wendell P. Woodring. It is most remarkably like the existing *Nectandra antillana* Meissner, a common woodland and river bank form throughout both the Greater and Lesser Antilles. A nature print of a leaf of the latter is introduced beside that of the fossil species for comparison. I have not searched herbaria to determine whether *Nectandra antillana* occurs on the mainland of Central America nor whether there are similar leafed *Nectandras* in the existing flora of Costa Rica, but presumably such is the case.

Among fossil forms the present Costa Rican species stands nearest to *Nectandra antillanafolia* Berry MSS., a rather common form of the Jackson Eocene deposits of Texas. It is also similar to two closely related species of the Wilcox Eocene of the Mississippi embayment region, namely, *Nectandra lancifolia* (Lesquereux) Berry [5] and *Nectandra glenni* Berry.[6]

Holotype.—Cat. No. 35468, U.S.N.M.

INCERTAE SEDIS.

PHYLLITES COSTARICENSIS, new species.

Plate 25, fig. 3,

Description.—It has been impossible to determine the botanical affinity of this very characteristic small leaf. It may be described as follows: Outline broadly spatulate, widest above the middle, with a rounded tip and a broad sessile sheathing base. Margins full and entire. Texture subcoriaceous. Length, about 5.5 cm. Maximum width, about 2.5 cm. Midrib extremely stout and prominent, expanded and flattened at the base. Secondaries subopposite, stout, numerous, and ascending except in the narrowed base, camptodrome. Tertiaries thin, but well marked, percurrent.

This form invites comparisons with a variety of recent forms. In the prominent venation it suggests a juvenile leaf or one in proximity to flowers. It is well marked and easily recognized, and should prove useful for purposes of correlation if subsequent collections are made. It suggests the family Moraceae to me, but I do not feel at all certain on this point.

---

[5] Berry, E. W., U. S. Geol. Survey Prof. Paper 91, p. 308, pl. 85, fig. 2, 1916.

[6] Idem., p. 303, pl. 85, fig. 1.

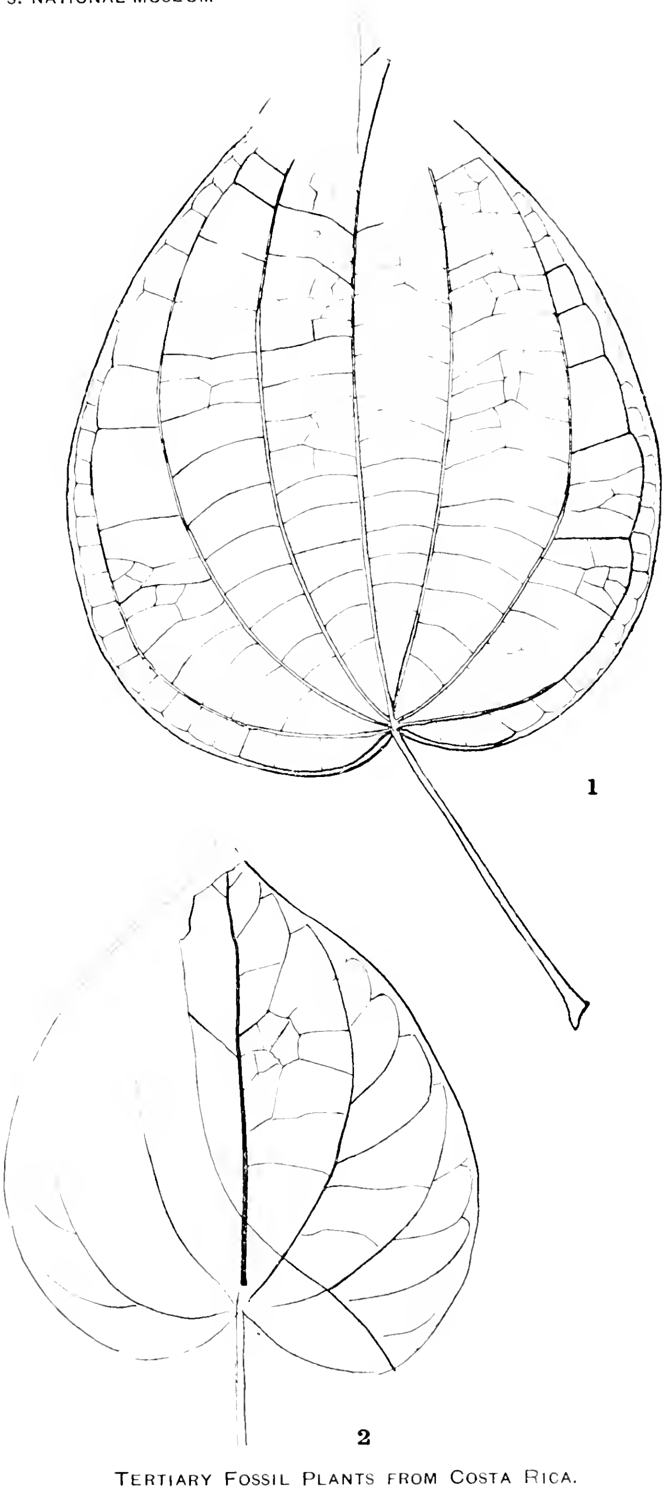
Additional examination of recent material in the United States National Herbarium since the foregoing was written, suggests the probability that the present form should be referred to the genus *Castilloa* Cervantes or to an ancestral form. The modern genus consists of a small number of species of trees found from Mexico to Panama and in Cuba, in which the juvenile leaves frequently lack the cordate base of the mature leaves, and are extremely close to the present fossil form.

Holotype.—Cat. No. 35469, U.S.N.M.

EXPLANATION OF PLATES.

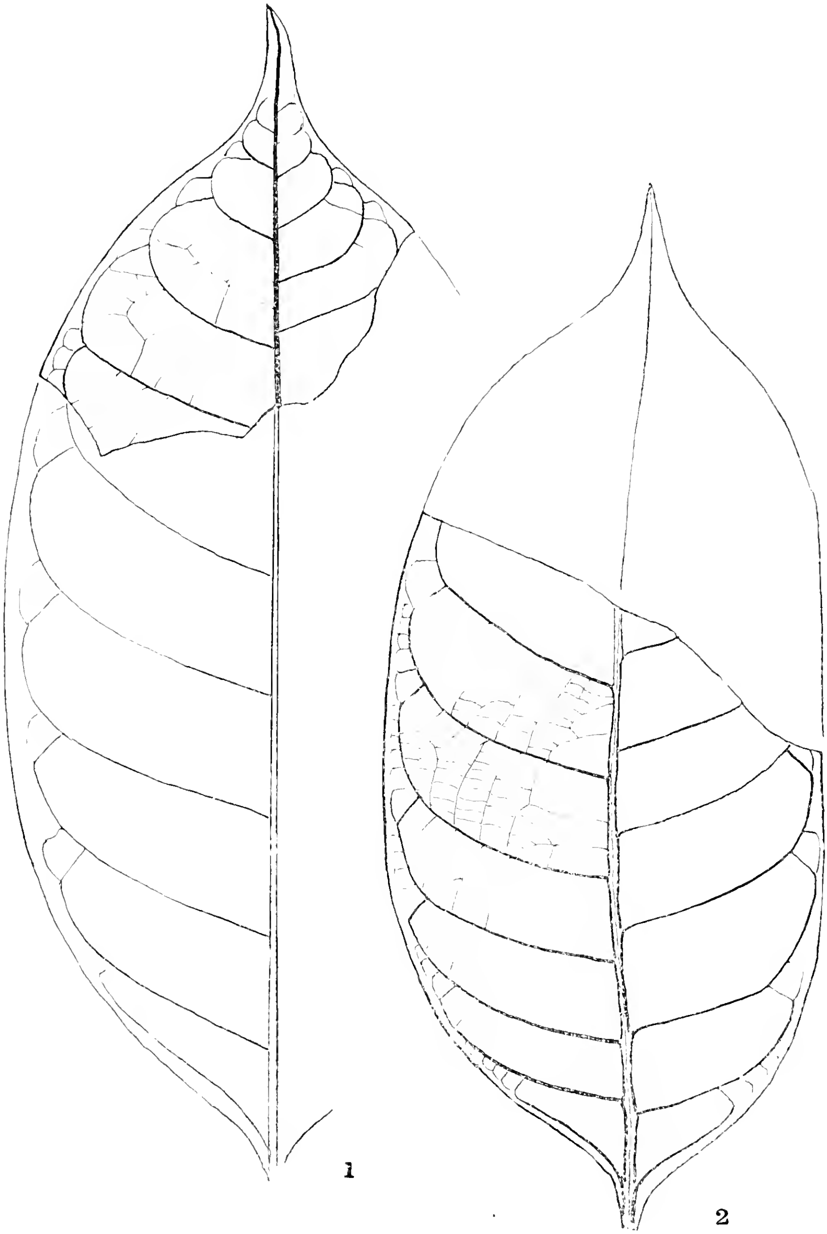
Plate 22.

Fig. 1. *Piperites cordatus* Berry, new species.
2. *Piperites buinquecostatus* Berry, new species.



TERTIARY FOSSIL PLANTS FROM COSTA RICA.

FOR EXPLANATION OF PLATE SEE PAGE 180.



TERTIARY FOSSIL PLANTS FROM COSTA RICA.

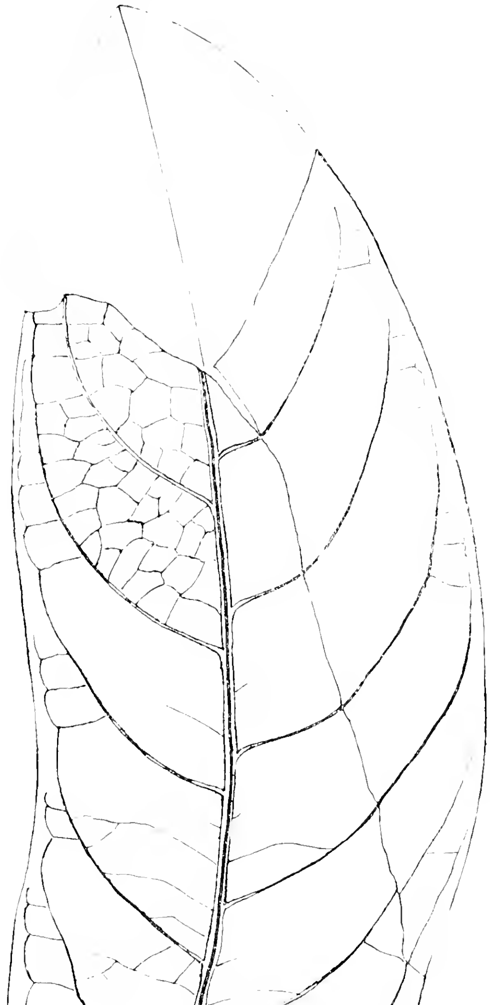
FOR EXPLANATION OF PLATE SEE PAGE 181.

PLATE 23.

FIG. 1. Upper surface and, figure 2, lower surface of *Ficus talamancana* Berry, new species.

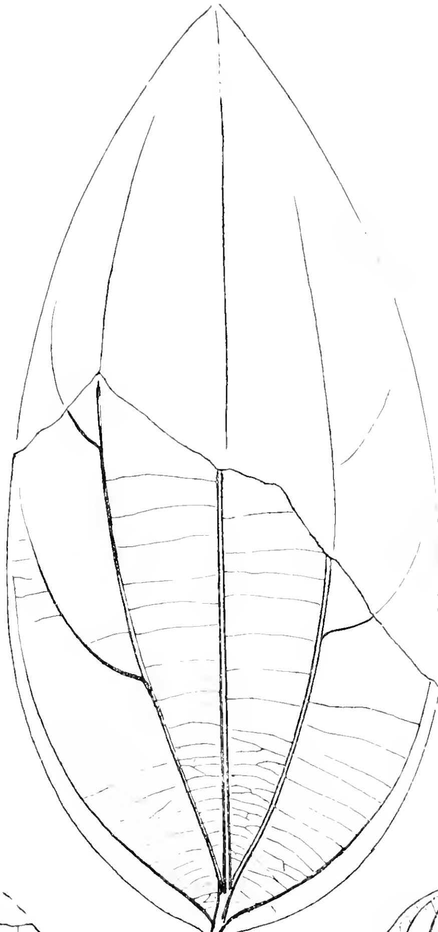
PLATE 24.

Anona costaricana Berry, new species.

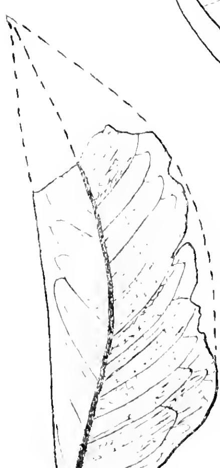


TERTIARY FOSSIL PLANTS FROM COSTA RICA

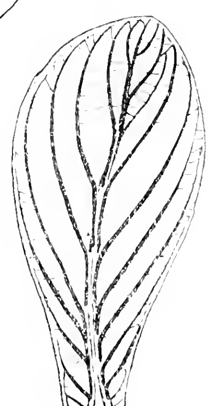
FOR EXPLANATION OF PLATE SEE PAGE 182.



1



2



3

TERTIARY FOSSIL PLANTS FROM COSTA RICA.

FOR EXPLANATION OF PLATE SEE PAGE 183.

PLATE 25.

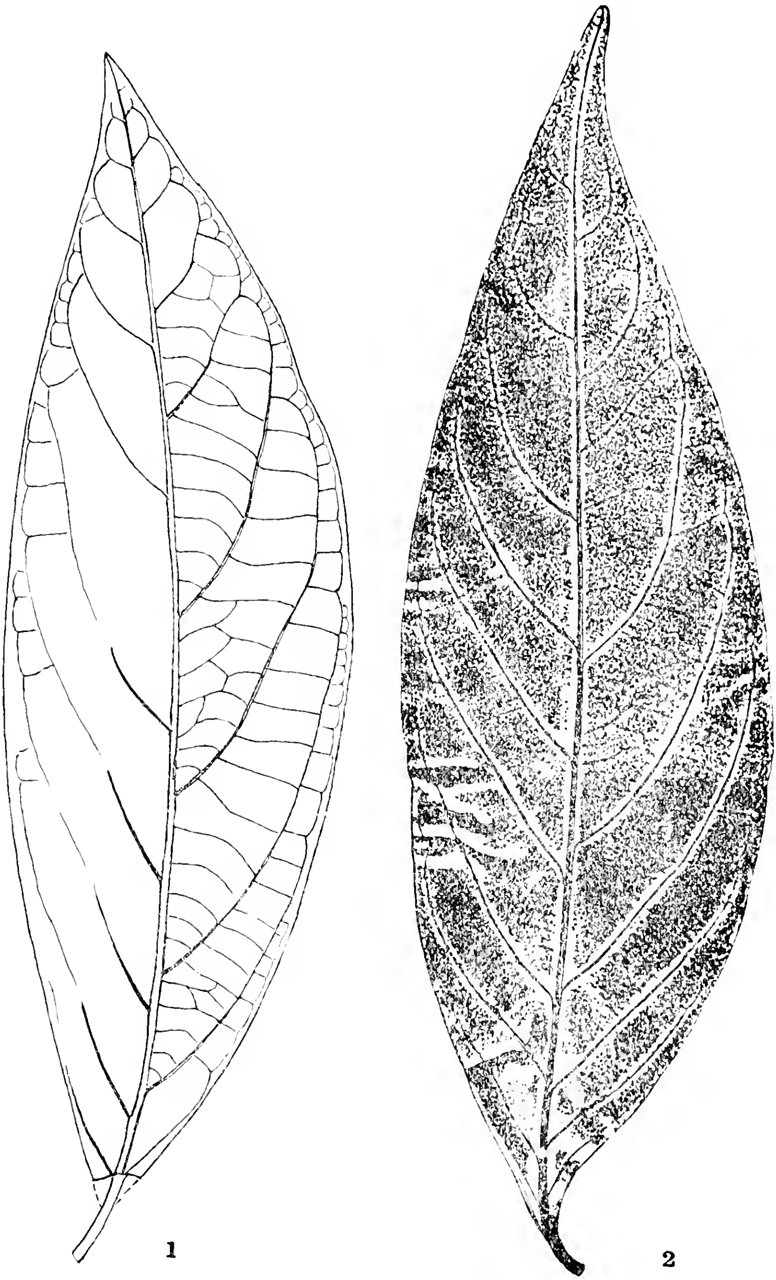
FIG. 1. *Goeppertia tertiaria* Berry, new species.

2. *Inga sheroliensis* Berry, new species.

3. *Phyllites costaricensis* Berry, new species.

PLATE 26.

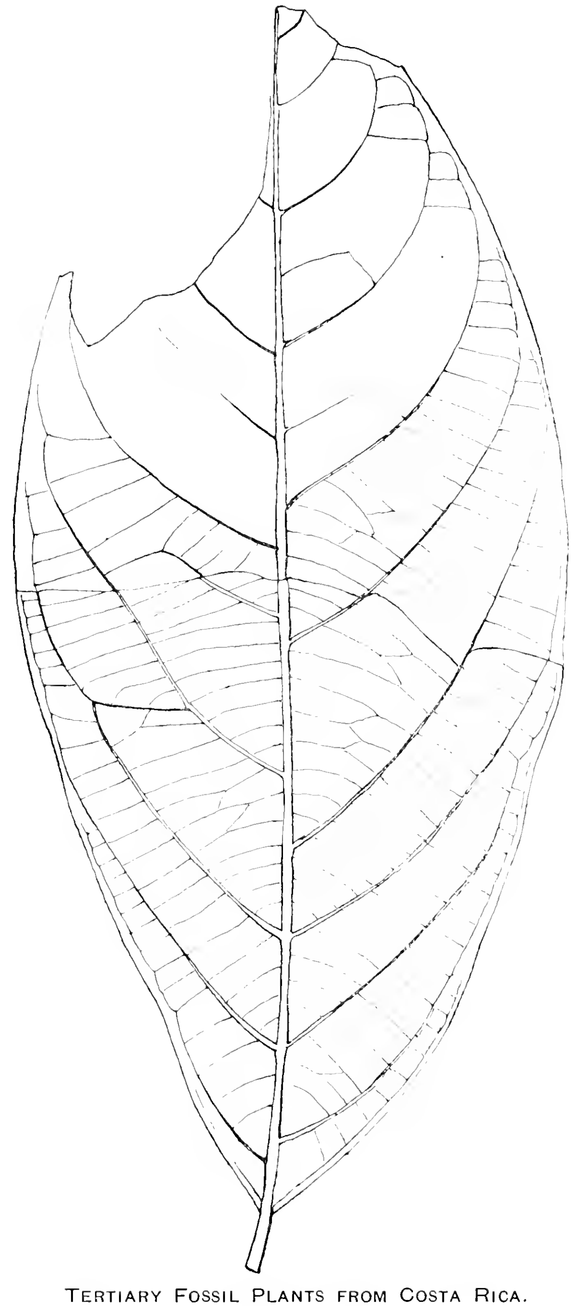
FIG. 1. *Nectandra* woodringi Berry, new species.
2. *Nectandra antillana* Meissner, existing species introduced for comparison.



1 2

TERTIARY FOSSIL PLANTS FROM COSTA RICA.

FOR EXPLANATION OF PLATE SEE PAGE 184.



TERTIARY FOSSIL PLANTS FROM COSTA RICA.

FOR EXPLANATION OF PLATE SEE PAGE 185.

PLATE 27.

Nectandra areolata Engelhardt.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE PRODUCING SUBTERRANEAN GALLS ON OAK.

By Lewis H. Weld,

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

Few galls on the roots of oaks, produced by the hymenopterous family Cynipidae, have ever been described. The present paper is an attempt to bring the American instances together from the scattered literature and to make considerable additions from the records of the bureau and from the writer's personal field notes made in various parts of the United States during a period of several years collecting. To the seven species already described as producing underground galls on oak, twenty-three new species are here added, several changes made in synonomy, revisions given of four of the smaller genera, and field notes included on eight additional subterranean galls not reared as yet, the galls being described without name. The paper is a contribution from the Branch of Forest Insects, Bureau of Entomology, and was undertaken at the suggestion of Mr. S. A. Rohwer, specialist in forest hymenoptera, to whom the writer is indebted for many helpful suggestions and for access to the records and collections in the Division of Forest Insects and in the United States National Museum.

Not all the species mentioned in the subjoined key to the galls have been reared, but in order to make the paper as complete as possible it was thought best to include these unreared galls under the writer's note numbers without generic determination in order that others may be stimulated to look for them and rear them if possible. Many interesting cases of alternation of generations are no doubt connected with galls on the roots of oak, and much biologic work will remain to be done when all the species have been discovered. Little collecting has as yet been done in the Rocky Mountain region, and new host oaks will be found for many of our better known eastern species.

In order better to study the characters used in classification, a specimen of each species here treated was dissected and the parts mounted in balsam.[1] Drawings were then made with a projection

[1] For this purpose alcoholic material can be used or pinned specimens can be relaxed by soaking overnight in 70 per cent alcohol to which some caustic potash has been added. Dissections are then made under binocular, the parts being removed to 70 per cent alcohol in a watch glass. After a few minutes this is drawn off by a fine pipette and replaced by absolute alcohol, then by carbol-xylol, and then parts are mounted in balsam.

microscope and certain ratios determined, using the width of the head as a convenient firmly chitinized base. The length of the mesonotum is the distance from the front margin of the mesoscutum to the hind end of the scutellum, these two remaining connected in a successful dissection. The mesonotum ratio is obtained by dividing this distance by the width of the head. The lengths of antenna and ovipositor were found by stepping dividers set for convenience at 5 mm. along the curves of the drawing and the ratio found by dividing by the width of the head. Some preliminary study indicates that these ratios are fairly constant regardless of the size of the individual in the species. The interocular area ratio can be determined from balsam slide or from pinned specimen by measuring the distance between the compound eyes at level of the antennae and dividing by length of eye as measured by a filar micrometer with a 2-inch or with a two-thirds inch objective.

In this paper galls are not regarded as a part of a species any more than is the work of a leaf-mining lepidopteron or the galleries of an engraver beetle, characteristic as such work may be of the species in question. A gall is a part of a plant and most cecidologists now hesitate to attach to such abnormalities alone binomial Latin names. One can not predict with any certainty what genus is responsible for a gall. Thus when it seems desirable to mention new unreared galls they will be referred to simply by number to avoid adding useless names to the bibliography. The classification of the Cynipidae will progress only by a study of the adults. The more biology that can be correlated the better, and the work of a species may often be the means of its quickest recognition, but the taxonomy of the group must rest on structural characters in the insects themselves. This policy would logically lead to the exclusion of the galls from the type material of a species, and yet it seems desirable that those examples of the work which the author associates with a certain species should be preserved and kept separate for future reference. There is no way to designate them at present except to call them types; and with this meaning only in mind, type labels have been attached to the galls which the author associates with the species. This association is absolutely certain in those rare cases where the identical gall from which the type fly came has been preserved, and this may be properly designated as a type gall. In most cases the association is a matter of judgment. Usually a lot of galls are put in a breeding cage together, and it is impossible to select the one from which a given adult emerged, and in some cases the type flies are cut from galls and the fragments are worthless for purposes of identification and others like them from the same or even different locality are the only ones at hand. They are at best only illustrations of what the author considers to be the work of the species; and with this meaning only attached, they are labeled as cotypes or paratypes in the collection, but they are not listed as type material in the body of the paper or in Museum type book.

In conformity with this view, the authorship of a species must be credited not to the one who first described and named the gall but to the one who first described the maker of the gall.

The number of specimens from which a new species has been described may be seen at the end of each description where the number of specimens measured to get size and range in length is indicated. Type material of all the new species has been deposited in the United States National Museum, and the number of specimens so deposited may be seen under the heading "*Type.*" The balance has been retained by the author for reference or exchange, for in many cases the material is sufficiently abundant so that exchanges can be arranged with other museums or workers. When the type material consists of specimens bred from different hosts or from different localities or consists of both reared and captured specimens, a "type" has been selected and the rest called "paratypes." When the series has been reared from a single polythalamous gall it is obvious that they are of equal value, and here the term "cotype" has been applied. The term "cotype" is also used for a series reared from a lot of monothalamous or polythalamous galls all collected on the same host from one locality. Few errors are likely to arise in this application of the term.

The arrangement of genera here given follows that of Dalla Torre and Kieffer in the 1910 monograph in Das Tierreich (Lief. 24), and their usage has been followed also in numbering the segments of the abdomen, calling the first free tergite of the apparent abdomen the second, the first being fused with the first sternum to form the petiole. The term parapsides is often here used for parapsidal grooves. Figures 23 and 25 are from negatives in the Division of Forest Insects, eastern station: the rest are from photographs by the author. Unless otherwise noted the galls are represented in natural size.

The names used for the oaks are those of the seventh edition of Gray's Manual for the northeastern United States, and for other regions what seemed to be the best names available. Throughout the paper the same name has been consistently applied to a given oak, but the name used may not in all cases be the one on which all botanists would agree. A study of the host relationships of the gall-making Cynipidae will undoubtedly throw light on the relationships of the oaks. Some species attack many oaks and others discriminatingly confine themselves to a single kind. One rootgall-forming species here treated occurs on at least ten species, all in the red oak group, and no doubt will be found on still others. One Californian oak has over forty different galls upon it, none of which occurs on any other oak in that region, so that finding one of these galls the identity of the oak is known at once. A few of these galls occur on a rare oak in southern Arizona and a few on an oak on the Channel Islands, showing, were botanical evidence not at hand, the close relationship of these local and isolated oaks. It is no uncommon thing to find herbarium sheets of oaks wrongly determined, the evidence being a gall accidently included. There is one American oak on which no Cynipid galls have yet been found. The author hopes at some time to be able to make a contribution to the botany of the oaks based on field observations on the galls.

SYNOPSIS OF SUBTERRANEAN CYNIPID GALLS ON OAK.

1. Galls on the true roots.

On small fibrous rootlets:

Single or few in cluster, brown, ellipsoid, 5 mm. in diameter, under large tree in forest, 1–5 cm. underground. *Q. bicolor* ..27. *Callirhytis ellipsoida* Weld, p. 227.

Similar but on *Q. alba* .... 28. *Callirhytis elliptica* Weld, p. 228.

On roots 5–15 mm. in diameter:

Large brown woody, single or agglomerated into irregular masses as big as a man's fist. *Q. stellata* .... 14. *Odontocynips nebulosa* Kieffer, p. 210.

Similar to above but on *Q. lyrata* and *Q. virginiana*.
Probably *No. 14*. See note, p. 211.

Fleshy, fig-shaped, white, in clusters, in spring, drying to a dark brown mass. *Q. virginiana, geminata* .... 35. *Belonocnema treatae* Mayr, p. 238.

2. Underground stem swelling, woody, polythalamous, cells under bark, which is not greatly thickened.

Large abrupt swelling covered with normal bark, at base of sprouts or on small saplings. *Q. agrifolia, californica, wislizeni* .... 41. *Weld No. 1501*, p. 243.

Abrupt, irregularly rounded, 1–3 cm. in diameter, brown, *Q. velutina, marilandica, texana* .... 29. *Eumayria floridana* Ashmead, p. 230.

Similar in size and shape but perhaps fleshy when fresh. Terminal on etiolated sprouts of a deciduous oak in stone pile or under humus, in Colorado, New Mexico. Arizona .... 38. *Weld No. 706*, p. 242.

Similar gall on *Q. emoryi* .... 39. *Weld No. 707*, p. 242.

Slight one-sided enlargement on stems 1 cm. or less in diameter. Cells thin-walled. nested under bark. Adults found in September. *Q. fendleri*. Colorado, New Mexico .... 33. *Compsodryoxenus tenuis* Weld, p. 235.

Similar on larger stems of *Q. gambelii*. Adults found in April. Colorado.
30. *Bassettia tenuana* Weld, p. 232.

Slight spindle-shaped enlargements at base of current year's shoots, in fall. Cells not twice as long as broad, not nested but scattered. *Q. chapmani, stellata*.
34. *Compsodryoxenus humilis* Weld, p. 236.

Similar in external appearance but cells elongated, at least twice as long as broad placed lengthwise. *Q. chapmani* .... 31. *Bassettia floridana* Ashmead, p. 233

3. Cells in thickened bark at crown of tree.

Occurring in large numbers forming swollen areas in the bark:
On main roots of trees of *Q. alba, prinus.*
21. *Callirhytis futilis* (Osten Sacken) (agamic generation), p. 221.
On main roots of tree or where bending limbs touch ground. *Q. chrysolepis.*
17. *Callirhytis hartmani* Weld, p. 214.
At base of sprouts or saplings. *Q. macrocarpa.*
32. *Compsodryoxenus illinoisensis* Weld, p. 234.
Small cells in swollen and distorted bases of sprouts. *Q. breviloba, stellata.*
13. *Xystoteras contorta* Weld, p. 209.
Thin-walled, nested cells in one-sided gradual swelling on small shoots of *Q. fendleri*..See *No. 33*, p. 235.
Similar but on *Q. gambelii* and adults in spring..............See *No. 30*, p. 232.
Occurring in groups of less than a dozen usually, sometimes single:
Ellipsoidal cells protruding abruptly from the bark in rows or groups or single and detachable, sometimes confluent, brown. *Q. catesbaei, myrtifolia, texana.*
23. *Callirhytis ovata* Weld, p. 222.
Cells in thick brown bark, forming a smooth abrupt local swelling of a small area. of one to five square centimeters, number of cells evident from outside. *Q. coccinea, rubra*............................24. *Callirhytis rubida* Weld, p. 224.
Similar local swelling, number of cells not so apparent. *Q. coccinea*............
25. *Callirhytis marginata* Weld, p. 225.

4. Detachable galls at crown (either on main stem or at base of sprouts from stumps or on "runner oak" sprouts).

Single or scattered in small numbers:
Monothalamous—
Hemispherical, rugose to nearly smooth, 10-15 mm. in diameter, leaving a radiating scar when detached, woody when mature. *Q. alba, macrocarpa, bicolor, prinus, stellata, chapmani* 18. *Callirhytis corallosa* Weld, p. 216.
Fleshy, thin-walled, gray, densely short pubescent, spherical or with pointed apex. In spring. *Q. chapmani, margaretta* 12. *Biorhiza ocala* Weld, p. 207.
Small, pointed at apex, shell thin and brittle. *Q. fendleri.* Colorado.
37. *Weld No. 704*, p. 242.
Spherical, 5 mm. in diameter, wall thin, surface brown and pubescent. On a deciduous oak at Las Vegas, New Mexico....40. *Weld No. 708*, p. 243.
Hemispherical, 2-3 cm. in diameter, brown when mature, disintegrating in time leaving a rough cell on bark persisting for years. *Q. wislizeni, californica, agrifolia*..................................See *No. 22*, p. 222.
Oval, brown, on thick bark at crown. *Q. catesbaei, texana, myrtifolia.*
See *No. 23*, p. 222.
Onion-shaped, longitudinally striate, pointed at apex, reddish-brown to white. *Q. rubra, velutina, marilandica, texana*.........See *No. 11*, p. 206.
Polythalamous—
Large, rounded, brown, up to 9 cm. in diameter, when mature like rotten wood inside with many thin-walled brittle cells. *Q. alba, macrocarpa, bicolor, prinus*......................19. *Callirhytis maxima* Weld, p. 217.
Similar to above on *Q. stellata*................Probably *No. 19*, p. 217.
Smooth, brown, 15 mm. in diameter, spongy interior decays leaving a mass of loosely-connected ribbed woody cells. *Q. rubra* 36. Weld *No. 405*, p. 242.
Hemispherical, dense tawny yellow tissue inside with a few cells at base. *Q. chrysolepis*....................................See *No. 26*, p. 226.

In clusters:

When fresh fleshy, pure white, or rosy red at apex, fig-shaped, growing quickly in spring and after insects emerge either rotting or shriveling into a hard but not woody mass. Galls of this sort, producing the sexual generation, seem to be limited to the genera *Trigonaspis* and *Belonocnema*. While the flies differ, it is not possible at present to separate the different kinds of galls except as the host oak and locality may be known. Other hosts for these species listed and other species will no doubt be found—

On *Q. alba, stellata, chapmani*....8. *Trigonaspis radicola* (Ashmead), p. 203.

On *Q. douglasii*....................7. *Trigonaspis obconica* Weld, p. 202.

On *Q. gambelii*, in Santa Catalina Mountains, Arizona.
9. *Trigonaspis fumosa* Weld, p. 204.

On *Q. reticulata* in Santa Catalina Mountains, Arizona..Probably *No. 9*, p. 205.

On roots of an unknown oak in Utah and Colorado.
10. *Trigonaspis pumiliventris* (Bassett), p. 205.

On *Q. virginiana*. Fresh galls probably similar to above and drying to a dark brown hard mass..............................See *No. 35*, p. 238.

On *Q. laceyi*, Texas. Dry galls 5 mm. in diameter, smooth.
42. *Weld No. 407*, p. 242.

On *Q. laceyi* and *virginiana*, surface pubescent......43. *Weld No. 408*, p. 243.

Tissue not so spongy, at least part of gall ultimately becoming brittle or woody and persisting:

Individual galls less than 6 mm. in diameter—

Cluster of 30–100. Cells fig-shaped with a slender stalk, ribbed surface and brittle wall, 6 mm. long by 4 mm. in diameter. *Q. rubra, texana, catesbaei, myrtifolia*....20. *Callirhytis enigma* Weld, p. 219.

On *Q. stellata*. Appearance when fresh unknown. Disintegrates and leaves about 20 hard brittle cells..............Probably *No. 19*, p. 217.

Cluster of scores of elongated angular wedge-shaped cells with rounded ends which decay away. Cluster measures up to 6 cm. in diameter and resembles ear of corn. White when fresh, becoming tan and brittle. *Q. rubra, texana, catesbaei, marilandica, brevifolia, nigra, myrtifolia.*
6. *Dryocosmus favus* Beutenmueller, p. 200.

Onion-shaped, pointed, longitudinally striate, white or rosy when fresh, later tan and brittle. Base of sprouts of *Q. rubra, velutina, texana, marilandica, falcata, laurifolia, catesbaei, brevifolia, myrtifolia.*
11. *Biorhiza caepuliformis* (Beutenmueller), p. 206.

Individual gall, averaging more than 7 mm. in diameter—

Hemispherical cluster up to 8 cm. in diameter, consisting of from 1 to 35 galls, each 2–3 cm. in diameter. White and fleshy, later tan, rough, cavernous within and disintegrating in time, so as to leave a rough cell at base, persisting on bark for years. Monothalamous. *Q. wislizeni, californica, agrifolia.*
22. *Callirhytis apicalis* (Ashmead), p. 222.

Hemispherical cluster of a few galls, measuring up to 3 cm. Tissue of gall dense, tawny yellow. *Q. chrysolepis.*
26. *Callirhytis fulva* Weld, p. 226.

Bullet galls on base of shoots, resembling *Disholcaspis globulus* (Fitch) in appearance and texture. Inner cell distinct and often free—

On *Q. alba*, galls often reddish...3. *Disholcaspis globosa* Weld, p. 196.

On *Q. prinus*........................See note under *No. 3*, p. 197.

On *Q. stellata* and *margaretta*. Galls reddish and becoming wrinkled on surface when dry.
5. *Disholcaspis terrestris* Weld, p. 198.

On *Q. breviloba*..............4. *Disholcaspis brevinota* Weld, p. 197.
On *Q. gambelii.* Larger and more irregular than those of *globulus.*
2. *Disholcaspis lacuna* Weld, p. 195.
Bullet galls of harder texture and no separable inner cell—
Blunt, reddish, 7-8 mm. in diameter. *Q. gambelii.*
1. *Disholcaspis acetabula* Weld, p. 194.
Similar on *Q. grisea, toumeyi, reticulata* and probably other oaks in the Rocky Mountain region..Probably *No. 1.* See note, p. 195.

TRUE STEM GALLS ERRONEOUSLY DESCRIBED AS ROOT GALLS. POLYTHALAMOUS.

Globose, hard, densely granular inside. On *Q. reticulata, arizonica, oblongifolia, toumeyi*................................15. *Andricus rhizoxenus* (Ashmead), p. 211.
Irregularly oblong, grayish, brown, and very hard and granular inside. Large Unknown oak. Mexico................16. *Andricus championi* Ashmead, p. 212.

CAPTURED SPECIES REPORTED IN LITERATURE AS FROM UNKNOWN GALLS ON ROOTS OF OAK.

Biorhiza nigra Fitch. See Ashmead, Trans. Amer. Ent. Soc., vol. 9, Proc., p. 24, and Riley, Science, new ser., vol. 1, p. 462. Later Ashmead placed this species in the genus *Xystoteras.*
Philonix fulvicollis Fitch.
Philonix nigricollis Fitch.

All three species were captured on snow. It is more than probable that they are not from root galls at all, but from leaf galls, as all the species of *Xystoteras* and *Philonix* whose galls are known come from leaf galls, which drop to the ground in late autumn. In several cases the adults are known to emerge in November or December after snow has begun to fly. They are very resistant to cold, are long lived, and oviposit in buds on pleasant days in winter.

Genus DISHOLCASPIS Dalla Torre and Kieffer.

KEY TO THE SPECIES OF DISHOLCASPIS HEREIN MENTIONED.

1. Scutellum not rugose on disk, but lacunose, i. e., with shallow contiguous pits in each of which is a setigerous puncture (best seen in balsam). Rocky Mountain species.. 2
Scutellum rugose, with setigerous punctures.................................. 3
2. Scutellum with shallow median groove on disk, head somewhat angular on sides, malar space striate, face with only a narrow dark transverse band across base of antennae, cubitus distinct............................*acetabula* Weld, p. 194.
Scutellum without median groove, sides of head rounded, malar space not striate, whole face infuscated, cubitus and apex of areolet very pale..*lacuna* Weld, p. 195.
3. Areolet reaching one-fourth way to basal and cubitus nearly reaching basal, the gap being less than length of areolet......................*globosa* Weld, p. 196.
Areolet reaching only one-sixth to one-fifth way to basal, gap between basal and proximal end of cubitus greater than length of areolet...................... 4
4. Mesoscutum distinctly broader than long (length about three-fourths width).
brevinota Weld, p. 197.
Mesoscutum length and breadth subequal or else longer than broad............ 5
5. Ocellar area black, pronotum infuscated on sides, mesopleura with an oblique black line across, mesoscutum infuscated between parapsides clear to scutellum, second abdominal tergite with broad dorsal infuscation, but red on sides.
globulus (Fitch).
6. Ocellar area not infuscated, no black line across sides of pronotum or across mesopleura, the infuscation between parapsides stops abruptly two-thirds way back to scutellum, second abdominal tergite with narrow dorsal black stripe and black on hind margin, sides red........................*terrestris* Weld, p. 198.

1. DISHOLCASPIS ACETABULA, new species.

Plate 28, fig. 1.

Agamic female.—Reddish brown; eyes, ocelli, flagellum, area about parallel lines, areas about lateral lines, base of scutellum, mesosternum, metathorax and propodeum black, abdomen infuscated dorsally. Head finely rugose, face with setigerous punctures and a transverse dark band through base of antennae, clypeus truncate, malar space striate, four-tenths eye, interocular area one and one-third times as broad as high, transfacial line 1.2–1.4 times facial, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third and fourth subequal, 5–12 gradually shorter, last twice as long as preceding. Mesoscutum smooth with setigerous punctures, parapsides deep, smooth, reaching half-way, wider behind, median black area extending two-thirds way back to scutellum, black area about each lateral line. Scutellum granular under lens, in balsam seen to be pitted with shallow contiguous depressions in each of which there is a setigerous puncture, faintly rugose behind, arcuate base opens out on to disk on which is a shallow median longitudinal groove. Propodeum with almost perfect semicircular ridge reaching two-thirds way to upper margin. Legs stout, coxae infuscated, hind femur spindle-shaped, tibia longer than tarsus, claws with tooth. Wings hyaline, veins black, first abscissa of radius angled above middle with spur, areolet reaching one-third and cubitus two-thirds way to basal, surface brown pubescent, margin ciliate. Abdomen smooth and shining, not compressed, second segment making about one-half in living specimen, well-separated patches of pubescence on sides, seventh sparsely pubescent, ventral spine tapering, in balsam twice as long as broad, ovipositor when dissected out over one and one-fifth times length of antenna. Using width of head as a base the length of mesonotum ratio is 1.5–1.6; antenna, 2.35; ovipositor, 2.85–3.0; wing, 4.5–4.8.

Length of 58 pinned specimens ranges from 4.0–5.3 mm. Average, 4.5 mm.

Type.—Cat. No. 22574, U.S.N.M. Forty cotypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—Brownish-red hard bullet galls in clusters at base of small sprouts, hidden by débris. Individual galls are 6–9 mm. in diameter, sessile, somewhat elongated, usually blunt, but sometimes pointed at apex. Surface finely wrinkled in preserved specimens. Interior of dense cellular tissue with a central thick-walled non-separable stony white larval cell. Exit hole in side. Occur in fall.

Type locality.—Colorado Springs, Colorado, in the Garden of the Gods. The writer found old empty galls there June 30, 1915, and fresh galls not yet full grown. On November 14, 1918, Mr. J. H.

Pollock collected these galls on a small oak at Palmer Park, but emergence was almost complete, as only one dead fly was found inside the galls. On August 24, 1919, he collected the galls from which the type flies were obtained and sent in as Hopkins U. S. No. 10781 *i*[1]. They were from Garden of the Gods and then contained pupae. Living flies were cut out of the galls on September 12 and October 3 and 7. The normal emergence is probably in October. The Division of Forest Insects has old galls collected at Manitou in January, 1914, by Mr. B. T. Harvey. The host species of this Colorado material is not determined. But the writer has collected similar galls on *Q. gambelii* on the Sandia Mountains, New Mexico, at 2,933 meters (8,800 feet), and in Arizona at Flagstaff and Williams and in the Santa Catalina and Huachuca Mountains.

Note.—Similar galls have been seen on *Quercus grisea* Liebmann in Sandia Mountains, New Mexico, at Prescott, Arizona, and Alpine, Texas; on *Q. toumeyi* Sargent at Patagonia, Arizona; and on *Q. reticulata* Humboldt, Bonpland, and Kunth in Huachuca Mountains, Arizona.

2. DISHOLCASPIS LACUNA, new species.

Plate 28, fig. 2.

Agamic female.—Reddish-brown to black; eyes and median area on face from ocelli down black; thorax with median black area on mesoscutum tapering to a point on scutellum and two lateral black areas enclosing lateral lines; metathorax, propodeum, and dorsal part of abdomen black. Vestiture whitish. Frons coriaceous, a short median groove below median ocellus and then a ridge to antennae, face pubescent and with coarser sculpture, interocular area from 1.3–1.5 times as broad as high, malar space a trifle less than half eye and equal to ocellocular space, mandibles 2-toothed, palpi 5- and 3-segmented, antennae reddish, filiform, 13-segmented, fourth and fifth equal, 6–11 gradually decreasing, last twice as long as preceding and incompletely divided below middle by a transverse furrow. Mesoscutum smooth with setigerous punctures, the two black, tapering, half-complete parapsides lying in the colored stripes between the median and lateral black areas, parallel and lateral lines smooth and bare. Scutellum in balsam lacunose with a setigerous puncture near front margin of each crescent-shaped depression, arcuate furrow at base smooth and not continuous with steep impressed areas on sides. Propodeum with carinae forming a semicircle almost touching upper margin. Hind leg with femur as broad as coxa, tarsus shorter than tibia, second shorter than fifth, claws with tooth. Wings hyaline with yellowish-brown veins. a brown knot just beyond costal hinge, first abscissa of radius angled, areolet large (its apex and cubitus very pale), surface pale pubescent, margin ciliate. Abdomen smooth and shining, second segment making two-fifths and with large light-colored pubescent areas at base well-separated dorsally, but reaching hind margin at sides, exposed part of seventh pubescent, ventral spine tapering, twice as long as broad, ovipositor when dissected out longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.5; antenna, 2.5; ovipositor, 3.1; wing, 4.3.

Length of 20 pinned specimens, 3.7–5.1 mm. Average, 4.3 mm.

Type.—Cat. No. 22575, U.S.N.M. Ten cotypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—Globular bullet galls in clusters at base of strong sprouts similar to those of *Disholcapsis terrestris* Weld on *Quercus stellata* Wangenheim. When fresh the galls are yellowish tinged with more or less rosy red, fleshy, 12–20 mm. in diameter, often distorted by mutual pressure. Inside there is a distinct but not loose thin-walled white larval cell.

Type locality.—Williams, Arizona. The type galls were collected August 1, 1916, and living adults were cut out of them on September 15, 1916. Similar galls were collected at Flagstaff, July 25, Grand Canyon, July 27, and near Monument Rock in the canyon east of Santa Fe, New Mexico, on July 18. Old galls were seen at Prescott, Arizona, April 14, 1918, and on June 27, 1918, at Soldier Camp in the Santa Catalina Mountains, both old and fresh ones, the latter in all stages of growth, only a few being full grown.

3. DISHOLCASPIS GLOBOSA, new species.

Plate 29, fig. 4.

Agamic female.—Black; first segment of antenna, ring around eye, vertex, two stripes on mesoscutum outside parapsides, basal third of space between parapsides, disk of scutellum except dark spot in center, legs except infuscated coxae, reddish-brown. Head coriaceous on frons with slight median ridge above antennae, faint radiating ridges about mouth, transfacial line 1.4 times facial, interocular area 1.35 times as broad as high, malar space over one-third eye, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third and fourth subequal, 5–12 gradually shorter, last over twice as long as preceding and incompletely divided by a transverse suture below middle so that in some positions it would be counted as 14. Mesoscutum smooth with setigerous punctures, parapsides deep, smooth, broader behind and reaching two-thirds way to front, anterior and parallel lines bare and polished. Scutellum rugose with setigerous punctures, the rugose arcuate furrow at base with two deeper places at sides. Propodeum with semicircular ridge above petiole reaching two-thirds way to upper margin. Wings hyaline, veins brown, first abscissa of radius angled, areolet large, reaching one-fourth distance to basal along prolonged axis of cubitus, cubitus reaching at least two-thirds distance to basal, surface pubescent, margin ciliate, first and second cross-veins slightly clouded. Abdomen smooth and shining, longer than high, second segment making three-fourths with well-separated large pubescent patches on sides, ventral spine tapering, in balsam three times as long as broad, ovipositor when dissected out longer than antenna. Using width of head as base, the length of mesonotum ratio is 1.4–1.5; antenna, 2.5–2.7; ovipositor, 3.4; wing, 4.6–4.8.

Length of 28 pinned specimens, 2.3–5.0 mm. Average, 4.0 mm.

This species is close to *Disholcaspis globulus* (Fitch) from which it may be separated by the following contrasts:

globosa.	*globulus.*
Clypeus distinctly emarginate.	Clypeus almost truncate.
Head rounded laterally.	Head somewhat angular.
Ratio transfacial to facial line less than 1.5.	Ratio between 1.5 and 1.6.
Well developed black spot on disk.	Only trace of spot on disk of scutellum.
Areolet reaching one-fourth way to basal.	Areolet reaching one-sixth to one-fifth way.
Cubitus reaching two-thirds way to basal.	Cubitus reaching one-half way to basal.

Type.—Cat. No. 22576, U.S.N.M. Fourteen cotypes.

Host.—*Quercus alba* Linnaeus.

Gall.—Similar to those of *Disholcaspis globulus* (Fitch) in appearance, but less regular in shape and dark red or sometimes yellowish. They occur in clusters at base of 2–3-year-old sprouts from stumps and are almost always hidden by débris. Scattering small ones are sometimes seen exposed a few inches above the surface. They are closely crowded together about the base of sprouts and there may be from two or three to as many as forty in the cluster. Each is 8–12 mm. in diameter, the interior spongy, with a distinct thin inner shell.

Type locality.—Fort Sheridan, Illinois. The writer has also collected these galls at Highland Park, Ravinia, Evanston, Glen Ellyn, and New Lenox, Illinois; at Ithaca, New York; and at Tuskahoma, Oklahoma. About Chicago the galls have been found containing pupae on September 12, and with adults October 3. Adults emerge in the late October and early November. At Ithaca pupae were found as early as September 1. The American Museum of Natural History has galls from Bartow, New York, collected by E. B. Southwick.

Note.—Similar galls were collected on *Quercus prinus* Linnaeus at East Falls Church, Virginia, August 31, 1919, and contained pupae September 13.

4. DISHOLCASPIS BREVINOTA, new species.

Agamic female.—Red; eyes, ocelli, area inclosing parallel lines, areas inclosing lateral lines black, propodeum, base of scutellum and dorsal part of abdomen infuscated. Head finely rugose, malar space striate, interocular area 1.1–1.3 times as broad as high, malar space less than 0.4 eye, transfacial line 1.5–1.6 times facial, clypeus truncate, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third and fourth subequal, 5–12 gradually shorter, last twice as long as preceding. Pronotum not infuscated on sides. Mesoscutum length to breadth as 21:27, smooth and with setigerous punctures, median black spot around narrow smooth parallel lines bilobed behind and reaching two-thirds way back to scutellum, lateral line areas black, parapsides not reaching over half-way. Scutellum rugose, with arcuate furrow at base in which are deeper places on sides. Propodeum with semicircular ridge above petiole touching upper margin. Mesopleura without oblique dark line across middle. Hind tarsi infuscated but exposed parts of coxae are not. Wings hyaline, veins black, first abscissa of radius angled above middle, areolet reaching one-fifth way to basal, cubitus reaching two-thirds. Abdomen not compressed, second segment infuscated dorsally and on hind margin, pubescent on sides, ovipositor when dissected out one and one-fifth times antenna. Using width of head as a base, the length of mesonotum ratio is 1.39; antenna, 2.2; ovipositor, 2.4; wing, 4.27.

Length of two pinned specimens, 3.9 and 4.1 mm.

Closely related in coloration to *Disholcaspis terrestris* Weld, but separated by the much broader thorax.

Type.—Cat. No. 22577, U.S.N.M. One cotype.

Host.—*Quercus breviloba* Sargent.

Gall.—A bullet gall at base of sprouts similar to those of *Disholcaspis terrestris* Weld on *Quercus stellata* Wangenheim.

Type locality.—Austin, Texas. Collected a few galls October 30, 1917. Cut out three living flies and one pupa November 13. Collected galls also at Boerne, Texas, October 27, and one gall opened on that date contained a pupa which transformed before November 10. The normal emergence is probably in the late fall.

5. DISHOLCASPIS TERRESTRIS, new species.

Plate 28, fig. 3.

Agamic female.—Head, thorax, and legs reddish-brown, but eyes, tip of mandibles, antennae, base of scutellum, metathorax, and propodeum black and black areas inclosing lateral lines and a median black area inclosing parallel lines and reaching back to middle of parapsides. Pubescence tawny. Abdomen very dark clear red, second tergite infuscated dorsally and on hind margin. Head coriaceous with radiating striae on malar space which is about four-tenths of eye and about equal to ocellocular space, interocular area 1.15–1.3 times as broad as high, facial line two-thirds of transfacial, axial four-tenths of transfacial, mandibles 2-toothed, palpi 5- and 3-

segmented, antennae filiform, 13-segmented, fourth and fifth subequal, 6–12 becoming shorter, last twice preceding with transverse suture below middle on one side incompletely separating it into two parts. Mesoscutum only a trifle broader than long, smooth with setigerous punctures, parapsides smooth, deep, wider behind, not extending over half-way, anterior and lateral lines polished black and bare. Scutellum broader than long, length 0.58 the width of head, rugose with setigerous punctures, groove at base also rugose, faintly margined behind. Propodeum with the median distance less than the width of petiolar fossa, with a semicircular ridge above petiole almost touching upper margin. Legs stout, hind femur broader than coxa, tarsus shorter than tibia, second shorter than fifth, claws with tooth. Wings subhyaline with distinct brown veins, second cross-vein slightly clouded, first abscissa of radius angled and with spur, areolet reaching about one-fifth and cubitus slightly over half-way to basal, surface pubescent, margin ciliate. Abdomen smooth and shining, not compressed, longer than high, second segment occupying three-fifths, with two large well-separated pubescent patches nearly reaching hind margin on sides, ventral spine in balsam tapering, over three times as long as broad, ovipositor when dissected out nearly one-third longer than antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.49; antenna, 2.6; ovipositor, 3.6; wing, 4.5.

Length of 89 pinned specimens, 3.8–5.7 mm. Average, 4.8 mm.

Type.—Cat. No. 22578, U.S.N.M. Type and 58 paratypes.

Host.—*Quercus stellata* Wangenheim and *Quercus margaretta* Ashe.

Gall.—Globular bullet galls up to 17 mm. in diameter in clusters on runner sprouts or sprouts from stumps at surface of ground hidden by loose débris. When fresh finely mottled with red, but when dry almost uniformly red and finely wrinkled. Inside is a distinct thin-walled central cell in the center of spongy brown tissue.

Type locality.—Ironton, Missouri. Type galls collected on *Q. stellata*, October 5, 1917, when a few of best developed contained adults and the rest pupae. The flies issued in breeding cage out of doors at Evanston, Illinois, November 6, November 11, and December 1, 1917, and living adults were also found in cage February 19 and March 11, 1918. Galls were also collected at Poplar Bluff, Missouri, October 8, 1917, and 18 flies were found alive in cage on December 18, the thermometer having registered −14° F. on December 10. Collected galls at Webster Groves, Missouri, September 9, 1915, and cut out living adults November 2. Have collected these galls also at Hoxie, Hot Springs, and Texarkana, Arkansas; and at Palestine and Trinity, Texas; Dothan, Alabama; Marianna, Tallahassee and Madison, Florida—all on *Q. stellata*. In the United States National Museum are galls from Shovel Mount, Texas, collected by F. G.

Schaupp on roots of post oak, with the label "Issued Febr. '97," but there are no flies with the galls.

The same species occurs on runner sprouts of *Q. margaretta.* A large number of the galls containing pupae were collected at Ocala, Florida, October 30, 1919, and adults began to issue in the breeding cage in early December. Galls at Green Cove Springs, Florida, contained adults on November 23. Flies from galls on *margaretta* are a little smaller (average of 24 was 4.1 mm.) than those from *stellata* (average of 65 was 5.1 mm.).

Genus DRYOCOSMUS Giraud.

6. DRYOCOSMUS FAVUS Beutenmueller.

Plate 29, figs. 5, 6, 7.

Dryocosmus favus Beutenmueller, Ent. News, vol. 22, 1911, p. 197.—Felt, N. Y. State Mus., Bull. 175, 1915, p. 48; Key to Amer. Ins. Galls, N. Y. State Mus., Bull. 200, 1918, p. 60.

This species was originally described from Louisiana and Pennsylvania from galls on *Quercus rubra* Linnaeus and *Q. coccinea* Muenchhausen. The writer has collected galls on *Q. rubra* in Illinois at River Grove, Willow Springs, Evanston, Winnetka, Ravinia, and Fort Sheridan; and at Ironton, Missouri; Hot Springs, Arkansas; and Plummer Island, Maryland. He has also taken the galls on six other host oaks not previously recorded, as follows:

Q. catesbaei Muenchhausen at Jacksonville, Palatka, Madison, Marianna, Ocala, Clearwater, Florida, and Troy, Alabama.

Q. marilandica Muenchhausen at Marianna, Florida.

Q. nigra Linnaeus at Gainesville, Florida.

Q. brevifolia Sargent at Marianna and St. Petersburg, Florida.

Q. myrtifolia Willdenow at Daytona, Florida.

Q. texana Buckley at Boerne and Kerrville, Texas.

The appearance of the fresh galls has never been described. As many as 400 often occur in a cluster, which may measure 6 cm. in diameter (fig. 6) and is found just at or below the surface of the ground and is usually hidden by débris. The cluster sometimes entirely surrounds the host stem when the latter is not more then 1 cm. in diameter. In the fall about one-half of the clusters found are galls that are just starting in early October or nearly full-grown later in the month and containing larvae and they still contain them as late as November 14 and through the winter. These fresh galls are white and fleshy, smooth on the surface, blunt-pointed at the tip (fig. 5). The other half are white and juicy or just beginning to turn brown. These contain adults as early as September 15 about Chicago, and they were still inside the galls on November 14. These galls were put out of doors in breeding cage and three flies issued by December 1, and on December 28 twenty-seven were found, the thermometer having registered $-14°$ F. in the interval. On the 19th of the next February over 200 were found alive in the cage, which had been buried up in the snow for six weeks without a thaw. On March 12 there were two more out. In Florida pupae were found in galls on October 11, 21, 23, and November 3, and the earliest record of finding adults in the galls was November 20 and the earliest emergence December 1.

The life history suggested from the above data is that the galls start in the autumn and get their full size quickly the first season and that the larvae do not transform until the next autumn when the galls are over a year old. After the larvae transform, the galls soon turn brown, the proximal part about the larval cell becomes hard and brittle, and during the winter the distal fleshy half of the gall becomes converted into soft spongy granular tissue through which the adults can easily chew their way (fig. 7) and it finally decays away entirely leaving the hard wedge-shaped bases containing the cells to persist for years. The adults either emerge in very late autumn or very early spring, and are wonderfully resistant to cold. But if there is an alternating generation it is unknown.

Genus TRIGONASPIS Hartig.

(Sexual generation.)

In the Dalla Torre and Kieffer monograph of 1910 the sexual generation of this genus is represented in the American fauna by only one species, namely, *radicis* Ashmead. Two more are here described and two are here transferred to *Trigonaspis* from other genera.

The galls of this group are all of the same type. They are all white or rosy, fleshy, fig-shaped, polythalamous, in hemispherical clusters at base of tree or stump. They reach maturity quickly in the spring, and with the escape of the winged flies either decay or shrivel up into an unrecognizable hard but not woody dark mass. They can not at present be distinguished except as host oak and locality may be known. Galls of *Belonocnema treatae* Mayr are also of this type but are said to occur in clusters on the small roots away from the trunk of the tree.

KEY TO SEXUAL GENERATION OF TRIGONASPIS

1. Wings with at least 4 distinct dark spots. A red and black species from California..*obconica* Weld, p. 202.
   Wings clear or at most faintly clouded, not spotted. Not red and black....... 2
2. Wing with very faint clouds in apical cell. Female with interocular area at least 1.4 times as broad as high. Hypopygium with spindle-shaped ventral spine..*radicola* (Ashmead), p. 203.
   Wing clear. Female with interocular area not over 1.3 times as broad as high even when measured in widest place. Ventral spine scarcely broadened.......... 3

3. Antennocular space equal to ocellocular. A smoky brown species from Arizona .... *fumosa* Weld, p. 204.
Antennocular space less than ocellocular. Light yellowish brown .... *pumiliventris* (Bassett), p. 205.
=*colorado* (Gillette).
=*radicis* Ashmead.

7. TRIGONASPIS OBCONICA, new species.

Female.—Black with abdomen, legs, clypeus, and scape red, flagellum brownish-red. Head broader than thorax, finely coriaceous, face slightly pubescent, clypeus truncate and protruding, median ridge below antennae, malar groove present, malar space 0.4 eye, ratio of antennocular space to ocellocular as 8 to 13, eyes bare, mandible 2-toothed, antennae 14-segmented, the third longest, last not quite twice preceding, distal third not thinner. Mesoscutum as long as broad, smooth and shining with a few minute hair-bearing punctures seen in balsam mount along the distinct deep smooth percurrent parapsides, no anterior, lateral or median lines. Length of scutellum 0.55 the width of head, rugose with microscopic punctures, margined behind, with two impressed triangular areas on sides, base with transverse arcuate furrow divided by a median longitudinal ridge which runs back one-third the length. Mesopleura smooth and polished except triangular area under wing. Propodeum with two slightly bent ridges inclosing a median area one and a half times as high as broad and smooth in center, spiracular areas somewhat rugose with hair-bearing punctures, spiracles elliptical. Legs with hind tarsi shorter than tibia, third and last segments equal, claws with an obscure tooth at base. Wings large, with distinct brown veins, pubescent and ciliate, notable for a large dark spot in base and three smaller ones in distal end of third cubital cell (R) and a larger fainter one in cell below, clouded around median hinge, cubitus reaching quite to basal, areolet present. Abdomen smooth and polished, longer than high, slightly compressed, second tergite two-thirds the length with slightly pubescent patches on sides, ventral spine in balsam hairy and broadened behind tip, ovipositor when dissected out not quite half length of antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.48; antenna, 2.8–2.9; ovipositor, 1.46; wing, 4.6.

Male.—Antennae 15-segmented, third longest and strongly excavated and thickened at apex, flagellum gradually tapering toward end, last segment shortest, length 4.9 times width of head. Abdomen petioled, compressed, infuscated posteriorly, second segment about half the length.

Range in length of 16 pinned males, 2.4–3.5 mm. Average, 3.2 mm. The two females measured 3.5 and 3.8 mm.

Type.—Cat. No. 22583, U.S.N.M. Female type, allotype, and 10 male paratypes.

Host.—Quercus douglasii Hooker and Arnott.

Gall.—An underground cluster of fleshy white galls at base of stumps similar to galls of *T. radicola* (Ashmead), but with longer and more slender pedicels. After flies emerge the galls decay. In May.

Type locality.—Los Gatos, California. Paratypes from Paso Robles also.

Biology.—Collected at Los Gatos May 14, 1918, when galls contained pupae and exit holes showed where some adults had already emerged. In breeding cages three males issued May 16 and three more on May 17. At Paso Robles on May 6 galls contained larvae and pupae. In cage four adults issued by May 13, six by May 25, and one June 2.

8. TRIGONASPIS RADICOLA (Ashmead).

Plate 30, fig. 8.

Dryophanta radicola Ashmead, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 116, No. 5.—Bridwell, Trans. Kan. Acad. Sci., vol. 16, 1899, p. 204.—Cook, 29th Rept. Dept. Geol. & Nat. Res. Indiana (1904), 1905, p. 836, fig. 29; Proc. Ind. Acad. Sci., (1904), 1905, p. 225.—Beutenmueller, Bull. Amer. Mus. Nat. Hist., vol. 30, 1911, p. 354, pl. 15, figs. 9-10.—Thompson, Cat. Amer. Ins. Galls, 1915, p. 5 and p. 38.—Felt, Key to Amer. Ins. Galls N. Y. St. Mus., Bull. 200, 1918, p. 54, fig. 87, 9-10.

Dryophanta radicicola Dalla Torre and Kieffer, in Wytsman Gen. Ins. Cynipidae, 1902, p. 53, No. 36.

Amphibolips radicola Ashmead, Cook, Ohio Nat., vol. 4, 1904, p. 117, figs. 76 *a* and *b*.

Diplolepis radicola Ashmead, Dalla Torre and Kieffer, Das Tierreich, Lief. 24, 1910, p. 360.

The galls of this species occur in clusters of a dozen or less, bursting out through the bark just below the surface of the ground in places where there is an abundance of humus at the base of tree or stump of *Quercus alba* Linnaeus. They are of white, soft, succulent tissue, rounded at end, but compressed into wedge shapes on sides, sometimes rosy if exposed. They develop rapidly in spring, becoming full grown and maturing the flies in about a month and then decaying. The writer has collected the galls at Miller, Indiana; Winnetka and Fort Sheridan, Illinois. Growing galls can be found in late May and the flies issue June 12-26, although in the late season of 1912 the first to issue came out on June 22, and they continued to come out until July 1. Males issue first. The fact that in 36 cases these galls were found at the base of stumps whose sprouts carried last year's oak-fig galls leads to the suspicion that this may be the alternating sexual generation of the wingless *Biorhiza forticornis* (Walsh). In one case there was failure to find them, and in one they were found where there were no fig galls. The *radicola* adults issuing in June are good fliers and are thought to fly to developing sprouts where they lay eggs and produce the fig galls in the fall. From these wingless adults (all females) issue in winter (in late December or in February and

March in breeding cage) to crawl down to base of same sprouts and lay eggs to produce this *radicola* gall in the spring. This cycle is not proven, and it remains for others to work out the details of the life history. Brodie was the first to suggest a connection between the fig gall and a root gall when in Annals of Report of Clerk Board Forestry, Ontario, 1896 (pp. 114–116), he says *forticornis* burrows into ground finding rootlets a few inches down in which they oviposit and in which are formed subterranean galls, but he does not describe them further. *Radicola* is not on "rootlets," but at base of tree.

In the forest insect collection at the United States National Museum are three males and three females of what seem to be this species reared in March, 1897, at Shovel Mount, Texas, by F. G. Schaupp "on roots of post oak."

9. TRIGONASPIS FUMOSA, new species.

Female.—Dark brown, front legs and thorax lighter. Head broader than thorax, very finely rugose, pubescent on face, clypeus truncate and reflexed, interocular space measured at top less than 1.1 times as broad as high, malar space .43 eye and with malar groove, antennocular space equal to ocellocular, palpi 5– and 3– segmented, mandibles with two sharp teeth, antennae 14-segmented, third longest, last not one and one-half times preceding, distal third not thinner. Pronotum smooth. Mesoscutum smooth and polished with two percurrent parapsides, no trace of lateral or anterior lines and no median although so transparent that the dark space between two underlying muscles might be mistaken for one. Scutellum finely and evenly rugose except for a small polished area on disk, with a few scattered punctures, six-tenths width of head, transverse arcuate furrow at base with faint median ridge, not margined behind, with two impressed areas on sides. Propodeum with two outwardly bent ridges inclosing an area smooth in center nine-tenths as broad as high, narrowed at top to two-thirds its widest width. Spiracular areas rugose, punctate, spiracles elliptical. Mesopleura smooth and polished except for finely striate area above, sparsely pubescent below. Legs pubescent except for bare areas on coxae, hind tarsi shorter than tibiae with second longer than fifth and claws with tooth Wings clear with distinct brown veins, areolet present, surface pubescent except at base, margin ciliate. Abdomen smooth and polished, second segment with scattered pubescence on sides. Ventral spine tapering and in balsam slightly spindle-shaped. Ovipositor when dissected out not three-tenths length of antenna, ovarian eggs well developed. Using width of head as base, the length of mesonotum ratio is 1.46; antenna, 3.6; ovipositor, 1.3; wing, 4.7.

Male.—Thorax and legs darker than in female. Antennae with third segment strongly bent, broken but probably 15-segmented.

Length of six females, 3.4–4.1 mm. Average, 3.9 mm. One male, 3.2 mm.

Type.—Cat. No. 22584, U. S. N. M. Six cotypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—White, fleshy, fig-shaped, polythalamous, in clusters on root at base of tree like those of *T. radicola* (Ashmead). They rot after flies emerge.

Type locality.—Santa Catalina Mountains, Arizona. Galls collected June 27, 1918, on the Mount Bigelow trail near Soldier Camp at an elevation of 2,350 meters. Many adults had already emerged, and flies and pupae were found inside when galls were cut open. One fly was captured on oak at Mount Bigelow lookout tower.[2]

Similar galls were seen in same locality on *Q. reticulata* Humboldt, Bonpland, and Kunth, and adults were emerging on June 26, but unfortunately none were preserved.

10. TRIGONASPIS PUMILIVENTRIS (Bassett).

Dryophanta pumiliventris Bassett, Trans. Amer. Ent. Soc., vol. 17, 1890, p. 69, Male.—Dalla Torre, Cat. Hym., vol. 2, 1893, p. 54.—Dalla Torre and Kieffer, Wytsman Gen. Ins. Cynipidae, 1902, p. 53, No. 34.—Beutenmueller, Bull. Amer. Mus. Nat. Hist., vol. 20, 1904, p. 26; vol. 30, 1911, p. 354.—Thompson, Cat. Amer. Ins. Galls, 1915, pp. 8, 38.—Felt, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 62.

Diplolepis pumiliventris Bassett, Dalla Torre and Kieffer, Das Tierreich, Lief. 24, 1910, p. 361.

Belonocnema colorado Gillette, Ent. News, vol. 4, 1893, p. 210, Female.—Cockerell, Ent. Student, vol. 1, 1900, p. 9.—Dalla Torre and Kieffer, Wytsman Gen. Ins. Hym. Cynipidae, p. 80, No. 1; Das Tierreich, Lief. 24, 1910, p. 725.

Belenocnema colorado Gillette, Beutenmueller, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 279.—Thompson, Cat. Amer. Ins. Galls, 1915, p. 36.

Trigonaspis radicis Ashmead, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 113, No. 1, Male and female.—Cockerell, Ent. Student, vol. 1, 1900, p. 10.—Dalla Torre and Kieffer, Wytsman Gen. Ins. Hym. Cynipidae, 1902, p. 56, No. 6; Das Tierreich, Lief. 24, 1910, p. 397.—Thompson, Cat. Amer. Ins. Galls, 1915, pp. 5, 42.—Felt, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

D. pumiliventris was described from males only and "from an unknown source" although there is a specimen in the American Entomological Society collection marked "cotype" bearing the label "Ct." The galls are described as "shrunken and distorted, probably soft and succulent when fresh, polythalamous, probably on oak." The writer has not seen the types but this description fits almost any preserved root gall of *Trigonaspis* very well. Bassett thought, however, that they were produced in the axils of leaves. Perhaps a branch had been inclosed in the sending to aid in the determination of the host plant and he thought they had fallen from

[2] Since the above was written the writer has seen in the United States National Museum collection a gall cluster with three females and one male from Williams, Arizona, bred in June, 1901 (Barber and Schwarz); one gall and a male (with 15-segmented antennae) from Pecos, New Mexico, bred June 22 (M. Grabham); and a female captured at light June 17, Pecos, New Mexico (Cockerell).

the axils of this twig. Three flies from Bassett are in the United States National Museum from the Ashmead collection, and Ashmead had placed them in the genus *Trigonaspis* in the case. They can not be separated in size, coloration, or sculpture from the males of *radicis* Ashmead. Using the width of the head as a base, the length of mesonotum ratio in *pumiliventris* is 1.5 and 1.6; in *radicis*, 1.5; wing ratio in *pumiliventris*, 5.5 and 5.6; in *radicis*, 5.27; length of antenna ratio in *pumiliventris*, 4.77; in *radicis*, 5.01; third segment of antenna in *pumiliventris* measures 0.61, 0.63, 0.67, 0.69 of width of head; in *radicis*, 0.59, 0.61.

T. radicis was described from one male and four female specimens from Utah, June 20, 1885, the gall being on the roots of an unknown oak. The types are in the United States National Museum together with ten others determined by Ashmead as *radicis* collected by E. A. Schwarz at four different localities in Utah in June, 1893. The writer has twenty males and two females which agree with these. They were taken at Colorado Springs, Colorado, on July 1, 1915, by sweeping on scrub oaks. As the males of these can not be separated from those of *pumiliventris* Bassett, *radicis* becomes a synonym of the older name.

B. colorado was described from a single female captured June 18, 1892, at Dolores, Colorado. Through the kindness of Professor Gillette the writer has been able to examine the type and finds that the front tibiae lack the characteristic spur of a *Belonocnema* and that it is a *Trigonaspis* and can not be separated from the female of *radicis* Ashmead. The head is not widened behind the eyes, the malar space has a groove and is 0.39 length of eye (in types of *radicis*, 0.36–0.40). Claws with tooth. Wing without spots or clouds. Wing ratio, 5.0 (in *radicis*, 4.82). *Mesonotum* ratio, 1.6 (in *radicis*, 1.56). Both have transfacial line about 1.1 times facial. Both have interocular area about 1.1 times as broad as high. Both have antennocular space less than ocellocular. As *radicis* is a synonym of *pumiliventris* based on a comparison of the males, and the female *colorado* agrees with the female of *radicis*, both *radicis* Ashmead and *colorado* Gillette become synonyms of *pumiliventris* Bassett.

Genus BIORHIZA Westwood.

11. BIORHIZA CAEPULIFORMIS (Beutenmueller).

Plate 30, fig. 9.

Andricus caepuliformis BEUTENMUELLER, Ent. News, vol. 22, 1911, pp. 67–70.
Biorhiza caepuliformis Beutenmueller, BEUTENMUELLER, Canad. Ent., vol. 49, 1917, p. 348.— FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 66.

The galls of this species occur singly or in clusters of as many as 30 at the base of vigorous young saplings or sprouts from stumps, usually hidden by débris and often inclosed in a cylindrical case made by ants about the cluster, as the galls give off an exudate when young of which the ants are fond. They burst out through a crack in the bark and when detached leave a characteristic cup-shaped cavity in the bark. Fresh galls are full grown about Chicago by August 1 and contain pupae by September 12 and the adults by October 3. In breeding cages the flies emerged November 23–26 and in greater numbers by December 2. In Florida pupae were seen October 10, 17, and 23, the earliest adults in the galls November 20 and the earliest emergence was December 1. The alternating generation is unknown.

The species was originally described from *Quercus velutina* Lamarck from Indiana. The writer has taken it on *Q. velutina* at Poplar Bluff and Ironton, Missouri; Hot Springs and Texarkana, Arkansas; and Falls Church, Virginia. He has also taken it on eight other host oaks as follows: On *Q. rubra* Linnaeus at Fort Sheridan, Ravinia, Winnetka, Evanston, River Grove, Glenn Ellyn, Willow Springs, and New Lenox, Illinois, and at Tuskahoma, Oklahoma; on *Q. marilandica* Muenchhausen at Hot Springs, Arkansas; Palestine, Texas; and Marianna, Florida. On *Q. texana* Buckley at Boerne and Kerrville, Texas. On *Q. falcata* Michaux at Dothan, Alabama. On *Q. laurifolia* Michaux at Daytona and Gainesville, Florida. On *Q. catesbaei* Michaux at Marianna, Florida. On *Q. brevifolia* Sargent at Marianna, Madison, Jacksonville, Ocala, and Gainesville, Florida. On *Q. myrtifolia* Willdenow at Carrabelle and Daytona, Florida. About Chicago these galls seem to be much more abundant some seasons than others.

From these galls come only agamic females. The antennae were described as 14-segmented. In this case the last is one and three-fourths times the preceding and often bears a more or less distinct transverse suture so that it is sometimes 15-segmented. The galls are largest on *Q. rubra*, and 30 flies from these galls in writer's collection measure 3.9–5.2 mm. Average, 4.6 mm. Using width of head as a base, the length of mesonotum ratio is 1.0; antenna, 2.7–2.9; ovipositor, 4.3–4.7; wing, 2.5–2.6. Ten flies from *Q. laurifolia* galls measure 3.6–4.2 mm. Average, 3.9 mm.

12. BIORHIZA OCALA, new species.

Female.—Head, thorax, and flagellum black; rest of body reddish-brown. Head broader than high, as broad as thorax, cheeks not wider than eyes, malar space about 0.3 eye and without furrow, palpi 5- and 3-segmented, antennae 14-segmented, third longest, fourth 0.7–0.8 third and equal to 1 plus 2, fifth 0.6 third, last one and one-half times preceding, distal third tapering to tip, mandibles three-toothed. Interocular area as broad as high. Mesoscutum smooth and shining with two complete, narrow, smooth parapsides and a few microscopic hairs along grooves. Scutellum rugose with transverse arcuate furrow at base divided by a median ridge which extends back to hind margin, faintly margined behind and overhanging the metathorax. Propodeum with two outwardly curved ridges inclosing a rugose area broader than high and only half as wide at top as at widest part. Spiracular areas rugose. Mesopleura polished except for sparsely pubescent patches above and below. Metapleura rugose with distinct oblique groove above. Legs inconspicuously pubescent, hind tarsi much shorter than tibia, second segment shorter than fifth, claws simple. Wings dusky, with distinct brown veins all of which are margined by clouds especially those forming marginal cell which has clear spot in center, areolet distinct, cubitus reaching basal, surface pubescent, margin ciliate. Abdomen smooth and polished, second tergite with scattered pubescence on sides, making up over two-thirds length, ventral spine in balsam broadened at base and hairy with acuminate apex, ovipositor when dissected out only little over half length of antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.5–1.8; antenna, 2.8; ovipositor, 1.5; wing, 4.1.

Male.—Similar to female in color, malar space one-eighth eye, interocular area three-fourths as broad as high, antennae longer, 15-segmented, third longest and not excavated, rest gradually getting shorter to the last which is shortest, gradually tapering toward end from about fifth, 3.9–4 times width of head. Median longitudinal ridge on scutellum evident only in transverse groove at base. Veins of wing not so heavily clouded as in female.

Range in length of seven females, 4.0–4.8 mm.; average, 4.4 mm. Of eight males, 3.7–4.3 mm.; average, 4 mm.

Type.—Cat. No. 22582, U. S. N. M. Type female, allotype, 3 male and 3 female paratypes.

Host.—*Quercus chapmani* Sargent.

Gall.—A thin-walled, fleshy gall growing singly and sessile on the side of roots which are 5-15 mm. in diameter. Galls are globular or with a point at apex, 4–6 mm. in diameter and covered with a very short dense pubescence, grayish if exposed or pale yellow if buried in the sand. In early spring.

Type locality.—Ocala, Florida. Collected April 17, 1914, when some flies had already emerged and others were cut out of the galls alive. They were not different from several males and females captured on April 17 and 18 at Ocala by sweeping on *Q. chapmani*, and these captured specimens form part of the type series.

Genus XYSTOTERAS Ashmead.

13. XYSTOTERAS CONTORTA, new species.

Plate 30, figs. 10, 11.

Agamic female.—Abdomen and eyes black, rest of body tan, with dorsal part of head and distal part of antennae infuscated. Head broader than thorax, coriaceous, shining, face with setigerous punctures, axial line 0.55 of transfacial, interocular area broader than high, malar space about one-third eye and with groove, ocellocular space longer then antennocular, antennae 13-segmented, first two not stouter than rest, second as long as a fourth. 5–13 gradually incrassated and bearing sense organs, last one and one-half times as long as preceding. Mesoscutum smooth and polished without trace of grooves, broader than long, concave on hind margin and united to scutellum without trace of suture except laterally on scapulae. Scutellum faintly coriaceous, with transverse groove at base in which is a median depression, rounded behind. Propodeum without carinae. Legs pale, hind tarsus shorter than tibia, second shorter than fifth, claws with weak tooth. Wings hardly protruding beyond tip of abdomen and here considered abbreviated but with complete and distinct venation, first abscissa of radius angled and a cloud from angle includes free part of subcosta, areolet complete, cubitus reaching basal, surface pubescent and margin ciliate. Abdomen compressed, broader than long, as long as head and thorax together, second segment making about one-third, ventral spine very short, ovipositor when dissected out one and four-tenths times antenna. Using width of head as a base, the length of mesonotum ratio is 1.0; antenna, 2.2; ovipositor, 3.1; wing, 2.4.

Length of 6 pinned specimens, 1.7–1.8 mm.

The only other described species in this genus is black, and the wings hardly reach base of abdomen. If wings are considered normal, it would run in the key to *Neuroterus*, to which it is not closely related.

Type.—Cat. No. 22585, U.S.N.M. Four cotypes.

Host.—*Quercus breviloba* Sargent, *Quercus stellata* Wangenheim

Gall.—Gnarled woody swellings at base of young sprouts which are only a few millimeters in diameter. Covered with normal bark. Polythalamous.

Type locality.—Austin, Texas. Collected galls on *Q. breviloba* October 30, 1917, both old galls and fresh ones with pupae in. Living adults were cut out on December 12. Collected one gall on *Q. stellata* at Palestine, Texas, October 16, 1917, and cut out one fly December 1.

Genus ODONTOCYNPS Kieffer.

14. ODONTOCYNIPS NEBULOSA Kieffer.

Plate 31, fig. 12.

Odontocynips nebulosa Kieffer, Bull. Laboro. Zool. Portici, vol. 4, 1910, p. 112, Female.—Dalla Torre, in Krancher Ento. Jahrb., 20 Jahrg., 1910, p. 176.—Felt, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.—Beutenmueller, Ent. News, vol. 29, 1918, p. 329.

This new genus and species was described in 1910 from flies only, captured in Georgia by Klug and in Texas by Boll. The types are in the Museum of Zoology, Berlin.

The writer recognized the genus in March, 1917, in specimens from Woodstock, Georgia, bred from a root gall on oak received by Doctor Felt and submitted to William Beutenmueller for examination. The flies agree fairly well with the published description of *nebulosa* Kieffer. As the only description of the gall is the brief characterization by Doctor Felt in 1918 in his Key to American Insect Galls (p. 54) as "Irregular, polythalamous root gall, diameter 3.5 cm. on *Q. minor*," a more extended description may be given here.

Host.—*Quercus stellata* Wangenheim.

Gall.—On the roots of young shoots that come up under larger trees. These shoots are only 30–90 cm. high and often occur in large numbers so that their tangled roots form a mat, and it is on these horizontal roots where the thicket is dense enough to accumulate humus that the galls are found. They occur on roots 5–15 mm. in diameter and are sometimes 5–10 cm. underground. Single galls are globular, 10–13 mm. in diameter, but they are usually aggregated into irregular lobed polythalamous masses as large as a man's fist or 8 cm. in diameter. They are covered with smooth bark, light colored like the normal bark of roots, but brown when dry. They are easily cut when fresh, but very hard and woody when dry. The larval cavities are about 6–8 mm. in diameter and the walls about 2 mm. thick. Exit holes 3 mm. in diameter. They are often attacked by whitish wingless plant lice attended by a pale yellowish ant.

Habitat.—The writer first collected the galls on September 9, 1915, at Webster Groves, Missouri, on *Quercus stellata*. They contained pupae on October 3, and adults October 26, but a few had a thick nutritive layer instead. The galls were buried in soil in greenhouse to determine date of emergence and still contained living flies January 17, 1916, but by March 20 all were gone. On October 4, 1917, the same locality was again visited and only one gall found where they had been very abundant two years before. Collected galls at Hoxie, Arkansas, October 10, 1917, and cut out living flies November 16. At Hot Springs, Arkansas, galls contained pupae on October 12. From others collected at Palestine, Texas, October 16, flies emerged indoors the next spring from February 20 to March 8. Old galls were seen at Marianna, Florida, October 11, 1919.

Agamic female.—The antennae of *nebulosa* are described as 16-segmented, but these are really 15-segmented, the last over twice as long as preceding and incompletely divided by a transverse groove a little below the middle so that in certain positions it would be counted as two.

Note.—Found a similar old gall on *Quercus lyrata* Walter and from it cut out a moldy fly belonging to the genus *Odontocynips;* and it is probably the same species, as these two oaks have many galls in common, but until reared it is better not to publish *lyrata* as a host of *nebulosa.*

At Cuero, Texas, October 23, and Austin, Texas, October 30, similar galls were found on roots of *Quercus virginiana* Miller, and a fragment of an adult in an old gall showed it to be due to an *Odontocynips.* Three stages of the galls were observed: 1, old galls with numerous exit holes where flies had emerged the previous spring; 2, fresh galls containing pupae; 3, fresh galls not distinguishable from the above but containing a thick transparent mass of nutrient material with a barely visible larval cavity. This suggests that the galls take two years to develop. Similar empty galls were seen at Kerrville, Texas, July 21, 1918. Until adults can be reared it is better not to publish *virginiana* as a host of *nebulosa,* however.

Genus ANDRICUS Hartig.

15. ANDRICUS RHIZOXENUS (Ashmead).

Plate 32, fig. 14.

Callirhytis rhizoxenus Ashmead, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 132, No. 35.—Cockerell, Ent. Student, vol. 1, 1900, p. 9.—Thompson, Cat Amer. Ins. Galls, 1918, pp. 5, 30.—Felt, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

Callirhytis rhizoxena Ashmead, Dalla Torre and Kieffer, in Wytsman Gen. Ins. Cynipidae, 1902, p. 67, No. 28; Das Tierreich, Lief. 24, 1910, p. 574.

This species was described as *Callirhytis rhizoxenus* from a gall "on the roots of a live oak at Fort Grant, Arizona." The type gall in the United States National Museum is ellipsoidal, 36 by 22 by 25 mm., smooth on outside, very dark brown, hard and granular inside instead of woody but contains no normal cells or exit holes. The type flies have the tarsal claws with a tooth and run to *Andricus.* They agree with adults the writer has reared from a rougher brownish (not carbonaceous black) gall terminal on twigs of *Quercus oblongifolia* Torrey at Patagonia, Arizona. They were collected July 6, 1918, and contained pupae, the flies issuing by July 19. The types agree also with flies from a similar gall on *Quercus toumeyi* Sargent collected at same time and place and from which living adults were cut out August 21. Similar galls occur also on *Quercus arizonica*

Sargent in this region, but no adults were reared. A smoother gall quite similar to the type of *rhizoxenus* in shape and size and color occurs on *Quercus reticulata* Humboldt, Bonpland, and Kunth (Plate 32, fig. 14) (seen in the Santa Catalina and Huachuca Mountains) but no adults were reared. As these always occur in the lower part of the clump of bushes, within 1 or 2 feet of the ground, terminal on the oak runner sprouts characteristic of this oak, it may well be that it was galls from this oak, occurring under débris perhaps, that were originally collected and described as root galls. The species should be considered as producing a stem gall, not an underground gall, and is treated in this paper merely to clear up the error in the literature.

16. ANDRICUS CHAMPIONI Ashmead.

Plate 31, fig. 13.

Andricus championi Ashmead, Ent. News, vol. 10, 1899, pp. 193–4, gall and female.—Dalla Torre and Kieffer, Wytsman Gen. Ins. Cynipidae, 1902, p. 59, No. 7.—Felt, Key to Amer. Ins. Galls N. Y. St. Mus., Bull. 200, 1918, p. 54.—Kinsey, Bull. Amer. Mus. Nat. Hist., vol. 42, 1920, p. 305.

Cynips ashmeadi Dalla Torre and Kieffer, Das Tierreich, Lief. 24, 1910, p. 440.

Andricus championi Cameron, Crawford, Proc. U. S. Nat. Mus., vol. 48, 1915, p. 580.

Gall only.

Cynips championi Cameron, Biol. Cent.-Amer. Hym., vol. 1, 1883, p. 70, gall only.—Dalla Torre and Kieffer, Wytsman, Gen. Ins. Cynipidae, 1902, p. 60; Das Tierreich, Lief. 24, p. 446, Fig. 190–1.

Cynips championii Cameron, Dalla Torre, Cat. Hym., vol. 2, 1893, p. 67.

The gall was described as a twig gall by Cameron in 1883 from Chiriqui, Mexico, collected by a Mr. Champion. Later Doctor Duges sent specimens of a large woody gall (the largest now preserved measures 11 by 8 by 7 cm.) to Doctor Ashmead, who curiously enough considered it to be a root gall and as such described it together with the maker under the name of *Andricus championi*. It is a true *Andricus*, and the three types are in the United States National Museum together with the nine galls and eight other flies from the same locality not labeled as types. Thinking that this was a root gall and hence different from Cameron's, the authors of the Tierreich monograph gave it the new name of *ashmeadi*. As Crawford has pointed out, however, Doctor Duges later wrote to Dr. L. O. Howard that he had never sent any root galls to Ashmead, and the specimens in the National Museum plainly show that they are twig galls, and without doubt they are the same as those described by Cameron. The species should then take the name which Ashmead gave it and be credited to him, as he was the first to rear and describe the maker.

In August, 1910, the writer saw these galls (Plate 31, fig. 13) fairly common on the oaks which grow on the higher slopes of the mountains at the west end of Lake Chapala above San Pedro in the State of Jalisco, Mexico. The fresh galls were only partly grown and although solid, were easily cut with a knife. They were grayish in color and the surface quite smooth, usually terminal on branches of large spreading trees. The old galls are harder, darker, and rougher and seem to persist on the tree for years. The largest gall seen was given to the writer by Mr. Dwight R. Furness who collected it near Ocotlan, Jalisco. It measures 16 by 12 cm. and is thus about twice as large as the specimen before Doctor Ashmead, which he called "the largest oak gall in the world." This species is here included merely because it has been erroneously considered to be a root gall.

Genus CALLIRHYTIS Foerster.

As here treated this genus is distinguished from *Andricus* Hartig by the absence of a tooth on the tarsal claw, thus following the interpretation of Mayr and the European writers. Ashmead in his key[3] reversed this interpretation, but a specimen of *Andricus trilineatus* Hartig, the genotype of *Andricus,* sent by Mayr to the United States National Museum, when dissected and parts mounted in balsam shows a distinct tooth on the tarsal claw, proving Ashmead in error. Whether the genotype of *Callirhytis* had a tooth on claw or not is not definitely known.

As thus understood, this large genus contains a very varied assortment of species in which further study will probably segregate certain groups under new names. Even in the few species here treated the first three form a group quite distinct from the others.

KEY TO THE ROOT-GALL-FORMING SPECIES.

1. Head and thorax uniformly covered with dense pubescence as in *Disholcaspis* . 2
   Pubescence dense only on local areas on head or thorax, or sparse and not hiding sculpture, or bare.......... 4
2. Antennae 16–17 segmented, first and third subequal, California *hartmani* Weld, p. 214.
   Antennae 13–15 segmented, third as long as first and second combined........ 3
3. Pubescent area on sides of second abdominal tergite extending almost to hind margin. Antennae 13-segmented with last nearly twice preceding or 14-segmented and last only slightly longer than preceding. *corallosa* Weld, p. 216.
   Pubescent area on second abdominal tergite reaching only two-thirds way to hind margin. Antennae 14-segmented with last twice preceding and sometimes incompletely subdivided.......... *maxima* Weld, p. 217.
4. Mesoscutum shining, alutaceous or coriaceous but no part rugose, with or without setigerous punctures.......... 5
   Mesoscutum more or less rugose at least on some part and if coriaceous dull.... 9
5. Scutellum disk almost flat, the septum between pits as broad as a parapside and lying in the same plane as the mesoscutum which is unusually flat or low-arched. Head seen from above stout, its length fully half its width......... 6
   Scutellum disk normally convex, the septum between pits not broad or in same plane as mesoscutum which is normally arched. Head seen from above more lunate, its length less than half its width.......... 7

[3] 1903, Psyche, vol 10, pp. 154–5.

6. Antennae arising below level of the middle of eye, reaching beyond tip of scutellum, 15-segmented, length at least twice width of head, last segment of flagellum stoutest. Mesoscutum highly polished and beautifully punctate. Abdomen ovate, ventral spine inconspicuous and not longer than broad. Size, 3.5–4.1 mm..*enigma* Weld, p. 219.
   Antennae arising at level of middle of eye, not reaching base of scutellum, length less than twice width of head, 14-segmented, last segment of flagellum not the stoutest, flagellum tapering toward tip. Abdomen truncate, ventral spine prominent and four times as long as broad. Size, 2.0–3.8 mm.
   futilis (Osten Sacken) (agamic gen.), p. 221.
7. Mesopleura mostly highly polished. Size, 5.0–7. 5 mm. California.
   apicalis (Ashmead), p. 222.
   Mesopleura not polished, sculptured..8
8. Whole body brownish red, pits deep and shining, mesopleura finely rugose without parallel ridges..*ovata* Weld, p. 222.
   Head and thorax dark red to black, pits rugose, not shining, mesopleura with closely parallel ridges..*rubida* Weld, p. 224.
9. Head and thorax black..*marginata* Weld, p. 225.
   Head and thorax not black..10
10. Antennae at least two and one-half times width of head, pedicel not as long as third segment. Maxillary palpi 5-segmented. Pits of scutellum longer than broad, opening out on to disk. California..............*fulva* Weld, p. 226.
   Antennae not twice width of head, pedicel as long or longer than third. Maxillary palpi 4-segmented. Pits normal..11
11. Basal two-thirds of second abdominal tergite black. Anterior lines black. Base of scutellum including pits black. Veins in distal half of wing distinct. Distal two-thirds of antennae infuscated..................*ellipsoida* Weld, p. 227.
   Whole of second abdominal tergite red. Anterior lines at most slightly infuscated. Only margins of pits infuscated. Veins in distal half of wing pale. Antennae not infuscated..*elliptica* Weld, p. 228.

17. CALLIRHYTIS HARTMANI, new species.

Plate 32, fig. 15.

Female.—Head and thorax yellowish, often more or less infuscated, with eyes, ocelli, antennae, anterior and lateral lines on mesoscutum, base of scutellum, metathorax, tibiae, and tarsi piceous or almost black; abdomen red and black. Head, except frons, and thorax clothed with dense whitish pubescence as in *Disholcaspis*. Head wider than thorax, granular, finely rugose on frons and a few fine striae on malar space, interocular area 1.4–1.6 times as broad as high, malar space slightly more than half eye, antennocular space less than ocellocular, mandibles 2-toothed, palpi 5-and 3-segmented, antennae 17-segmented, tapering gradually from about tenth to tip, first longest, second half of first, third slightly shorter than first, rest gradually shorter to sixteenth which is hardly longer than wide, last but trifle longer than preceding. Mesocutum in balsam longer than broad, smooth with setigerous punctures, parapsides deep, widened behind, not reaching to anterior lines but showing again at front margin, anterior and lateral lines enclosed in dark field, median groove a mere notch on hind margin. Scutellum broader than long, truncate and becoming rugose behind, slightly margined on sides, the two smooth quadrate, shallow foveae at base obscured by pubescence. Propodeum with two stout parallel carinae inclosing a smooth and nearly square area. Legs with hind tarsus shorter than tibia, second and fifth subequal, tarsal claws simple. Wings with distinct brown veins, third abscissa of subcosta straight not reaching margin, first abscissa of radius angled and with spur, areolet complete but small reaching only one-tenth way to basal, cubitus almost reaching basal, surface short brown pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and shining, not compressed, second segment occupying over seven-tenths with two triangular densely pubescent patches on sides at base and basal two-thirds black. Ventral spine tapering, in balsam twice as long as broad. Ovipositor when dissected out shorter than antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.4; antenna, 1.75; ovipositor, 1.67; wing, 4.0.

Range in length of 36 pinned specimens, 4.4–5.5 mm. Average, 4.8 mm.

Only female gall-making Cynipid known with 17-segmented antennae.

Type.—Cat. No. 22566, U.S.N.M. 30 cotypes.

Host.—*Quercus chrysolepis* Liebmann.

Gall.—Large area of greatly thickened bark causing a large swelling at the base of saplings or rough swollen areas at the crown of large trees, especially on callus tissue. This thickened bark contains hundreds of larval cells about 6 mm. long. Such areas also occur where a limb bends over and the elbow touches the ground. The bark becomes over an inch thick and the wood underneath very rough and knotty. On trees in moist gulches.

Type locality.—Los Gatos, California. The type galls containing living adults were collected November 2, 1918, by Mr. R. D. Hartman and sent in under Hopkins No. 15922[a] and placed in rearing at the Eastern Station, East Falls Church, Virginia. The flies emerged April 9, 16, 26, 1919.

The writer saw old galls in the San Gabriel Mountains on August 8, 1916, near Coldbrook camp, and at Camp Baldy on June 17, 1918. Empty galls were also seen at St. Helena, California, on May 28, 1918. On May 13, 1918, while collecting with Mr. Hartman at Los Gatos, galls were found in which there was a thick layer of translucent nutritive tissue with no larval cell visible. These were perhaps formed by the flies that had emerged earlier in spring.

18. CALLIRHYTIS CORALLOSA, new species.

Plate 32, figs. 16, 17.

Female.—Reddish brown to black in some individuals, with compound eye, anterior and lateral line areas on mesonotum black; head, thorax and legs covered with whitish or tawny pubesence as in *Disholcapis.* Head finely punctate, not as broad as thorax, mandibles two-toothed, palpi 5- and 3-segmented, antennae 13-segmented with the last not quite twice as long as preceding and in one specimen in balsam showing a faint subdivision into two, facial quadrangle transverse. Mesoscutum punctate, parapsidal grooves deep, smooth, percurrent; smooth bare parallel lines extend back half way, longer and more distinct than the lines over base of wing, median groove wanting or a mere notch on hind margin. Scutellum broader than long and truncate or faintly excavated behind with two well-separated smooth, oval pits at base; propodeum with two almost straight and parallel ridges inclosing a somewhat rugose area broader than high, no median ridge. Legs stout, hind coxae with a sharp ridge behind, tarsal claws simple, divergent. Wings dusky with distinct brown veins, second cross-vein angled, areolet reaching one-fifth and cubitus two-thirds way to basal, surface pubescent, margin ciliate. Abdomen smooth and shining, not compressed, the large pubescent areas on sides of second segment widely separated dorsally and nearly reaching the hind margin, exposed parts of the other segments microscopically punctate and the seventh pubescent. Ventral spine tapering and in balsam about five times as long as broad. Ovipositor when dissected out a little longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.4–1.6; antenna, 2.1–2.3; ovipositor, 2.0–2.6; wing, 3.5–4.0.

Range in length of 14 specimens, 4.6–6.3 mm. Average 5.4 mm.

Runs in Dalla Torre and Kieffer's key (1910) to *Callirhytis crypta* Ashmead, from which it is separated by its large size, distinct parapsides, lack of median groove, and presence of a distinct areolet.

Type.—Cat. No. 22567, U.S.N.M. Type and 4 paratypes.

Host.—*Quercus macrocarpa* Michaux, *Quercus alba* Linnaeus, *Quercus bicolor* Willdenow, *Quercus stellata* Wangenheim, *Quercus prinus* Linnaeus, and *Quercus chapmani* Sargent.

Gall.—At base of thrifty sprouts about stumps or on bark of small trees just below surface of ground, 12–15 mm. in diameter and 6–10 mm. high, brown, convex, button-shaped, irregularly ridged exteriorly, some being much more rugose than others, with a clasping or sessile base and when broken off showing an impressed scar with radiating ridges which become more conspicuous in decaying galls Galls on *stellata*, *chapmani*, and *prinus* are much smoother externally than those on the other three hosts mentioned and those figured (plate 32, fig. 16) are from *chapmani.* The outer spongy layer disintegrates with age leaving a hard woody cell 7 by 5 mm., with a wall one-half millimeter thick.

Type locality.—Fort Sheridan, Illinois. Galls collected October 3, 1914, on *macrocarpa* and *alba*, about half containing living adults and half full-grown larvae. Others were found there on October 30, on *bicolor*, and from another collected October 29, 1916, the adult emerged in breeding cage on April 28, 1917. These galls have been taken also at Winnetka, New Lenox, and Glen Ellyn, Illinois, on the above hosts.

Smoother button-shaped galls with the same radiate scar when detached were found on the roots of *chapmani* at Ocala, Florida, April 17, 1914, some empty and others containing full-grown larvae, and again October 30, 1919, when half contained pupae and half adults. More were seen at Clearwater and at Daytona and Daytona Beach, Florida. Some of these, when opened December 3, gave five larvae and two pupae which transformed December 12. These smooth galls were also taken on roots of *stellata* at Mineola, Texas, September 2, 1915. They were empty. More were taken in fall of 1917 at Poplar Bluff, Missouri, Texarkana, Arkansas, and two at Palestine, Texas, from one of which a living fly was cut November 20, 1917. Similar smooth galls were found on roots of *prinus* at East Falls Church, Virginia, September 1, 1919, and one then cut open contained a pupa, and three living flies were cut out on December 9.

The normal emergence seems to be in spring, in April, and to be distributed over two years.

19. CALLIRHYTIS MAXIMA, new species.

Plate 33, fig. 18.

Female.—Very dark reddish-brown to black, with head, thorax, and legs white-pubescent. Head finely granulate, eyes bare, mandibles two-toothed, palpi 5- and 3-segmented, antennae 14-segmented, the last one and a half times as long as the preceding and in some specimens incompletely or rarely completely divided into two parts. Mesoscutum finely punctate, parapsidal grooves narrow, deep, smooth, and percurrent; smooth black parallel lines extend back about as far as lines over the base of wings extend forward; a notch on hind margin is the only trace of a median groove. Scutellum rugoso-punctate, with arcuate furrow at base separated by a more or less distinct low median ridge into two smooth pits which open behind on to disk. Propodeum with two straight almost parallel ridges inclosing a slightly rugose area broader than high. Wings large, transparent, veins brown, areolet distinct, pubescent, ciliate on margin. Legs stout, punctate, tarsal claws simple, divergent. Abdomen not compressed, smooth and shining except for large punctate pubescent patch on either side of base of second segment, a very few hairs on exposed part of seventh. Ventral spine in balsam three times as long as broad, ovipositor when dissected out equal to length of antenna, ovarian eggs well developed. Using width of head as base, the length of wing ratio is 3.6–3.8; mesonotum, 1.5; antenna, 2.0–2.2; ovipositor, 2.1–2.2.

Range in length of 40 pinned specimens is 4.2–4.8 mm. Average, 4.5 mm.

Runs in Dalla Torre and Kieffer's key (1910) to *Callirhytis radicis* Bassett, from which it may be distinguished by the larger size, longer pubescence on wing, and presence of white pubescence on body.

Type.—Cat. No. 22568, U.S.N.M. 20 cotypes.

Host.—*Quercus alba* Linnaeus, *Quercus macrocarpa* Michaux, *Quercus bicolor* Willdenow, *Quercus prinus* Linnaeus.

Gall.—A large rounded mass, 90 by 50 by 50 mm. or smaller, growing out from side of one of main roots at base of tree or stump just below surface of the ground. Surface uneven but smooth, brown. When mature the interior is soft and easily cut or crumbled with the fingers, and might be taken for a piece of well-rotted wood until he numerous hard shell-like thin-walled brown cells are noticed mbedded in the whitish matrix. When the moisture is dried out the galls are as light as cork.

Type locality.—Fort Sheridan, Illinois.

Biology.—On October 4, 1914, galls were found on *Q. macrocarpa* with adults ready to emerge; others with the substance of the gall firmer contained full-grown larvae, others less than half an inch in diameter were fleshy with larval cavities barely visible, suggesting that the gall takes three years to mature, or else two, and the larvae in some do not transform the second fall but hold over until the third. At Winnetka, Illinois, October 30, some galls contained adults and others were very small. On November 1, immature galls were found at New Lenox, Illinois. On April 24, 1915, a small gall was found on *Quercus alba* from which adults were issuing. They were smaller, averaging 3.4 mm., but otherwise similar. Found gall at Highland Park, Illinois, on May 12, 1917, looking as if the adults had but recently issued; another at Fort Sheridan May 25 showed exit holes where all the adults had escaped. Collected a fine gall on *Quercus alba* May 6, 1914, on Plummer Island, Maryland. Adults evidently transform in autumn and emerge the next spring in late April or early May. A single fly of what seemed to be this species was noted in the stomach contents of blue-headed vireo (*Lanivireo solitarius* (Wilson) at Washington, District of Columbia, on April 15. A single old gall of this species was found on roots of *Quercus prinus* in September, 1919, at East Falls Church, Virginia, and another at Plummer Island, Maryland.

20. CALLIRHYTIS ENIGMA, new species.

Plate 33, figs. 19, 20.

Female.—Almost bare and almost black, the legs and antennae reddish-brown. Head broader than high, as broad as thorax, cheeks a trifle longer than half the eye, finely pebbled above and punctate pubescent on face which has a broad median elevation from base of antennae to the impressed clypeus, mandibles 2-toothed, palpi 5-and 3-segmented, antennae 15-segmented, arising below middle of eyes, first longest and stoutest, third one and one-half times fourth, the rest becoming gradually shorter and stouter, the last at least one and one-half times as long as preceding (which is as broad as long) and as stout. Mesoscutum not high-arched, polished, beautifully coriaceous with scattered punctures bearing scarcely visible hairs. Parapsidal grooves distinct, percurrent, broader behind, deep with transverse ridges in bottom, median groove extending forward nearly half-way, anterior and lateral lines very faint impressions. Scutellum rugose behind with a median smoothish area on disk, the rugose pits are distinctly bordered behind and separated by a septum as broad as a parapside in which there is often a trace of a median groove; with impressed hairy areas at sides. Propodeum with two outwardly bent ridges inclosing a smooth area slightly narrower above, in which are two faint longitudinal lines, spiracular areas hairy, spiracles nearly round, petiole very rugose. Mesopleura longitudinally striate below. Legs punctate pubescent, hind coxae with bare ridge behind, tarsal claws simple, divergent. Wings with pale yellow distinct veins, second cross-vein heaviest and not angled, areolet present, surface pubescent, margin distinctly ciliate only on hind margin of hind wing. Abdomen slightly compressed, longer than high, smooth and shining, posterior edge of second and exposed parts of others microscopically punctate, second with widely separated, small, narrow pubescent patches at base. Ventral spine mostly concealed, not twice as long as wide. Ovipositor when dissected out one and one-third times as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.2; antenna, 2.4–2.5; ovipositor, 3.3; wings, 3.65.[4]

Range in length of 76 pinned specimens, 3.0–4.1 mm. Average, 3.7 mm. Mode, 3.9 mm.

This species is closely related to *saltatus* which Ashmead in 1881 made the type of the new genus *Trisolenia* separated from *Andricus*, which he understood to have simple claws by the sharply defined

[4] These ratios are from the type material from *Q. rubra* from Winnetka, Illinois. Paratype flies from Florida from *Q. catesbaei* and *Q. myrtifolia* agree with these in sculpture but have length of antenna ratio 2.0; ovipositor, 2.6; and wing, 3.1.

parapsides, complete median groove, 15-segmented moniliform antennae, and bare wings. Both species have a characteristic "planed-off" appearance of the mesonotum, with the scutellum in the same plane as the mesoscutum. The same is true of the root-gall (or *radicicola* Dalla Torre) form (agamic generation) of *Callirhytis futilis* (Osten Sacken). At present *Trisolenia* has been reduced to synonomy under *Andricus* (it should have been made a synonym of *Callirhytis* instead), and if this group of species is ever segregated into a separate genus it would take the name of *Trisoleniella* Rohwer and Fagan 1917 (*Trisolenia* having been preoccupied by Ehrenberg in *Protozoa* in 1861).

Type.—Cat. No. 22573, U.S.N.M. Type and 42 paratype flies.

Host.—*Quercus rubra* Linnaeus, *Quercus catesbaei* Michaux, *Quercus myrtifolia* Willdenow, *Quercus texana* Buckley.

Gall.—In clusters of as many as 150 at the base of young sprouts 4–10 cm. underground. Clusters are roughly spherical and may measure 2.5 cm. in diameter. The appearance of the fresh galls is unknown. The type flies are from a disintegrated cluster, and a fleshy layer had evidently rotted away, leaving a hard and brittle shell 4 by 6 mm., longitudinally ridged, with a wall about one-half a millimeter thick. (Plate 33, fig. 20.) The fleshy layer is evidently thin, for in the sandy soils of Florida it seems to dry down on the inner shell instead of decaying as in the more humid northern soils, and the ridges show through. The species was known to the writer years before an intact cluster was found, and it was not until flies were reared from these Florida galls, in 1919, agreeing with the types that the character and appearance of the cluster was known. The galls figured are from *Q. catesbaei.* (Plate 33, fig. 19.)

Habitat.—The type flies are from Winnetka, Illinois, where a disintegrated cluster containing adults was found October 22, 1914, at the base of a young sapling of *Q. rubra.* Empty galls of this species were also seen at Ravinia and Highland Park, Illinois. Intact clusters of galls were collected at Madison, Florida, October 21, 1919, on *Q. catesbaei.* They then contained pupae, and adults were cut out December 4, agreeing with the Winnetka specimens. Others were seen at Gainesville, Ocala, Marianna, and Jacksonville. The same species was found on *Q. myrtifolia* at Carrabelle, Florida, October 19, and at Daytona November 20, and both pupae and adults were found when cut open on December 3. Empty galls were seen on *Quercus texana* at Boerne, Texas. The United States National Museum has a single similar fly from Jacksonville and a gall cluster from Georgiana, Florida, both without date or host records; also an empty gall cluster from Ocean Springs, Louisiana, collected February 3, 1898, on "*Q. phellos*?."

21. CALLIRHYTIS FUTILIS (Osten Sacken.)

(Agamic generation=*radicis* Bassett=*radicicola* Dalla Torre.)

Plate 33, fig. 21.

Callirhytis radicis BASSETT. Psyche, vol. 5, 1889, p. 237.—DALLA TORRE and KIEFFER, Wytsman Gen. Ins. Hym. Cynipidae, 1902, p. 66, No. 26.—Das Tierreich, Lief. 24, 1910, p. 571.—BEUTENMUELLER, in Smith Ins., N. J., 1910, p. 601.—THOMPSON, Cat. Amer. Ins. Galls, 1915, pp. 5, 30.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

Andricus radicicola DALLA TORRE, Cat. Hymen., vol. 2, 1893, p. 95.

Callirhytis radicicola Dalla Torre, MAYR, Verh. Zool-.Bot. Ges. Wien, vol. 52, 1902, p. 289.

Andricus (*Callirhytis*) *radicis* Bassett, VIERECK, Hym. of Conn., 1916, p. 426.

On May 12, 1917, a dozen or more Cynipids of the same species were seen ovipositing in the unopened buds of *Quercus alba* Linnaeus at Fort Sheridan, Illinois. Investigation showed that there were hundreds of cells (*radicis* form of *C. futilis*) in the bark of the main roots (Plate 33, fig. 21) at the base of the tree from which these flies were coming and they were seen crawling up the trunk, and from these cells similar flies were cut. On May 6, 1914, at Plummer Island, Maryland, oak-wart galls were seen on the leaves of *alba*, and a large number of cells were found in the bark of the main roots and from them two living adults were cut. At Starved Rock, near Utica, Illinois, May 31, 1913, the wart galls were very common on one tree of *alba*, and the old *radicis* cells in the bark of the root were found, exit holes showing where adults had emerged earlier in spring to produce the current crop of leaf galls. In this thickened bark, however, there were nests of cells with a thick nutritive layer. These were probably formed in the fall of 1912 by flies from the 1912 wart galls and would not give adults until the spring of 1914. Old cells of what is probably this species were observed in the thick bark at the crown of a large tree of *Quercus prinus* Linnaeus, at East Falls Church, Virginia, on September 1, 1919.

Measurements of 75 pinned specimens, of which 53 were Bassett "cotypes," gives the range in size as 1.9–3.4 mm. Average, 2.7 mm. Using the width of the head as a base, the length of mesonotum ratio is 1.2; length of antenna, 1.6–1.8; ovipositor, 2.5–2.8; wing, 3.4–3.6. Wing not ciliate on margin. The antennae were described as 14-segmented. In some of the cotypes they are 13-segmented, the last over twice preceding, but often with a transverse suture, which may completely divide it into two separate segments.

22. CALLIRHYTIS APICALIS (Ashmead).

Plate 34, fig. 22.

Andricus apicalis ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 120. No. 12.—COCKERELL, Ent. Student, vol. 1, 1900, p. 9.—DALLA TORRE and KIEFFER, Wytsman, Gen. Ins. Hym. Cynipidae, 1902, p. 61, No. 6.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 5, 31.

Callirhytis apicalis Ashmead, MAYR, Verh. Zool.-Bot. Ges. Wien, vol. 52, 1902, p. 289.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 573.—FULLAWAY, Ann. Ent. Soc. Amer., vol. 4, 1911, pp. 354.—FELT, Key to Amer. Ins. Galls N. Y. St. Mus., Bull. 200, 1918, p. 54.

This species was described from material from *Quercus wislizeni* A. de Candolle. The writer has taken galls on that oak in the San Gabriel Mountains, at Los Gatos, and Bagby, California. He has also found them on *Quercus californica* Cooper in Sequoia National Park, at Los Gatos and Dunsmuir, California, and on *Quercus agrifolia* Née at Carpinteria, Santa Margarita, Paraiso Springs, Los Gatos, and St. Helena, California. The fresh galls are greenish-white, tinged with red if exposed to light, fleshy, single, or in groups of a few or in clusters that may be as much as 8 cm. in diameter and contain as many as 35 galls. The fresh galls are found in May in all stages of growth. By June 1 they are full grown. They then turn brown and the juicy interior becomes converted into brittle, cavernous tissue, with a series of thin plates radiating out from the hard basal cell. In galls taken to Evanston, Illinois, pupae were found by September 1 and also on October 10, November 17 (transformed December 6), and December 23. Living adults were cut out of this lot of galls on December 23, March 20, and April 18. Some larvae do not pupate until the second autumn, however. The normal emergence is probably in early spring, one of the type series having been reared February 17. After the insects escape, the peripheral tissues weather away in time, leaving the rough hard larval cells attached to the bark to persist for years.

Measurements of 33 pinned specimens, including the types, give the range in size as 5.3–7.5 mm. Average, 6.1 mm. Using the width of head as a base, the length of mesonotum ratio is 1.38; length of antenna, 2.28; ovipositor, 4.26; wing, 3.6. Wing not ciliate on margin. Propodeum with a median longitudinal ridge.

23. CALLIRHYTIS OVATA, new species.

Plate 34, fig. 23.

Female.—Brownish-red, antennae infuscated distally and abdomen dorsally, eyes black. Head broader than thorax, finely granulate with whitish hairs on face, clypeus almost smooth, interocular area 1.1–1.2 times as broad as high, malar space 0.3–0.4 eye, mandible 2-toothed, palpi 5- and 3-segmented, antenna 13- or 14-segmented, third longer than first, fourth three-fourths of third, fifth equal to second, rest gradually shorter to twelfth which is as broad as long, thirteenth more than twice as long as preceding and partially or wholly subdivided by a transverse groove a little back of middle. Pronotum rugose. Mesoscutum shining, coriaceous with setigerous punctures anteriorly but not rugose, parapsides complete but less distinct in front, median nearly complete, anterior and lateral lines faintly impressed. Scutellum rugoso-punctate, pits at base narrow, deep, shining, smooth or with faint longitudinal ridges, triangular impressed areas on sides. Propodeum with two ridges slightly bent inwardly and inclosing a reticulate area broader at the top, spiracular areas and petiole rugose. Mesopleura finely rugose. Hind tarsi shorter than tibiae, second shorter than fifth, claws weak, simple, divergent. Wings subhyaline, veins brown, first abscissa of radius faintly angled and slightly clouded, areolet not reaching over one-fifth way to basal, cubitus not reaching basal, surface pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and shining, longer than high, slightly compressed, second segment occupying about two-thirds and with only inconspicuous patches of hair on sides, its hind margin and exposed parts of rest microscopically punctate, ventral spine short, hardly longer than broad, ovipositor when dissected out nearly one and two-thirds times as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.2–1.3; antenna, 1.5–1.7; ovipositor, 1.9–2.0; wing, 3.0–3.1.

Range in length of 77 pinned specimens, 2.8–4.8 mm. Average, 3.9 mm. Mode, 4.0 mm.

Type.—Cat. No. 22569, U.S.N.M. Type and 42 paratypes.

Host.—*Quercus catesbaei* Michaux, *Quercus myrtifolia* Willdenow, *Quercus texana* Buckley.

Gall.—Cells in and protruding from the brown bark at crown of small trees, 5 to 10 cm. underground. When single, they are elliptical in outline, sessile, 6 mm. high by 5 mm. in diameter, light brown in color and smoother than the surrounding bark. Exit hole 2.6 mm. in diameter at distal end. They are sometimes detachable. They often occur in rows or in groups of a dozen or more. When confluent, a local swelling of the bark is produced, but the number of cells contained is evident. The figure shows galls on *Q. myrtifolia.* On *Q. catesbaei* they usually occur on larger roots at least 2 to 5 cm. in diameter and often in the angles where branch roots arise.

Habitat.—The type galls were collected at Marianna, Florida, October 11, 1919, on *Q. catesbaei* and then contained pupae. Living flies were cut out of the galls on December 3. More were taken at Ocala October 30, and these also contained pupae. Galls found at Ocala April 15, 1914, were empty. These galls were also found at Madison and Jacksonville. The species transforms inside the galls in November and probably emerges in early spring. The fact that some galls still contained larvae in December when others in the same groups contained adults suggests that the emergence is distributed over two years. Similar galls were collected on *Q. myrtifolia* at Daytona, Florida, on November 20, 1919. Some pupae had already transformed into adults and a few were still in pupa state when flies were cut out on November 28 and December 3. At Boerne, Texas, October 26, 1917, old galls were seen on *Q. texana* as well as full-grown fresh ones, some of which contained a thick nutritive layer and others pupae or adults.

24. CALLIRHYTIS RUBIDA, new species.

Plate 36, fig. 31.

Female.—Head and thorax deep red to black, legs and antennae brownish-red, abdomen infuscated, red at base. Head broad as thorax, rugose, whitish hairs on face, clypeus almost smooth, interocular area 1–1.2 times as broad as high, malar space 0.3–0.4 eye with a few parallel ridges, mandibles 2-toothed, palpi 5- and 3-segmented, antenna 14-segmented, third a trifle shorter than first, second and fifth equal, 4–13 gradually shorter, last a little longer than preceding. Some specimens have 12 segments, the last with one or even two incomplete transverse grooves. Pronotum rugose. Mesoscutum distinctly coriaceous with setigerous punctures scattered along grooves, parapsides complete, rugose, slightly wider behind, median complete, parallel and lateral lines not polished, but sunken. Scutellum coarsely rugose with coriaceous spot on disk sometimes, arcuate furrow at base rugose, and separated from impressed areas on sides, divided into two pits. Propodeum with two straight parallel ridges inclosing a reticulate area in which there is sometimes a trace of a median ridge. Mesopleura finely rugose with parallel longitudinal ridges across middle. Hind tarsus shorter than tibia, second shorter than fifth, claws simple. Wings hyaline, veins brown, first abscissa of radius slightly clouded and faintly angled in middle, areolet complete, reaching about one-fifth distance to basal, cubitus not reaching basal, surface pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and shining, longer than high, laterally compressed, second segment occupying about two-thirds and with only inconspicuous patches of hair on sides, its hind margin and exposed parts of rest microscopically punctate, ventral spine short, in balsam about twice as long as broad, ovipositor when dissected out nearly one and two-thirds times length of antenna. Using width of head as a base, the length of mesonotum ratio is 1.3–1.4; antenna, 1.9; ovipositor, 2.9–3.0; wing, 3.6.

Length of 9 pinned specimens, 3.4–3.8 mm. Average, 3.6 mm.

Type.—Cat. No. 22570, U.S.N.M. Type and 8 paratypes.

Host.—*Quercus coccinea* Muenchhausen. *Quercus rubra* Linnaeus.

Gall.—Cells in the thick brown bark at or just below surface of ground on stumps or trees. Abrupt local swellings are formed which may even surround small saplings, the number of contained cells somewhat evident externally. (Plate 36, fig. 31.)

Type locality.—Ravinia, Illinois. Galls collected October 22, 1916, and when cut open about half contained full-grown larvae and half living adults. Host oak not recorded. On May 19 a similar gall was found at Millers, Indiana, in the thick bark of a stump of *Q. coccinea*, and a living fly was cut out, which agrees with the Ravinia specimen in structure, but measures only 2.5 mm. Galls found on *Q. rubra* at Plummer Island, Maryland, and cut open September 21, 1919, gave five adults, two pupae, and several full-grown larvae.

25. CALLIRHYTIS MARGINATA, new species.

Female.—Head and thorax black, legs and antennae brown, abdomen almost black. Head evenly rugose, face with whitish hairs, clypeus impressed, rough, as long as broad, interocular area 1.1 to 1.2 times as broad as high, malar space without groove and 0.38–0.47 eye, antennae 14-segmented, distal half infuscated, first shorter than third, third and fourth subequal, 6–13 gradually shorter, last about twice preceding and incompletely divided above middle by transverse groove. Pronotum rugose with parallel ridges on sides. Mesoscutum finely pebbled, becoming slightly rugose in front, grooves with upturned margins posteriorly, parapsides wider behind, rugose and percurrent, median complete, wider behind, lateral lines smooth, anterior not smooth and somewhat indistinct and sunken. Scutellum coarsely rugose with two narrow, deep, rugose pits at base separated by a septum, impressed areas at sides. Propodeum with two outwardly-curved ridges inclosing a rugose area wider than high, in which in some specimens there is a trace of a median ridge. Mesopleura finely rugose with no parallel ridges. Legs with coxae infuscated, hind tarsus shorter than tibia, second shorter than fifth, claws simple, divaricate. Wings hyaline, veins brown, first abscissa of radius angled, cubitus reaching basal, areolet complete, reaching about one-fifth way to basal, surface short pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and polished, longer than high, somewhat compressed, second segment occupying over four-fifths and with inconspicuous patches of hair on sides, its hind margin and exposed parts of rest microscopically punctate, ventral spine in balsam about twice as long as broad, ovipositor when dissected out about same length as antenna. Using width of head as base, the length of mesonotum ratio is 1.38; antenna, 2.0; ovipositor, 2.0; wing, 3.7.

Length of six pinned specimens, 3.6–4.1 mm. Average, 3.9 mm.

Type.—Cat. No. 22571, U. S. N. M. Two cotypes.

Host.—*Quercus coccinea* Muenchhausen.

Gall.—Abrupt cushion-like swelling in the bark just at or below the surface of the ground on young sprouts which are 5–10 mm. in diameter. Single or confluent so that they may contain one to a half a dozen cells which are 4–5 mm. in diameter. They are similar to those of *Callirhytis rubida* Weld.

Type locality.—Fort Sheridan, Illinois. One cluster of these galls was found April 25, 1915, and one fly emerged in collecting box and two were cut out of galls. Three more of same species were found ovipositing in the side of the swelling buds in the same clump of sprouts at whose base the galls were found.

26. CALLIRHYTIS FULVA, new species.

Plate 34, fig. 24.

Female.—Dark red and black. Head finely rugose, broadened behind eyes, cheeks a trifle longer than half the length of eye. Mandibles two-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third longest, last over twice as long as preceding and incompletely divided by a transverse groove into two whose lengths are in the ratio of 9 to 14, or 14-segmented, with no suggestion of fusion of last two. Mesoscutum rugose in front but not transversely so, with a few inconspicuous hairs from scattered punctures. Parapsidal grooves rugose, deep and broad behind, complete but less distinct in front, median line percurrent, smooth parallel lines and lines over base of wings black. Scutellum coarsely rugose, the two pits distinctly bordered laterally but opening posteriorly out on to disk and separated only by a low median ridge, with impressed pubescent areas at sides above base of hind wings. Propodeum with two straight parallel ridges inclosing a smooth but pubescent area slightly higher than wide. Mesopleura finely longitudinally striate. Legs lighter in color, tarsal claws weak, simple, divergent. Wings with yellowish veins, the second cross-vein brownish, bent at an angle and usually with a short spur, areolet incomplete or absent, surface pubescent, margin not ciliate. Abdomen black, smooth, and shining, slightly compressed, longer than deep, second segment with two lateral oval pubescent patches at base nearly touching dorsally, hind margin of all microscopically punctate. Ventral spine in balsam a little more than twice as long as broad. Ovipositor when dissected out shorter than length of antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.3; antenna, 2.5; wing, 3.7–3.8; ovipositor, 1.7.

Range in length of 50 pinned specimens, 3.0–4.0 mm. Average and median, 3.6 mm.

Related to *Callirhytis radicis* Bassett, to which the individuals with 14-segmented antennae run in Dalla Torre and Kieffer's key (1910). The pits of *radicis* do not open out behind on to scutellum, the median area on propodeum is broader than high, and the malar space is not over half the length of eye.

Type.—Cat. No. 22572, U. S. N. M. Twenty-four cotypes.

Host.—*Quercus chrysolepis* Liebmann.

Gall.—Hemispherical when single or forming a hemispherical group with individual galls compressed laterally into angular cross-section by mutual pressure, produced on roots just under surface of ground. Single galls measure up to 22 mm. in diameter by 18 mm. high, groups of two to eight measure up to 35 mm. diameter. Tissue of gall mustard yellow, pithy distally, becoming more compact about the proximally placed larval cell.

Type locality.—San Gabriel Mountains, California.

Biology.—Collected one-half mile above Coldbrook Camp in San Gabriel River canyon above Azusa, California, August 6, 1916. The larvae change into pupae about November 1, and into adults later in the autumn, but probably do not emerge until next spring. In breeding cage out of doors at Evanston, Illinois, they issued March 10–19.

27. CALLIRHYTIS ELLIPSOIDA, new species.

Plate 36, fig. 30.

Agamic female.—A black and tan species. Compound eye, clypeus, tip of mandible, flagellum, broad stripe along parallel and lateral lines on mesonotum, base of scutellum, metanotum, propodeum, metapleura and upper part of mesopleura, sternum, most of second abdominal segment except a broad oblique band, black or nearly so, there being much variation in different individuals; rest of body pale yellow to fuscous. Head finely rugose, covered with white pubescence except on vertex, mandibles with two sharp teeth, maxillary palpi 4-segmented with first short and second and fourth equal, labial palpi 3-segmented with second almost as long as other two. Eyes bare. Antennae 13-segmented with the last twice as long as the preceding and incompletely divided by a groove near the middle or 14-segmented with last two subequal. Mesoscutum finely rugose but not transversely so, parapsidal furrows obliterated in front as is also the median, smooth anterior parallel lines extend back over half way and the fine ridges on each side suggest a feather, the lateral lines extend forward half way and are bordered by a pebbled area. Scutellum rugose with two rugose pits at the base separated by a narrow ridge and opening behind on to disk. Carinae on propodeum straight, converging slightly above, inclosing a reticulate area above rugose petiole. Wings transparent, veins distinct and pale yellowish, very minutely short brown pubescent, ciliate only on hind margin of hind wing, areolet reaching about one-eighth way to basal, cubitus curved and almost reaching basal. Legs with coxae and tarsi darker, hind tarsi shorter than tibiae, tarsal claws simple, divergent. Abdomen smooth and shining, longer than high, slightly compressed, the second segment with patch of whitish hairs at base on either side, making up three-fourths the length, the third making up almost all the rest. Ventral spine twice as long as broad. Ovipositor when dissected out a trifle longer than antenna. Ovarian eggs well developed, 0.14 mm. long, and including pedicel, 0.76 mm. Using width of head in balsam mount as a base, the length of wing ratio is 3.8–4.0; antenna, 1.7–1.8; mesonotum, 1.45; ovipositor, 2.0–2.1.

Range in length of 30 pinned specimens, 3.3–4.5 mm. Average, 3.8 mm. Median, 3.75 mm.

Type.—Cat. No. 22564, U. S. N. M. Sixteen cotypes.

Host.—*Quercus bicolor* Willdenow.

Gall.—Ellipsoid, 4.5 by 5.5 mm., single or in small clusters on the small roots just below surface of ground under the tree. Surface smooth, brown. Monothalamous with a firm wall less than one-half millimeter thick when mature, exit hole at end 2 mm. in diameter. Immature galls lighter in color, fleshy, translucent white inside.

Habitat.—Type locality, Wilmette, Illinois. Collected also at Evanston and Winnetka, Illinois.

Biology.—The galls probably take two years to develop, the larvae transforming to adults the second autumn but not emerging from the galls until the following spring between April 15 and May 7. They are all females. They oviposit at once in the swelling buds of the same tree, but the alternating sexual generation is unknown.

28. CALLIRHYTIS ELLIPTICA, new species.

Plate 35, fig. 26.

Agamic female.—Head reddish brown, abdomen brighter red, antennae, legs, and thorax honey-yellow with the more heavily chitinized parts reddish. Head rugose, as broad as thorax, widened behind eyes, pubescent on face, clypeus almost circular with two deep impressions at insertion, malar space about 0.4 eye, interocular space about one and one-fourth times as broad as high, antennocular and ocellocular spaces equal, palpi 4- and 3-segmented, mandibles 2-toothed, antennae 13-segmented, first and third equal, fifth half as long as third, fifth to twelfth subequal, last not quite one and one-half times preceding, or 14-segmented, with last two subequal. Sides of pronotum rugose. Mesoscutum a trifle broader than long, surface pebbled with a tendency to become rugose on front and along the parapsides which are obliterated in front, anterior parallel grooves rugose extending back over half way, smoother lines over base of wings, a shallow rugose streak makes an indistinct incomplete median. Scutellum very rugose, with two rugose, sometimes communicating pits at base and impressed areas at sides, pits open behind. Propodeum with two outwardly bent ridges inclosing a reticulate area broader than high and narrowed gradually toward top, petiole rugose. Mesopleura pubescent except on the more finely rugose center. Hind leg with tarsus shorter than tibia, third shorter than fifth, claws simple. Wings clear, apparently bare but in balsam very short pubescent, ciliate only on margin of hind wing, veins yellowish, areolet small or incomplete. Abdomen smooth and shining, slightly compressed, longer than high, second segment with two densely pubescent patches on sides. Ventral spine tapering, in balsam twice as long as broad, ovipositor when dissected out about one and three-tenths length of antenna, ovarian eggs well developed. Using width of head as base, the length of mesonotum ratio is 1.4; antenna, 1.9; ovipositor, 1.9; wing, 3.5.

Range in length of 10 pinned specimens, 3.7–4.3 mm. Average, 3.9 mm.

This species can be separated from *Callirhytis ellipsoida* Weld only by color markings which, however, seem to be constant. The galls also are similar but on a different oak.

Type.—Cat. No. 22565, U. S. N. M. Type fly and gall. Four paratypes.

Host.—*Quercus alba* Linnaeus.

Gall.—An abrupt ellipsoidal swelling on small rootlets found an inch or two under the humus on forest floor underneath large trees. Brown, smooth, thin-walled when mature, monothalamous, and similar to galls of *Callirhytis ellipsoida* Weld on *Quercus bicolor* but the fly is different.

Type locality.—The type fly was cut out alive from a gall found at Highland Park, Illinois, October 22, 1916, on root of an undetermined oak. On May 11, 1919, five similar flies were collected at Glencoe, Illinois, ovipositing on buds of *Quercus alba*. On May 23, 1919, found similar galls on roots of white oak at Ravinia, Illinois. Some showed exit holes from which flies had recently emerged; others were full grown but contained a thick translucent nutritive layer and a barely visible larval cavity; others had a large cavity and a third of the nutritive layer left and a nearly full-grown larva which would probably transform in the fall and emerge next spring in early May. In the United States National Museum are three similar flies collected by J. G. Barlow at Cadet, Missouri, April 27 and May 5, 1883, ovipositing in buds of white oak. Also two from Nyack, New York, collected by J. L. Zabriskie, April 21, 1885, on buds of *Quercus alba*.

These galls were also collected at Marianna, Florida, October 10, 1919, on the roots of *Quercus alba* growing in deep woods. A dead adult was cut out on December 6, and mounted in balsam. This agrees with the type material and proves the type gall to have been on white oak. Galls collected in Washington, District of Columbia, on *alba* contained living flies on October 31, 1920.

Genus EUMAYRIA Ashmead.

29. EUMAYRIA FLORIDANA Ashmead.

Plate 35, fig. 27.

Eumayria multiarticulata ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 133, gall only.

Eumayria floridana ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 147, No. 35, and p. 133.—CRESSON, Syn. Amer. Hym., 1887, p. 310.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 106.—DALLA TORRE and KIEFFER, in Wytsman Gen. Ins. Cynipidae, 1902, p. 68, No. 1.—ASHMEAD, Psyche, vol. 10, 1903, p. 153.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 277.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 601.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 38.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

Doctor Ashmead described a root gall on *Quercus laurifolia* Michaux in 1887 in Transactions American Entomological Society (vol. 14, p. 133) as *Eumayria multiarticulata*. Later in the same paper he described *Eumayria floridana*, male and female, without gall, from five specimens taken at large in March, 1887, in Florida. In the old Ashmead collection at the United States National Museum are three male flies with the label "Jacksonville, Florida," and bearing a white label with the word "type." These are evidently of the original five. The American Entomological Society probably has another one. In the Museum collection, however, probably years later, he placed a red label with "U.S.N.M. Type 2883" on a gall which answers the description of *multiarticulata* and also on a female fly and accessioned them as *Eumayria floridana*. Both bear the "U.S. D.A. No. 2647" and are from Georgiana, Florida. With these are 37 other females all bearing the same number. The emergence dates are April 12, 13, 19, 20, 25, 27, and May 3, 1882. Pinned in case with them is a slip with name "*Eumayria multiarticulata*," showing that as that name had been applied only to gall, he wished to call the species *floridana* and wished the large series of reared flies to be included in the type series for in the type book he wrote "many types." Whether there were any males in the reared series or any females in the captured series is not known. The writer has reared both males and females from galls collected at Jacksonville, Florida, and these agree with both sexes in the Museum, so that there is no doubt that the Museum material belongs to one species.

As Ashmead's description of the adults was very brief, the following notes are added from the type material in the Museum:

Female.—Dark yellowish-brown. Head coriaceous, broader than thorax, axial line 0.6 of transfacial, facial less than transfacial, interocular area 1.48 times as broad as high, antennocular and ocellocular spaces equal, malar space without groove and 0.68 length of eye, antennae with last segment two and one-fifth times as long as thirteenth without evidence of fusion. Mesoscutum coriaceous with scattered setigerous punctures, parapsides percurrent, lateral and parallel lines present and a broken row of large punctures forming an incomplete median. Scutellum coarsely pitted and rugose behind with smoothish spot on disk just behind the two distinctly separated pits, impressed areas on sides. Propodeum with two slightly curved ridges inclosing a smooth area broader than high. Legs with hind tarsus shorter than tibia, second and fifth subequal, claws simple. Wings with brownish veins, those beyond second cross-vein faint, first abscissa of radius arcuate, second not reaching margin, areolet small and indistinct, margin not ciliate. Abdomen compressed, longer than high, second segment occupying over four-fifths with ring of hairs at base, ventral valve in balsam twice as long as broad, ovipositor when dissected out a little longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.1; antenna, 2.2; ovipositor, 2.3–2.5; wing, 3.0.

Male.—Body darker but not black, antennae 2.8 times width of head.

Length of 38 pinned females, 2.2–2.7 mm. Average, 2.4 mm. Length of each of the three Jacksonville males, 2.2 mm.

Gall.—Photographed from galls on *Quercus catesbaei* Michaux collected at Jacksonville, Florida. In the late fall the galls contain a thick translucent nutritive layer in each cell. They should be collected in the spring for rearing.

Host.—It was described from *Quercus laurifolia* Michaux. The writer has collected galls on nine other species of oak, as shown below.

Habitat.—From *Quercus catesbaei* at Ocala and Jacksonville, Florida, galls were taken and adults of both sexes reared that agree with the types in the United States National Museum. They were collected April 21 and April 25, 1914, and the flies emerged and died in the box before August 10. Galls of this species and on this host were seen at Green Cove Springs, Ocala, Madison, and Gainesville, Florida. Galls have been taken, but no flies reared from the following oaks:

Q. rubra Linnaeus at Ravinia, Fort Sheridan, Highland Park, and Evanston, Illinois.

Q. coccinea Wangenheim at Millers, Indiana, and Evanston, Illinois.

Q. velutina Lamarck at Hot Springs, Arkansas.

Q. falcata Michaux at Gainesville, Florida.

Q. texana Buckley at Boerne and Kerrville, Texas.

Q. marilandica Muenchhausen at Mineola, Texas, and Hot Springs, Arkansas.

Q. brevifolia Sargent at Marianna and Ocala, Florida.

Q. myrtifolia Willdenow at Carrabelle and Daytona, Florida.

Genus BASSETTIA Ashmead.

In addition to the generic characters given by Ashmead, the following, taken from the genotype, may be added, and they apply as well to the other species in the genus: The margin of the front wing is not ciliate, the second segment of the antenna is as broad as the first, and both are flattened to fit the curvature of the strongly convex face when the antennae are bent backward, the eyes are almost flat, flush with the surface of the face, making the outline of head from above almost semicircular.

KEY TO DESCRIBED SPECIES.[5]

1. Head and thorax brownish-yellow.............................*pallida* Ashmead.
   Head and thorax black or nearly so..2
2. Wing with distinct brown veins. Ventral spine twice as long as broad.
   tenuana Weld, p. 232.
   Wing with veins pale. Ventral spine over four times as long as broad..........3
3. Mesoscutum in side view with its arch three-fourths as high as length of eye and with an abrupt curvature anteriorly..................*floridana* Ashmead, p. 233.
   Mesoscutum with arch six-tenths as high as length of eye and its profile without an abrupt curve anteriorly..................................*gemmae* Ashmead.

30. BASSETTIA TENUANA, new species.

Female.—Black, with tibiae, tarsi, antennae (and in one specimen the whole head) reddish-brown. Head broader than thorax, axial line 0.65 of transfacial, widened behind eyes, coriaceous with scattered setigerous punctures, malar space without groove, at least 0.9 length of eye, interocular area nearly twice as broad as high, mandibles 2-toothed, palpi 5- and 3-segmented, antennae stout, 13-segmented, first longer than third and equal to fourth and fifth together, second as stout as first and equal to fourth, 4–12 subequal, last about twice as long as preceding and fully as stout. Pronotum coriaceous and slightly pubescent. Mesoscutum longer than broad, coarsely coriaceous, with two distinct percurrent parapsides, which, if prolonged, would meet just behind center of scutellum, parallel and lateral lines present, separated from scutellum by a distinct suture. Scutellum coarsely coriaceous, narrower behind, with two narrow, deep, smooth, distinctly separated pits at base and two impressed areas at sides. Propodeum with two straight carinae inclosing a slightly reticulate area wider than high and slightly narrower at the top, petiole rugose. Legs with hind tarsus shorter than tibia, second shorter than fifth, claws weak, simple, divergent. Wings rather broad, width 0.42 of length, transparent, with distinct yellowish-brown veins, first abscissa of radius arcuate and slightly clouded, second strongly bent, areolet distinct, cubitus reaching

[5] *Cynips tenuicornis* Bassett, which Ashmead placed in this genus (Trans. Amer. Ent. Soc., vol. 14, p.147), is a *Diplolepis* Geoffroy. The mesoscutum is not transversely rugulose, not longer than broad, the first two segments of antenna are not flattened, tarsal claws have a distinct tooth, and the wing margin is ciliate.

basal, very short brown pubescent, ciliate only on hind margin of hind wing. Abdomen longer than thorax, longer than high, laterally compressed, smooth and shining, second segment occupying about two-thirds and with a tuft of hairs on each side at base. Ventral spine tapering, about twice as long as broad, ovipositor when dissected out nearly one and one-half times as long as antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.3; antenna, 2.1; ovipositor, 3.1; wing, 3.3.

Length of 9 pinned specimens, 2.5–3.1 mm. Average, 2.9 mm.

Type.—Cat. No. 22581, U. S. N. M. Type and 5 paratypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—Similar to those of *Compsodryoxenus tenuis* Weld. The insects gnaw individual exit holes through the brown bark, which after a year or two becomes cracked and rough.

Type locality.—Las Vegas, New Mexico. Galls were collected in a patch of runner oak of an unknown species on April 4, 1918. They then contained adults, and living flies were cut out which bear Hopkins U. S. No. 15601[d1]. On April 19 similar galls were collected at Flagstaff, Arizona, on *Quercus gambelii*. They contained similar adults, which issued April 10–16 and bear Hopkins U. S. No. 15601[d].

31. BASSETTIA FLORIDANA Ashmead.

Plate 34, fig. 25.

Bassettia floridana Ashmead, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 147.—Cresson Syn. Amer. Hym., 1887, p. 310.—Dalla Torre, Cat. Hym., vol. 2, 1893, p. 117.—Dalla Torre and Kieffer, Wytsman Gen. Ins. Hym. Cynipidae, 1902, p. 72, No. 1; Das Tierreich, Lief. 24, 1910, p. 648.—Thompson, Cat. Amer. Ins. Galls, 1915, p. 36.

This species was described from four females captured at large in Florida. In cutting open galls of *Compsodryoxenus humilis* Weld (p. 236) some specimens were found with much longer larval cells than is characteristic of that species, and the flies ran to the genus *Bassettia*. They agree very well with the two types of *B. floridana* Ashmead in the United States National Museum (one pinned and one in balsam), except that in these fresh specimens the abdomen is longer than head and thorax together, while in the dry pinned type it equals thorax. The eight fresh flies measure 2.75–2.95 mm. The type *floridana* measures 2.6 mm. As the original description of *floridana* was brief, some further notes from the type specimens are here added and the associated gall described for the first time.

Host.—*Quercus chapmani* Sargent.

Gall.—Spindle-shaped enlargements at base of current year's shoots occurring in patches of runner oak in fall. (Plate 34, fig, 25.) In external appearance they can not be separated from galls of *Compsodry-*

oxenus humilis Weld, but the larval cells are ellipsoidal, 3.25 mm. long by 1.25 mm. in diameter, lying lengthwise just under the bark.

Female.—Head wider than thorax, second segment of antenna as broad as first and both flattened, abdomen longer than high, ovipositor when dissected out one and one-third times as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.3; antenna, 2.0; ovipositor, 2.8; wing, 3.3.

Habitat.—Ocala, Florida. Galls collected October 30, 1919. When cut open February 23, 1920, pupae and four transformed flies were found.

Genus COMPSODRYOXENUS Ashmead.

This genus is not closely related to *Rhodites*, as indicated in the Tierreich key on page 299, for the hypopygium is not ploughshare-shaped as in that genus. It is more closely related to *Solenozopheria* Ashmead and may be recognized by the use of Ashmead's key in Psyche (vol. 10, p. 155), where it is placed close to *Bassettia* Ashmead. Only two species have been described, both from twig galls, and three more are here added, also from slight twig swellings at the base of young sprouts underground. As access was had to the types of the described species, a key to the existing species in the genus is here presented.

1. Front wing with the normal pubescent surface and ciliate margin............... 3
   Front wing very *short* pubescent and without the normal ciliate margin........ 2
2. Scutellum mostly rugose, slightly coriaceous on disk. Size 2.8–4.1 mm. Average 3.6 mm. California................................*maculipennis* Ashmead.
   Scutellum disk coriaceous, rugose behind and on sides. Size 2.3–3.0 mm. Average 2.5 mm. Arizona....................................*brunneus* Ashmead.
3. Wings clear..*illinoisensis* Weld, p. 234.
   Wings with basal vein clouded and a more or less distinct transverse cloud or spot on second cross-vein and areolet.. 4
4. Antennae 12-segmented, postocellar line shorter than ocellocular, interocular area square or higher than broad...........................*tenuis* Weld, p. 235.
   Antennae 13-segmented, postocellar line longer than ocellocular, interocular area at least 1.1 times as broad as high.......................*humilis* Weld, p. 236.

32. COMPSODRYOXENUS ILLINOISENSIS, new species.

Plate 35, fig. 28.

Female.—Black with head, except eyes, antennae and legs brownish. Head broader than thorax, widened behind eyes, coriaceous, sparsely pubescent on face, axial line 0.58 of transfacial, interocular area 1.16 times as broad as high, malar space four-tenths length of eye and with fine groove, palpi 5-and 3-segmented, antennae 13-segmented, first, third, and fourth equal, 5-12 progressively shorter, last trifle more than one and one-half times preceding. Pronotum coriaceous on sides. Mesoscutum evenly coriaceous, only little longer than wide, parapsides faint, deeper posteriorly, lateral and anterior lines present. Scutellum coriaceous on disk becoming rugose behind, with a few scattered setigerous punctures, arcuate furrow at base on which are several longitudinal ridges. Propodeum with two straight carinae inclosing a smooth area slightly longer than wide and wider at the top and with faint median ridge. Mesopleura coriaceous becoming polished on hind margin. Legs microscopically coriaceous also, all last tarsal segments infuscated, tarsal claws simple. Wings clear with brown veins, first and second cross-veins slightly clouded, areolet present, surface pubescent and margin ciliate. Abdomen much compressed, higher than long, smooth and polished, second segment occupying about half the length and with a few scattered hairs on each side at base. Hypopygium prominent, ventral spine twice as long as broad, ventral valves protruding at an oblique angle, ovipositor when dissected out nearly one and two-thirds as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.16; antenna, 2.5; ovipositor, 4.4; wing, 3.8.

Range in length of 23 pinned specimens is 1.8–2.7 mm. Average, 2.1 mm.

Type.—Cat. No. 22580, U. S. N. M. Type and 12 paratypes.

Host.—*Quercus macrocarpa* Michaux.

Gall.—Cells in the thickened bark at the crown of small sapling causing an abrupt swelling of four to five times the normal diameter of the shoot and extending for a distance of as far as 30 cm., or in bark at base of young shoots in such numbers as to cause a noticeable swelling. Almost wholly buried under the débris on forest floor. Resembles the gall of the sexual generation of *Callirytis futilis* (Osten Sacken) on roots of large trees of *Quercus alba*, except that cells are smaller.

Type locality.—Winnetka, Illinois. One gall was found October 22, 1914, and contained living adults. Another was found November 1, with adults emerging, and they continued to come out until November 11. Another gall was found at Fort Sheridan, Illinois, on October 3, 1914, and living flies were cut out of it on October 29.

33. COMPSODRYOXENUS TENUIS, new species.

Plate 36, fig. 29.

Female.—Species nearly black, head (except eyes) and thorax being more or less brownish, antennae and tarsi still lighter brown. Head broader than thorax, axial line 0.55 of transfacial, face closely punctate, frons and cheeks coriaceous, broadened slightly behind eyes, malar space one-fifth eye with parallel striae, interocular area not as wide as high, antennocular space less than ocellocular, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 12-segmented, first, third, and fourth equal, 7–11 getting gradually shorter and barrel-shaped, last a little over twice as long as preceding which is a little longer than broad, distal two-thirds stout. Pronotum coriaceous on sides. Mesoscutum slightly longer than broad, coriaceous with distinct smooth parallel and lateral lines and well-separated parapsides obsolete anteriorly and in which are a few scattered punctures visible in balsam, separated from scutellum by a distinct suture. Scutellum rugose, with arcuate reticulate furrow at base. Propodeum with two parallel carinae inclosing a smoothish area in which is a faint median ridge, spiracular areas reticulate. Legs with hind tarsus shorter than tibia, claws simple. Wings with distinct brown veins, first abscissa of radius arcuate, areolet indistinct, surface pubescent, margin ciliate, a transverse clouded area extends from origin of radius nearly across wing, first cross-vein also slightly clouded. Abdomen strongly compressed, as deep or deeper than long, smooth and shining, hypopygium prominent with ventral spine about as long as broad, ventral valves protruding obliquely, ovipositor when dissected out longer than antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.25; antenna, 2.28; ovipositor, 3.1; wing, 3.4.

Length of 8 pinned specimens 1.7–2.1 mm. Average, 1.9 mm.

Type.—Cat. No. 22579, U. S. N. M. Four cotypes.

Host.—*Quercus fendleri* Liebmann.

Gall.—A slight gradual enlargement at crown of small saplings which are 3–15 mm. in diameter. The larval cells are not scattered uniformly but occur in nests of three or four to a dozen cells under the bark in a sort of depression or pocket in the wood.
The cells are white, brittle, thin-walled, about 2–3 mm. in diameter.

Type locality.—Trinidad, Colorado. The type galls were collected July 10, 1916. They then contained pupae, and when cut open September 16 living flies were obtained. Natural emergence date unknown. Similar but larger old galls were collected at Las Vegas, New Mexico.

34. COMPSODRYOXENUS HUMILIS, new species.

Female.—Nearly black; head, thorax, base of abdomen more or less brownish. Head broader than thorax, interocular area 1.1 times as broad as high, malar space nearly 0.4 eye and with parallel striae, palpi 5- and 3-segmented, antennae 13-segmented, first, fourth and fifth subequal, third slightly longer than first, last twice as long as preceding, flagellum darker distally. Pronotum coriaceous. Mesoscutum broader than long, coriaceous, parapsides faint, broadly separated behind. Scutellum rugose, with arcuate furrow at base without septum and not limited laterally, slightly margined behind. Propodeum with usual parallel ridges and a distinct median. All last tarsal segments infuscated, claws weak, simple, divergent. Wing with distinct dark veins, first abscissa of radius arcuate and about half length of second, areolet present, first cross-vein heavily clouded, large transverse cloud in radial area, surface pubescent, margin ciliate. Abdomen broader than long, smooth and polished, second segment occupying about half the length. Hypopygium prominent, ventral spine twice as long as broad, ventral valves protruding at an oblique angle, ovipositor when dissected out longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.2–1.3; antenna, 2.4; ovipositor, 3.1–3.3; wing, 3.2.

Range in length of 15 pinned specimens 1.9–2.2 mm. Average, 2.0 mm.

Type.—Cat. No. 22831, U. S. N. M. Type and 8 paratypes.

Host.—*Quercus chapmani* Sargent and *Quercus stellata* Wangenheim.

Gall.—A slight spindle-shaped enlargement at base of one-year-old sprouts in patches of runner oak. In autumn they are on current year's growth. Maximum diameter of gall is about twice that of normal shoot. Cells are scattered, not nested, just under the bark, about 1.5 by 2.0 mm. and extending about 1.25 mm. into the wood, the deeper part narrower.

Habitat.—Type locality, Ocala, Florida. The galls were collected October 30, 1919, in a patch of *Quercus chapmani*, Hopkins U. S. No. 15634*c*. These galls then contained larvae and pupae. The type fly was cut out January 12, 1920. Other galls were collected on same oak at Green Cove Springs, November 23, 1919, containing adults which were cut out on December 1. One gall was taken on *Quercus stellata* October 11 at Marianna, and lighter colored flies similar in structure were cut out December 6.

Genus BELONOCNEMA Mayr.

This genus is based on a species producing a fleshy root gall on live oak in Florida. Ashmead described it as *Dryorhizoxenus floridanus* and sent material to Europe where Mayr described it also. In Transactions American Entomological Society (vol. 13, p. 63), Ashmead acknowledges that Mayr's name of *Belonocnema treatae* has precedence. In Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien (vol. 52, p. 287), Mayr states that the correct spelling of his genus is *Belonocnema*.

In Psyche (vol. 10, p. 150) Ashmead has erroneously placed the genus in that section of the key with undeveloped wings, whereas flies of both sexes have normal wings. He also erred in considering the palpi as 6– and 4–segmented. Balsam mounts of type material show that the maxillary palpi are 5– and the labial 3–segmented. If the scutellum is considered to have an arcuate furrow at the base without pits, the genus would run in the Ashmead key to *Dryocosmus*, and if bifoveolate as Ashmead stated to *Biorhiza*. From either it is easily separated by the characteristic spur at the apex of the front tibiae and by the clouded veins about the short marginal cell.

KEY TO DESCRIBED SPECIES.[6]

1. Spur on front tibia as long as metatarsus, twice as long as furcula. Middle tibia with distinct spur. Abdomen reaching far beyond apex of radial cell. No areolet .... *fossoria* Weld, p. 240.
   Spur on front tibia one-fourth length of metatarsus, not longer than furcula, No spur or middle tibia. Abdomen reaching only to base of radial cell. Areolet present 2
2. Thorax clear straw yellow. Females, 3.0–4.4 mm. Average of 23, 3.7 mm. Males 3.4–3.75 mm. Average of 9, 3.6 mm .... *treatae* Mayr. p. 238.
   Thorax dark brown. Agamic females, 2.0–3.1 mm. Average of 47, 2.7 mm. *kinseyi* Weld, p. 241.

35. BELONOCNEMA TREATAE Mayr.

Dryorhizoxenus floridanus ASHMEAD Trans. Amer. Ent. Soc., vol. 9, 1881, Proc. p. xxv; vol. 12, 1885, p. 293; vol. 13, 1886, p. 63.

Belenocnema treatae MAYR Genera Gallenb. Cynip., 1881, p. 17; 20 Jahresber. Com. Oberrealsch. I Bez. Wien, 1881, p. 17 note.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 131.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 26. 1909, p. 278, pl. 51, fig. 1.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 5, 36.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54, fig. 65, I.

Belonocnema treatae Mayr, ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, p. 133.—CRESSON, Syn. Amer. Hym., p. 174.—ASHMEAD, in Packard 5th Rept. U. S. Ent. Comm., p. 104.—DALLA TORRE and KIEFFER, Wytsman Gen. Ins. Cynipidae, 1902, p. 80, No. 2; Das Tierreich, Lief. 24, 1910, p. 725.

Belonocnema floridanus Ashmead CRESSON, Syn. Amer. Hym., 1887, p. 174.

The type galls of this species were found while ploughing under a live oak (*Quercus virginiana* Miller) in March. They were just below the surface on the small rootlets (up to 10 mm. in diameter) and in clusters every 4 or 5 inches. They are described as irregular, somewhat wedge-shaped, soft and fleshy, easily detached, of a yellowish color, the first true root gall to be described in this country. Two hundred flies were reared. The galls are still preserved in the United States National Museum, black or brownish and very similar to the dried galls of the sexual generation of *Trigonaspis*.

The writer has never seen the fresh galls, but on two occasions has found the dried-up galls of what was probably this species on the roots of *Quercus geminata* Small, at St. Petersburg and Clearwater, Florida, in November. In each case they were on the roots of saplings whose leaves bore immense numbers of globular, tan-colored galls, described in 1861 by Osten Sacken as *Cynips q. virens*. This suggests that these pea galls on leaf might be the alternating generation of *Belonocnema treatae*, but further observations or experimental evidence will be necessary to prove it. The type galls[7] in the United States National Museum have a label in Doctor Ashmead's hand "agamic female of *B. treatae* Mayr," showing that he had already suspected this relationship. The writer also has reared adults from these leaf-pea galls and they prove to be all females and to belong

[6] For discussion of *Belonocnema colorado* Gillette see p. 205.

[7] Three agamic flies from Jacksonville, Florida, also bear the same label.

to the genus *Belonocnema*, thus strengthening the supposition. The writer thus proposes to transfer the maker of this oak leaf-pea gall to *Belonocnema*, leaving the proof of the association with *treatae* to others. It appears, however, that the maker of these pea galls is still undescribed. Ashmead reared a single fly in February supposedly from over 200 of these galls and described it as *Cynips q. virens*, transferring it to *Andricus* later, but the type fly in the United States National Museum has a question mark after the genus. This type is in bad condition, but agrees with the description, and is plainly a *Disholcaspis* and agrees with *Disholcaspis ficigera*, a gall of which had evidently been mixed in with the others by mistake, and such a gall was found in the Ashmead duplicate gall collection in a box of oak leaf-pea galls which may have been his breeding cage. Thus the single fly reared was associated with the wrong gall, a mistake which would not have occurred had the species been described from adequate material. As the classification of the Cynipidae must be based upon the adults rather than upon their work, the maker of the stem gall known in literature as *ficigera* must take the oldest name applied to it, namely, *virens*, and the maker of the leaf gall needs description. However the leaf-pea gall-fly of Florida proves to be different from those from similar galls in Texas so that there are two species to describe. Although somewhat outside the scope of the present paper, these changes are here included, and the synonomy of each species follows, together with field notes on each.

DISHOLCASPIS VIRENS (Ashmead).

Cynips q. ficus Ashmead, Trans. Amer. Ent. Soc., vol. 9, 1881, Proc., p. 14, gall only.

Cynips q. ficigera Ashmead, Trans. Amer. Ent. Soc., vol. 12, 1885, Proc., p. 6, female and gall.

Holcaspis ficigera Ashmead, Trans. Amer. Ent. Soc., vol. 12, 1885, p. 296 (*Loxaulis* is typo. error); vol. 14, 1887, p. 132.—Cresson, Syn. Amer. Hymen., 1887, p. 179.—Ashmead, in Packard 5th Rept. U. S. Ent. Comm., 1890, p. 106.—Dalla Torre, Cat. Hymen., vol. 2, 1893, p. 56.—Bridwell, Trans. Kansas Acad. Sci., vol. 16, 1899, p. 204.—Dalla Torre and Kieffer in Wytsman Gen. Ins. Hymen. Cynipidae, 1902, p. 54.—Beutenmueller, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 40, pl. 8, figs. 2–5.—Thompson, Cat. Amer. Ins. Galls, 1915, p. 10, 27, 39.

Disholcaspis quercus-ficigera Ashmead, Dalla Torre and Kieffer, Das Tierreich, Lief. 24, 1910, 379.

Disholcaspis ficigera Ashmead, Felt, Key to Amer. Ins. Gall, N. Y. St. Mus., Bull. 200, 1918, p. 71, fig. 64, 2–5.

Host.—*Quercus virginiana* Miller and *Quercus geminata* Small.

Habitat.—The writer has collected galls on *Quercus virginiana* at Jacksonville, Gainesville, Ocala, Cottondale, Marianna, River Junction, Carrabelle, Live Oak, and Daytona, Florida; Savannah, Georgia; and Cuero, Texas. He has galls from Mobile Bay (James Hayes), Billy Island, Georgia (Dr. J. C. Bradley); and Victoria County, Texas

(J. D. Mitchell). He has collected galls on *Quercus geminata* at Carrabelle, Clearwater, and Daytona Beach, Florida.

Biology.—Growing galls are found in October secreting honey-dew and frequented by flies, wasps, and yellow jackets. Galls from Texas sent to Evanston, Illinois, gave flies December 14. Others remained inside the galls and were cut out alive on December 20 and February 6. Under natural conditions emergence is probably in late fall. When attacked by quest-flies, which make cells in distal parts of the gall, the size of the gall is much reduced.

BELONOCNEMA FOSSORIA, new species.

Cynips q. virens OSTEN SACKEN, Proc. Ent. Soc. Phila., vol. 1, 1861, p. 57, No. 2, gall only.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 9, 1881, Proc., p., 10.

Andricus virens ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, 1885, p. 295; vol. 14, 1887, p. 127.—CRESSON, Syn. Amer. Hymen., 1887, p. 176.—ASHMEAD, in Packard 5th Rept. U. S. Ent. Comm., 1890, p. 106.—COCKERELL, Entomologist, vol. 23, 1890, p. 74.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 103.—DALLA TORRE and KIEFFER, in Wytsman Gen. Ins. Hym. Cynipidae, 1902, p. 65.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 16, 29, 34.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 95.

Andricus quercus-virens Ashmead, DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 547.

Agamic female.—Uniformly reddish. Head quadrangular, width 2.8 times length of eye. Interocular space 0.72 transfacial and area twice as broad as high. Facial line 0.82 times transfacial. Malar space 0.63 eye, groove shallow. Palpi 5 and 3. Antennae 13; lengths as 19:7:19:13:11:10:10:10:9:9:9:9:18. On same scale width from 7 to end is 8. Mesoscutum smooth and polished, grooves percurrent. Scutellum faintly margined, disk granulate. Wing longer than abdomen but reduced, veins about radial cell clouded, no areolet, pubescent and ciliate. Legs short and stout, evidently adapted for digging, furcula of fore tibia reaching beyond middle of metatarsus, spur on middle tibia as long as normal spines, claws simple. Hypopygium short, ventral spine broad, short. Ovipositor longer than antenna, stout. Using width of the head as a base the length of mesonotum ratio is 1.1, antenna, 1.8-2.0, ovipositor 1.9-2.2, wing 2.6-2.9. Range in length of 22 pinned specimens 2.3-3.1 mm. Average 2.7 mm.

Type.—Cat. No. 24099, U.S.N.M. Type and 10 paratypes.

Host.—*Quercus geminata* Small, and *Quercus virginiana* Miller.

Gall.—Globular, hard, tan-colored galls occurring in numbers on the under side of the leaf. Monothalamous, 4–6 mm. in diameter, of dense cellular tissue.

Habitat.—The type material is from galls collected at Clearwater, Florida, November 7, 1919, on *geminata* and sent in as Hopkins U. S. No. 15634[f]. Flies issued December 8. Three paratypes from Jacksonville are probably from *virginiana*. The writer has seen galls at

Jacksonville, Daytona, Tallahassee, and Gainesville on *virginiana* and on *geminata* at St. Petersburg and Daytona Beach. Dr. J. C. Bradley has collected galls at St. Simon's Island, Georgia.

BELONOCNEMA KINSEYI, new species.

Agamic female.—Reddish-brown, thorax darker. Head broader than thorax, width 2.4 times length of eye, finely coriaceous, malar space with groove and less than half length of eye, antennocular space two-thirds ocellocular, interocular area nearly 1.6 times as broad as high, transfacial line 1.1–1.2 times facial, palpi 5- and 3-segmented, antennae 13-segmented, third one and two-thirds times fourth, 4–12 gradually shorter, last just over twice preceding. Pronotum with scattered punctures bearing white hairs. Mesonotum shining, smooth, bare except for a few setigerous punctures along the complete, deep, narrow parapsides, anterior and lateral lines very faint. Scutellum rugose behind and on sides of disk, with scattered setigerous punctures; base with two smooth distinct pits, sides with triangular rugose impressions. Propodeum with two strongly curved irregular ridges inclosing a rugose area. Front tibia prolonged on one side into a curved spine ending in a short blunt spine and almost as long as the normal forked spine on the other side. Hind tarsus shorter than tibia, second shorter than fifth, tarsal claws simple. Wings hyaline, veins brown, second cross-vein heavily clouded, second abscissa of radius strongly bent and thickened at apex, areolet small and indistinct, cubitus reaching basal, surface brown pubescent and margin ciliate. Abdomen smooth and shining, compressed, longer than high, second segment with dorsal darker area and patch of scattered hairs on sides, ventral spine about as long as broad, ovipositor three-fourths length of antenna, eggs well developed. Using the width of the head as a base, the length of antenna ratio is 2.3–2.5; length of mesonotum ratio, 1.3; wing, 3.8–3.9; ovipositor, 1.8–2.0.

Range in length of 62 pinned specimens, 2.0–3.1 mm. Average, 2.7 mm.

Mr. A. C. Kinsey was the first to call the writer's attention to the fact that adults bred from these leaf galls did not agree with the description of *Andricus virens* Ashmead. Later an examination of the type of *virens* showed it to be a *Disholcaspis*.

Type.—Cat. No. 22832, U. S. N. M. Twenty-seven cotypes. Fifteen cotypes are in collection of William Beutenmueller.

Host.—*Quercus virginiana* Miller.

Gall.—Similar to those of *Belonocnema fossoria* Weld.

Habitat.—The type material is from *Quercus virginiana* collected October 26, 1917, at Boerne, Texas. The galls then contained pupae and adults. Flies emerged in cage before November 15, and one more was found alive in cage March 23, 1918. These galls were also seen at Houston, Wharton, Victoria, Cuero, and Austin, Texas, in October, 1917, and at Sabinal and Kerrville, Texas, in July, 1918. The galls are found full grown by the end of July, contain pupae in October, and adults emerge in November.

36. WELD 405.

Plate 37, fig. 32.

Host.—*Quercus rubra* Linnaeus and *Quercus nigra* Linnaeus.

Gall.—A polythalamous, somewhat globose, gall with a smooth brown surface, 15 mm. in diameter, attached at the crown and hidden under humus. When mature the epidermis disintegrates revealing a cluster of whitish, longitudinally ridged, relatively large woody cells.

Habitat.—Old galls were collected at Ironton, Missouri, on *Quercus rubra* October 5, 1917, and at Gainesville, Florida, October 23, 1919, on *Quercus nigra.*

37. WELD 704.

Host.—*Quercus fendleri* Leibmann.

Gall.—Cylindrical, acuminate at apex, thin-walled, smooth, 5 mm. long by 2 mm. in diameter, attached near fork at base of small sprouts at surface of ground, very easily detached.

Habitat.—Collected at Trinidad, Colorado, July 11, 1916, and one at Morley, Colorado, April 2, 1918.

38. WELD 706.

Host.—*Quercus gambelii* Nuttall and probably other Rocky Mountain oaks.

Gall.—Cluster of several dozen hairy brown cells that are probably fleshy when fresh, at end of vigorous etiolated shoots coming up under loose stone piles or under mass of humus. It is probably a spring gall. The clusters measure up to 2–3 cm. in diameter.

Habitat.—Collected old galls in July, 1916, at Trinidad, Colorado; Las Vegas, and Rito de los Frijoles near Buckman, New Mexico; Grand Canyon and Flagstaff, Arizona.

39. WELD 707.

Plate 37, fig. 35.

Host.—*Quercus emoryi* Torrey.

Gall.—Similar in size and appearance to that of *Eumayria floridana* Ashmead.

Habitat.—Old galls found at Prescott, Arizona, April 13, 1918.

40. WELD 708.

Host.—A deciduous oak.

Gall.—On under side of main root in clump of small bushes, single, or if clustered only one well developed, 5 mm. in diameter, surface brown, hairy, wall thin and cavity large.

Habitat.—Collected at Las Vegas, New Mexico, April 4, 1918.

41. WELD 1501.

Plate 37, fig. 33.

Host.—*Quercus agrifolia* Née, *Quercus wislizeni* A. de Candolle *Quercus californica* Cooper.

Gall.—Abrupt oblong swellings at base of sprouts which are only a few millimeters in diameter. The gall may measure 25–35 mm. in diameter by 35–75 mm. long. It is hard and woody when dry, covered with normal brown bark which is not much thickened. Cells radially arranged in pockets in the wood. Exit holes with a characteristic smooth ring.

Habitat.—The writer has collected old galls on *Quercus wislizenii* on Mount Tamalpais, in San Gabriel and San Antonio River canyons in San Gabriel Mountains, in Ojai Valley, and at Santa Margarita, California; on *Quercus agrifolia* at Newhall, near Carpinteria, at Santa Margarita, Paso Robles, Paraiso Springs, Monterey, and Los Gatos; on *Quercus californica* at Dunsmuir and in Sequoia National Park. Fresh galls nearly full grown but too immature for rearing were seen only once at Monterey, on May 11, 1918.

42. WELD 407.

Plate 37, fig. 36.

Host.—*Quercus laceyi* Small.

Gall.—Dried-up galls, 5 mm. in diameter, were found at base of stump in the late fall. They were globular, with a slight pedicel, produced in a cluster. Probably a fleshy spring gall of the *Trigonaspis* type.

Habitat.—Boerne, Texas.

43. WELD 408.

Plate 37, fig. 34.

Host.—*Quercus laceyi* Small and *Quercus virginiana* Miller.

Gall.—Confluent, globular, dried-up galls, 4 mm. in diameter, in a small cluster, pubescent on surface. Found in fall on young shoots of live oak buried under thick bed of dead leaves and on *laceyi* attached to a large root.

Habitat.—Boerne and Cuero, Texas.

EXPLANATION OF PLATES.

Figures natural size except where otherwise noted.

PLATE 28.

FIG. 1. Galls of *Disholcaspis acetabula* Weld.
2. Galls of *Disholcaspis lacuna* Weld.
3. Galls of *Disholcaspis terrestris* Weld on *Q. stellata.*

PLATE 29.

FIG. 4. Galls of *Disholcaspis globosa* Weld.
5. Fresh galls of *Dryocosmus favus* Beutenmueller on *Q. rubra.*
6. Same. Old gall on *Q. catesbaei.*
7. Same. Individual galls cut longitudinally, × 5.

PLATE 30.

FIG. 8. Galls of *Trigonaspis radicola* Ashmead.
9. Galls of *Biorhiza caepuliformis* (Beutenmueller).
10. Galls of *Xystoteras contorta* Weld on *Q. breviloba.*
11. Same. On *Q. stellata.*

PLATE 31.

FIG. 12. Galls of *Odontocynips nebulosa* Kieffer.
13. Gall of *Andricus championi* Ashmead.

PLATE 32.

FIG. 14. Galls of *Andricus rhizoxenus* (Ashmead) on *Q. reticulata.*
15. Galls of *Callirhytis hartmani* Weld.
16. Galls of *Callirhytis corallosa* Weld on *Q. chapmani.*
17. Same. On *Q. macrocarpa.*

PLATE 33.

FIG. 18. Galls of *Callirhytis maxima* Weld.
19. Galls of *Callirhytis enigma* Weld on *Q. catesbaei.*
20. Same. Individual old galls, × 5.
21. Galls of *Callirhytis futilis* Osten Sacken (Agamic generation).

PLATE 34.

FIG. 22. Galls of *Callirhytis apicalis* (Ashmead).
23. Galls of *Callirhytis ovata* Weld.
24. Galls of *Callirhytis fulva* Weld.
25. Galls of *Bassettia floridana* Ashmead, × 2.

PLATE 35.

FIG. 26. Gall of *Callirhytis elliptica* Weld, × 5.
27. Galls of *Eumayria floridana* Ashmead.
28. Gall of *Compsodryoxenus illinoisensis* Weld.

PLATE 36.

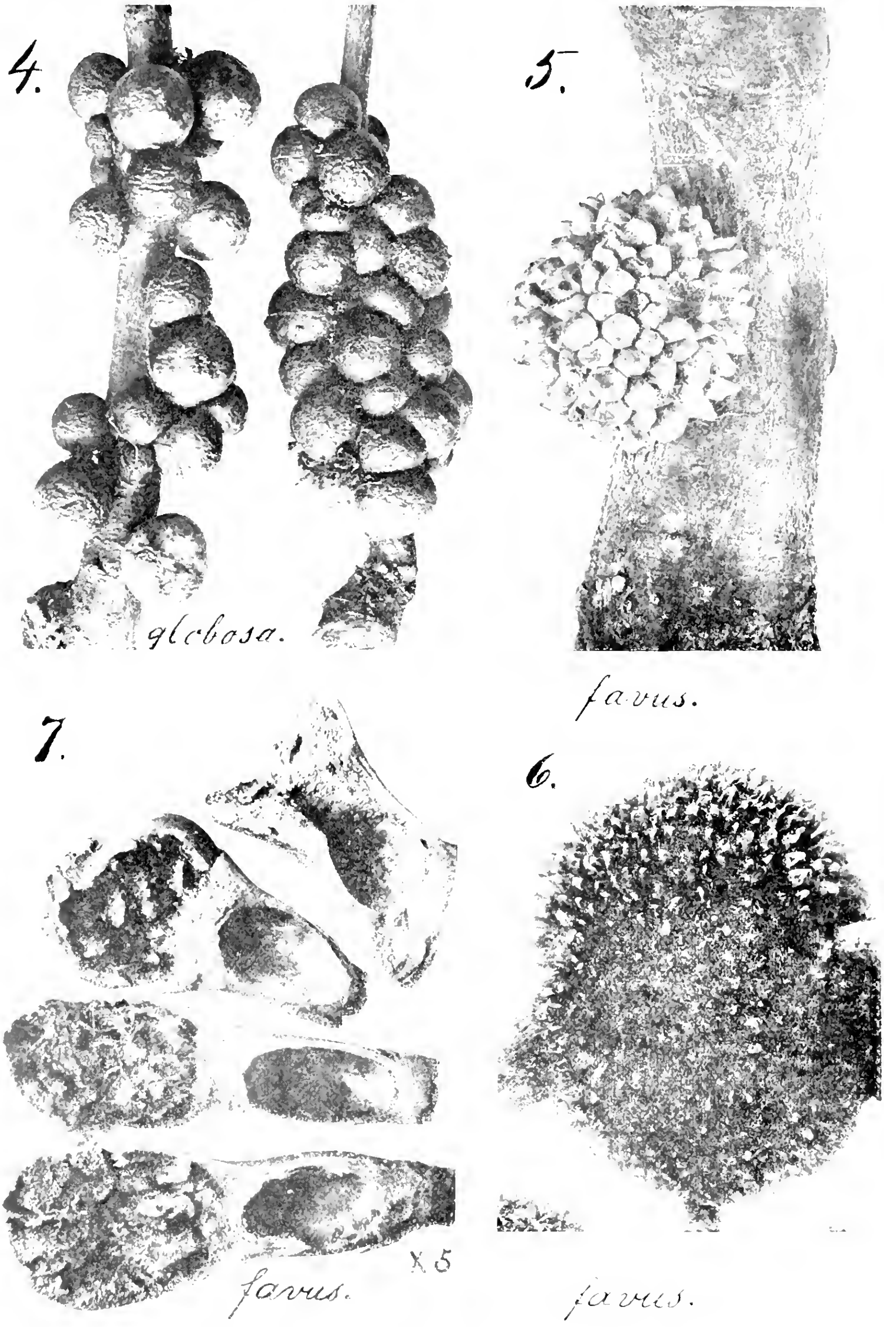
FIG. 29. Galls of *Compsodryoxenus tenuis* Weld.
30. Galls of *Callirhytis ellipsoida* Weld.
31. Galls of *Callirhytis rubida* Weld.

PLATE 37.

FIG. 32. Weld 405.
33. Weld 1501.
34. Weld 408.
35. Weld 707.
36. Weld 407.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



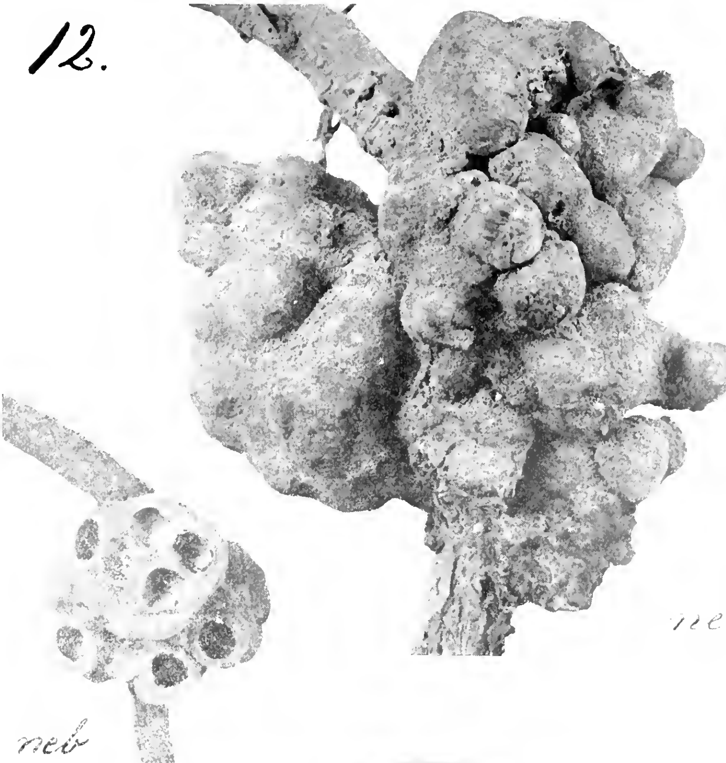
AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.

American Gallflies of the Family Cynipidae.

For explanation of plate see page 244.

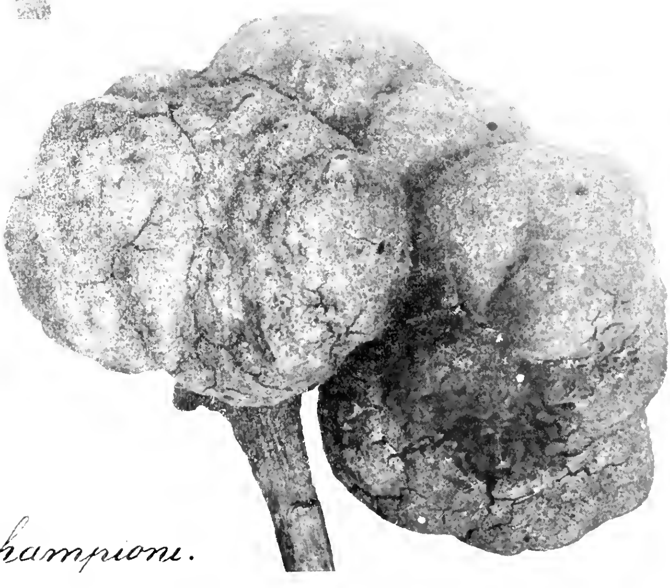
12.



nebulosa.

neb

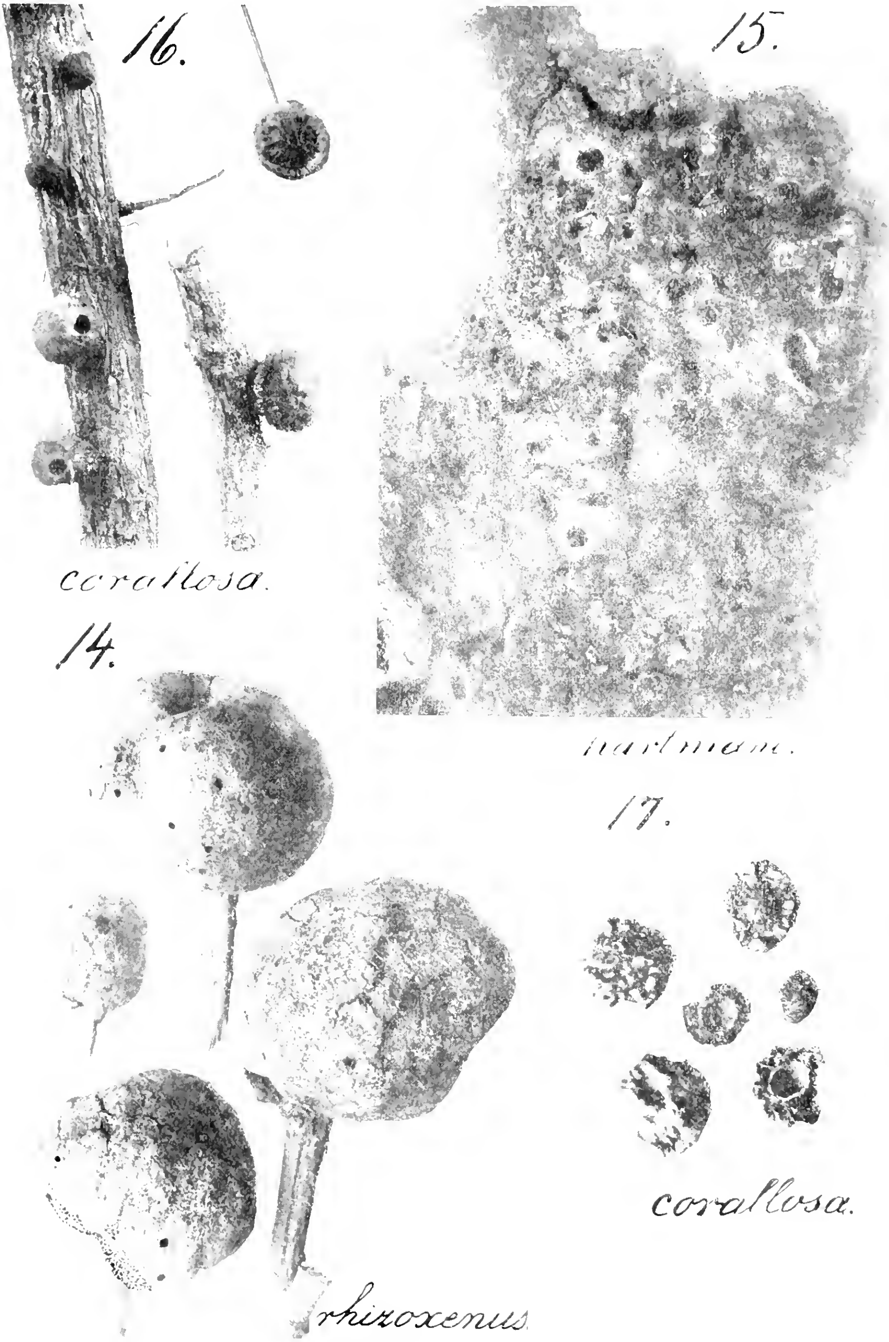
13.



championi.

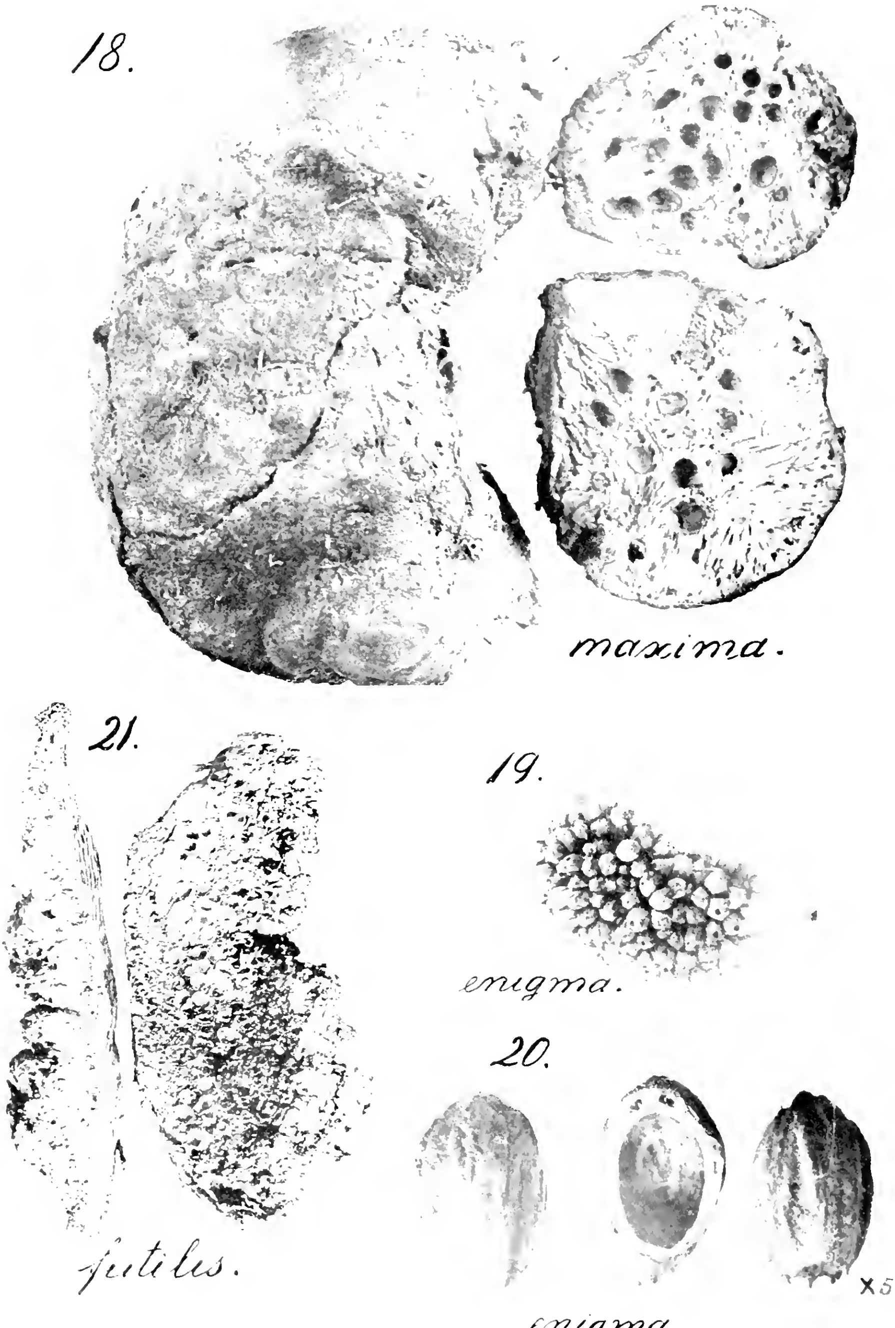
AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



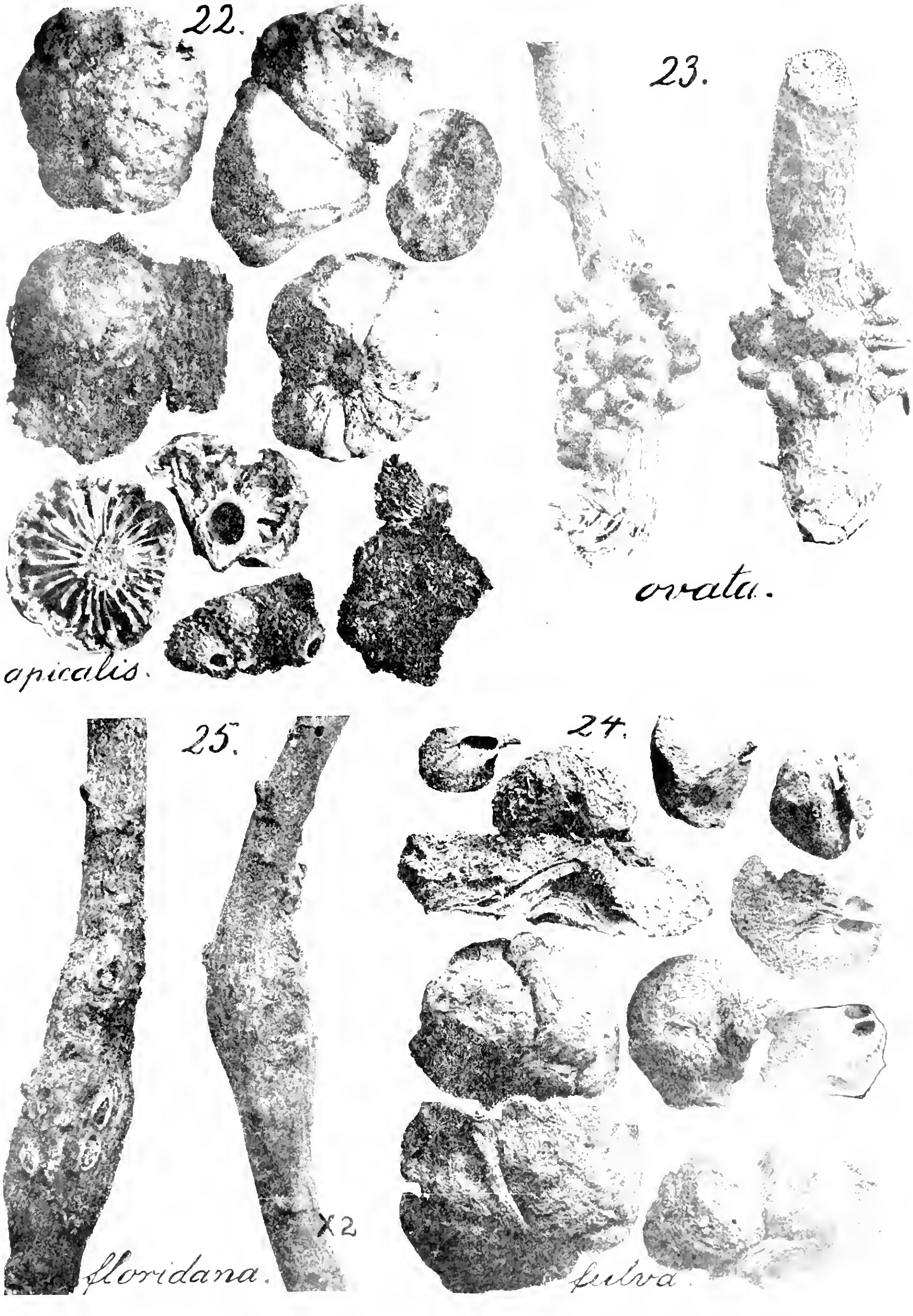
AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

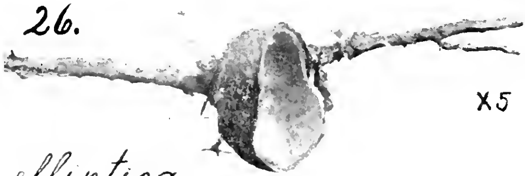
FOR EXPLANATION OF PLATE SEE PAGE 244.



AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

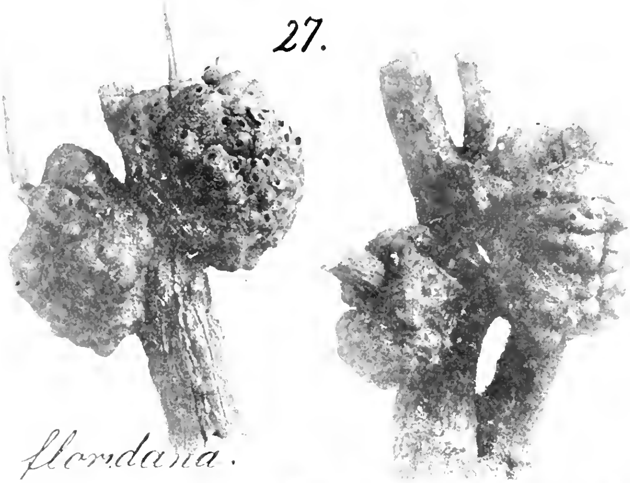
FOR EXPLANATION OF PLATE SEE PAGE 244.

26.



elliptica.

27.



floridana.

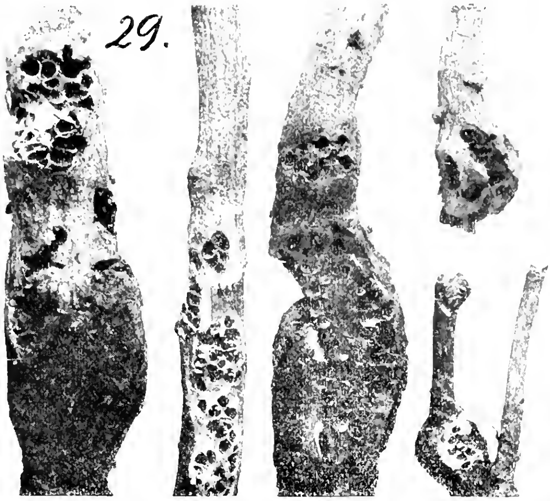
28.

illinoisensis.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244

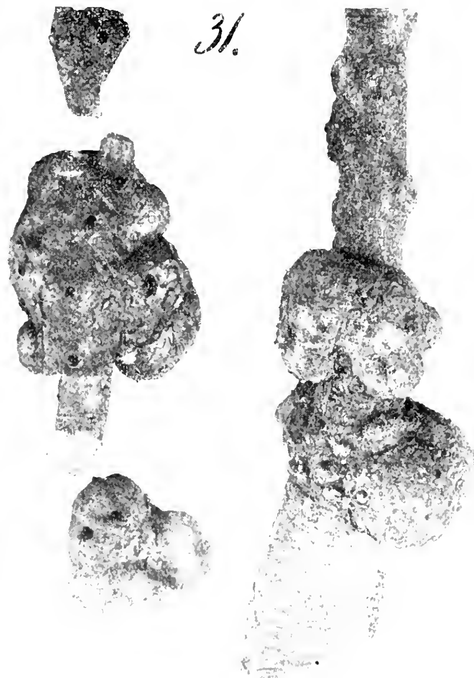
29.



tenuis.

30.

31.

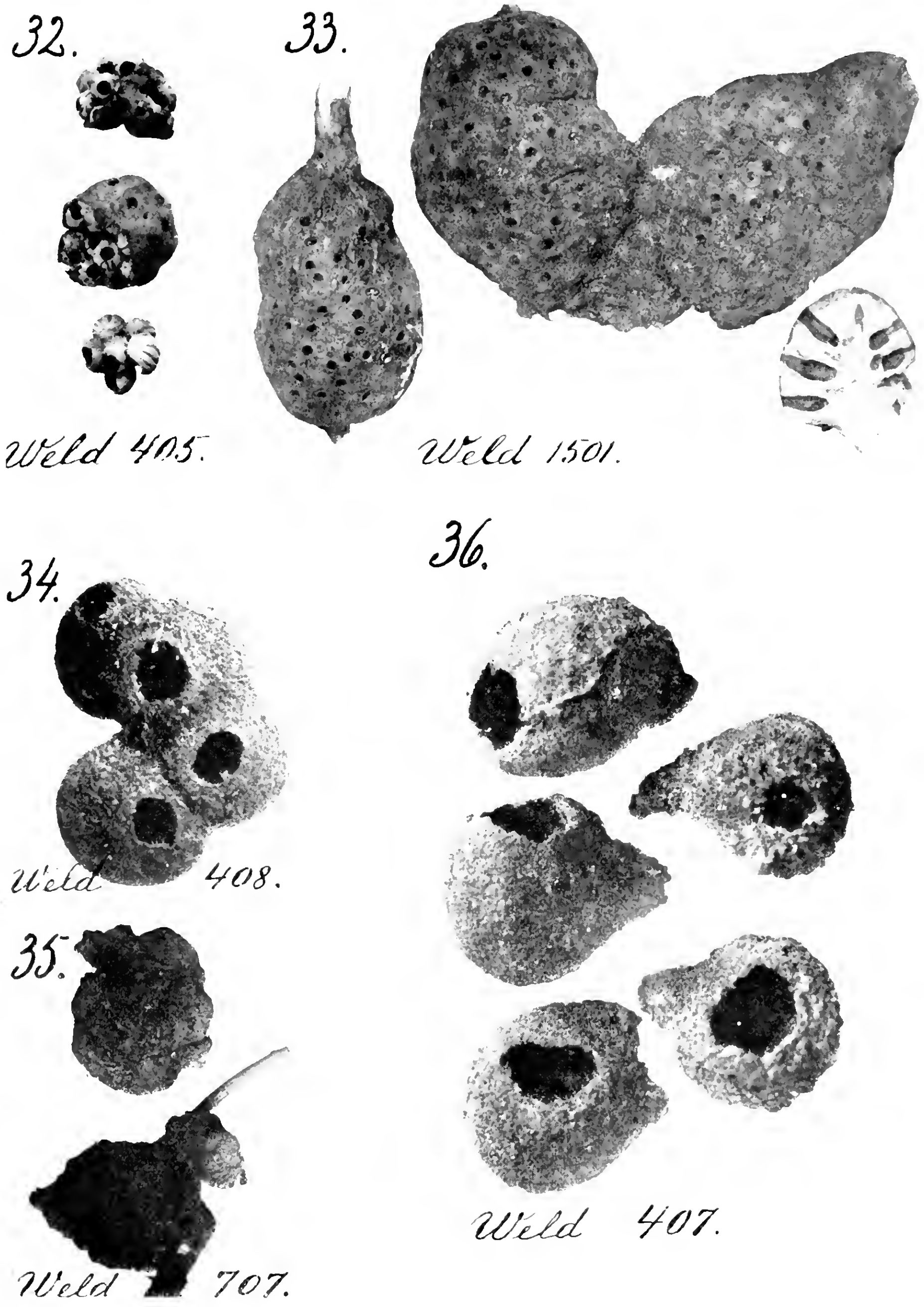


ellipsoida.

rebuda.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.

SPECIES INDEX.

This index includes all species referred to in this paper. Generic names are in bold face and synonyms in italics.

HOST INDEX.

NEW MOLLUSKS FROM CAMAGUEY AND SANTA CLARA PROVINCES, CUBA.

By Carlos de la Torre,
Of the University of Havana,
and
John B. Henderson,
Of Washington, District of Columbia.

The new mollusks herein described are of the genera *Opisthosiphon* and *Eutudora* only, and are all from the Cubitas range of mountains in Northern Camaguey or from certain detached portions of the system lying to the east near the boundary line of the Oriente Province, or to the west, near, or just over, the boundary line of the Santa Clara Province. New species of other genera from the same general region will be published in a forthcoming paper, when a full discussion of the notable features of this somewhat isolated faunula may more properly be presented. A brief description of the Sierra de Cubitas has, however, already appeared.[1] A few species of the Urocoptidae from this region have been described, and these will be included in the forthcoming paper referred to. But one species of *Opisthosiphon* [2] of this region has heretofore appeared in print, and that one is herein republished in order to complete this list of the Annulariidae.

As one of the genera and two of the subgenera to which all these new species are referred are of so recent creation, it may be well to refer to their descriptions in the Proceedings of the United States National Museum (vol. 58, pp. 49–82). The subgenus *Opisthosiphon* includes species of the genus *Opisthosiphon* destitute of spiral sculpture outside of the umbilical walls, the typical subgenus admitting these species possessing spiral sculpture on the spire of the shell even though obsolete.

The genus *Eutudora* includes species with a typical Tudoroid operculum but having some form of breathing device to enable the animal to obtain air when the aperture is closed by withdrawal of the operculum. The subgenus *Eutudorops* includes members of *Eutudora* that possess an axial sculpture rendered wavy or articulate by more or less obsolete spiral cords.

[1] Nautilus, vol. 29, No. 2, p. 17, June, 1915.
[2] *O. berryi* Clapp, Nautilus, vol. 32, No. 3, p. 86, January, 1919.

The following are the species of these groups so far known from the region in question:

Opisthosiphon (*Opisthosiphona*) *berryi* Clapp.

Opisthosiphon (*Opisthosiphona*) *berryi berryi* Clapp.

Opisthosiphon (*Opisthosiphona*)*berryi semiapertum*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *paredonense*, new species.

Opisthosiphon (*Opisthosiphona*) *paredonense paredonense*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *paredonense transitorium*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *obturatum*, new species.

Opisthosiphon (*Opisthosiphona*) *obturatum obturatum*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *obturatum subobturatum*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *obturatum banaoense*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *apertum*, new species.

Opisthosiphon (*Opisthosiphona*) *dalli* Torre and Henderson.

Opisthosiphon (*Opisthosiphona*) *bioscai*, new species.

Opisthosiphon (*Opisthosiphona*) *bioscai bioscai*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *bioscai tersum*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *salustii*, new species.

Opisthosiphon (*Opisthosiphona*) *evanidum*, new species.

Opisthosiphon (*Opisthosiphona*) *evanidum evanidum*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *evanidum degeneratum*, new subspecies.

Opisthosiphon (*Opisthosiphona*) *occultum*, new species.

Opisthosiphon (*Opisthosiphon*) *protractum*, new species.

Opisthosiphon (*Opisthosiphon*) *judasense*, new species.

Opisthosiphon (*Opisthosiphon*) *detectum*, new species.

Opisthosiphon (*Opisthosiphon*) *obtectum*, new species.

Opisthosiphon (*Opisthosiphon*) *obtectum obtectum*, new subspecies.

Opisthosiphon (*Opisthosiphon*) *obtectum tenuicostum*, new subspecies.

Opisthosiphon (*Opisthosiphon*) *lamellicostatum*, new species.

Eutudora (*Eutudorops*) *paradoxum*, new species.

OPISTHOSIPHON (OPISTHOSIPHONA) BERRYI Clapp.

Opisthosiphon berryi Clapp, Nautilus, vol. 32, No. 3, 1919, p. 86, pl. 7, fig. 14.

Plate 38, figs. 1–4.

Shell longitudinally finely plicate, ochraceous buff, encircled with a broad chocolate-brown band on the periphery of the last whorl and on the lower half of the earlier whorls; slightly shining; decollated. Suture deep, crenate, four or five spiral ridges appearing on the umbilical region. Remaining whorls four, very convex. Aperture vertical, circularly oval; peristome white, double; the inner, a brief continuation of the whorl; the outer, on the right side, smooth, slightly expanded, at the suture broadly expanded and excavated over the breathing tube, adnate to the penultimate whorl; columellar margin expanded horizontally above in a broad flange adnate to the penultimate whorl, a large lobe curving over and nearly covering the umbilical region, interrupted below by a broad sinus where the lip is abruptly reflexed and attached to the whorl, a smaller lobe expanded horizontally below. A minute breathing pore within the aperture near the posterior angle connects with a tube, somewhat concealed in the expanded and excavated lip, which, curving back to the suture, descends and ends in the narrow space between the ultimate and penultimate whorls. Numerous strong raised lamellae mostly originating on the inner lip, but occasionally extending along the parietal lip, cover that portion of the tube visible within the lip. Operculum as in *Opisthosiphon pupoides* Morelet.

Type.—In the collection of the Museum of Comparative Zoology, Cat. No. 42005. It was collected by Dr. S. S. Berry at Cairije, Cerro de Tuabaquey, Province Camaguey, Cuba, and measures: Length, 13.5 mm.; greater diameter, 9 mm.; lesser diameter, 7.3 mm.; altitude of aperture, 4.7 mm.; width of aperture, 4 mm. A paratype from the same locality is in Doctor Berry's collection. It measures: Length, 14.5 mm.; greater diameter, 9.7 mm.; lesser diameter, 7.5 mm.; altitude of aperture, 5.5 mm.; width of aperture, 4.3 mm.

OPISTHOSIPHON (OPISTHOSIPHONA) BERRYI BERRYI Clapp.

Plate 38, figs. 1–4.

This, the typical subspecies, is characterized by the greater expansion of the peristome which completely conceals the umbilicus. It appears to be confined to the locality given for Mr. Clapp's type.

OPISTHOSIPHON (OPISTHOSIPHONA) BERRYI SEMIAPERTUM, new subspecies.

Plate 38, figs. 5–8.

The rather solid shell is ovate conic with open umbilicus partially concealed by the inner expansion of the peristome; decollated, leaving three and a half to four convex whorls. The color is ochraceous buff to very light yellow or straw—(*a*) unicolor, (*b*) with a single narrow or broad band of chestnut, (*c*) with several revolving rows of small rufous spots. The suture is deeply impressed and more or less irregularly crenulate by the thickening of the axial lirae into hollow white bulbs, becoming larger and more prominent on the summit of the last whorl, especially near the aperture. The sculpture consists of axial lirae, more widely spaced upon the earlier whorls, but quite densely disposed upon the last whorl. Within the umbilical region are five or six low cords crossed by the axial threads. The vertical aperture is ovate, pointed above. The peristome is double consisting of an inner peritreme but slightly produced, and an outer peritreme moderately expanded on the outer margin but considerably so on the inner, where it is recurved and bent back partially to conceal the umbilicus and then becoming adnate to the penultimate whorl, it again expands above the aperture into a deeply laminated pointed extension and bent back from the plane of the aperture. From this upper expansion and back of it projects a siphonal tube, which extends downward between the last and penultimate whorls and opens into the umbilical space. This tube communicates with the interior of the last whorl through the opening just back of the aperture in the upper angle of the whorl. The operculum is normal.

Type.—Cat. No. 314945, U.S.N.M., a female specimen, comes from the Circulo cave in the Province of Camaguey, Cuba, and measures: Length, 13 mm.; greater diameter, 9 mm.; lesser diameter, 7 mm.; length of aperture within, 5 mm.; width of aperture within, 3.5 mm.

Measurements of other specimens are as follows: Male, length, 9.75 mm.; greater diameter, 8.1 mm.; lesser diameter, 5.75 mm.; length of aperture within, 4 mm.; width of aperture within, 3 mm. Female, length, 16.5 mm.; greater diameter, 11.25 mm.; lesser diameter, 8.75; length of aperture within, 6 mm.; width of aperture within, 5 mm.

Specimens were collected in the following localities in the Province of Camaguey, Cuba: Cerro de Tuabaquey, El Cercado, San Francisco, Cueva del Circulo, La Loma, Corral de Cairije, Los Cangilones, etc., all in the eastern part of the Sierra de Cubitas, by Biosca, Torre, Henderson, Simpson, Sifontes, and Salustio Garcia. This species was first found by Federico Biosca, professor of natural history in the Institute of Camaguey.

This subspecies differs from the typical subspecies chiefly in the lesser expansion of the peristome over the umbilicus and in its greater color variation.

OPISTHOSIPHON (OPISTHOSIPHONA) PAREDONENSE, new species.

Plate 38, figs. 9–11.

The shell is oblong-ovate, quite solid, umbilicated, truncated, leaving three and a half to four convex whorls. The last whorl is solute for a distance of about two millimeters. The suture is deep and irregularly crenulate. The color range is from a pale russet to purplish brown, sometimes unicolored, but generally encircled below the periphery by a band of dark purple. The sculpture consists of axial threads more widely spaced upon the early postnuclear whorls and increasing in number upon the succeeding whorls. On the last whorl the riblets are densely crowded (eight to nine to one millimeter).

At the summit of the whorls, just below the suture, many of the riblets are expanded into hollow bulbs, often several meeting to form one bulb. Spiral sculpture consists only of about twelve low cords within the umbilical region. The aperture is vertical, oval, somewhat pointed above; the peristome is duplex, the inner peritreme is not produced; the outer peritreme is but slightly expanded, evenly so all around in the typical form, not so in another subspecies; above the posterior angle of the aperture the expanded peristome is gathered into a triangular projection ending in a short siphonal tube, which curves backward and then toward the penultimate whorl. The tube communicates with the interior of the shell at a point just back of the aperture in the posterior angle. Operculum typical. Type measurements are given under subspecies.

OPISTHOSIPHON (OPISTHOSIPHONA) PAREDONENSE PAREDONENSE, new subspecies.

Plate 38, figs. 9-11.

This, the typical subspecies, is characterized by the even expansion of the peristome about the aperture. It never touches the whorl above.

Type.—A female specimen, Cat. No. 314946, U.S.N.M., comes from Los Paradones, Camaguey Province, Cuba. It measures: Length, 10.75 mm.; greater diameter, 9.4 mm.; lesser diameter, 7 mm.; length of aperture within, 5.5 mm.; width of aperture within, 4 mm. Another specimen, a male, measures: Length, 10.75 mm.; greater diameter, 8.15 mm.; lesser diameter, 6.7 mm.; length of aperture within, 4.5 mm.; width of aperture within, 3.8 mm.

Representatives of this subspecies come from Camaguey Province, Cuba at Los Paradones, a narrow pass through the Cubitas range of mountains. They were collected by Salustio Garcia, Pablo Sifontes, Torre, Henderson, and Simpson.

OPISTHOSIPHON (OPISTHOSIPHONA) PAREDONENSE TRANSITORIUM, new subspecies.

Plate 39, figs. 1-2.

A subspecies distinguished from the typical subspecies by reason of the uniformly greater expansion of the peristome on the inner side. This is not, however, carried to the extent sufficient to conceal the umbilicus, but it does touch or impinge upon the next whorl above. All other features are identical.

Type.—Cat. No. 314947, U.S.N.M., is from the entrance of La Guanaja or Paso del Este, in the Cubitas Mountains, Camaguey Province, Cuba, and measures: Length, 11.8 mm.; greater diameter, 8.5 mm.; lesser diameter, 6.75 mm.; length of aperture within, 4.5 mm.; diameter of aperture within, 3.5 mm. It is a female specimen.

Male specimens are smaller.

OPISTHOSIPHON (OPISTHOSIPHONA) OBTURATUM, new species.

Plate 39, figs. 3–6.

The shell is ovate-conic, decollated, thin but solid, umbilicus either entirely closed by an affixed and adnate expansion of the peristome or partially so by a less expanded peristome. The color is of a light straw to dark russet, unicolored or with one dark chestnut band; none are dotted. Whorls are convex with a deeply impressed suture which is crenulated by the thickening of alternate lirae into hollow white bulbs. The last whorl is adnate or slightly solute. The sculpture consists of axial threadlike riblets which are not increased in number upon the later whorls, there being about four to each millimeter. Spiral sculpture is confined to about four or five low cords within the umbilical region. These are not apparent in perfect specimens where the umbilicus is hidden by the peristome expansion. The aperture is vertical, oval, and slightly arched above. The double peristome is white. The inner peritreme is not projecting but slightly recurved over the outer peritreme. The latter is expanded all around, evenly and regularly so on the outer side. On the inner side it abruptly curves down to close completely or partially the umbilicus and to cover a space along the penultimate whorl. Finally, above the posterior angle of the aperture it again expands into a concave triangular-shaped projection which is a part of and supports a siphon which bends back and down to terminate in the suture just back of the aperture. The surface of the expanded outer peritreme is concentrically ribbed, most prominently so in the triangular projection above. The operculum is normal, but shows an individuality in that the calcareous portion does not reach to the edge of the basal horny plate. A tendency is also shown in the slight raising of the edges of the lamellae to suggest the Annularia structure.

Three subspecies are indicated:

OPISTHOSIPHON (OPISTHOSIPHONA) OBTURATUM OBTURATUM new subspecies.

Plate 39, figs. 3–6.

This, the typical subspecies, is characterized by the extreme expansion of the peristome which completely covers and seals the umbilicus and becomes adnate to the adjoining whorl. The last whorl is not solute.

Type.—Cat. No. 314948, U.S.N.M., is from Paso de Lesca (or Cocinas) in the Sierra de Cubitas, Camaguey Province, Cuba. It measures: Length, 15 mm.; greater diameter, 10 mm.; lesser diameter, 8.5 mm.; length of aperture within, 6 mm.; diameter of aperture within, 4 mm. It is a female specimen.

Taken also at the Paso de la Escalera near Ermita Vieja in the same range of hills, by Torre, Henderson, and Simpson.

OPISTHOSIPHON (OPISTHOSIPHONA) OBTURATUM SUBOBTURATUM, new subspecies.

Plate 39, figs. 7–11.

This subspecies differs from the typical form in that the umbilicus is not wholly closed nor concealed by the expansion of the peristome and in that the last whorl is shortly solute. The color is generally dark and shows a tendency in some specimens to a single narrow dark band.

Type.—A female, Cat. No. 314949, U.S.N.M., was collected by Torre, Henderson, and Simpson in the cave of Los Indios in the District of Banao, western part of the Cubitas range, Province of Camaguey, Cuba, and measures: Length, 13.9 mm.; greater diameter, 8.9 mm.; lesser diameter, 7.5 mm.; length of aperture within, 4.6 mm.; diameter of aperture within, 3.75 mm.

OPISTHOSIPHON (OPISTHOSIPHONA) OBTURATUM BANAOENSE, new subspecies.

This form resembles the typical subspecies in having the umbilicus wholly sealed over by the expanded peristome, or, if not actually sealed and closed thereby, at least wholly covered and concealed. The only persistent difference is one of size, specimens of this form being uniformly smaller. As in *Opisthosiphon* (*Opisthosiphona*) *obturatum*, shells are usually banded. The color of the tip and first nepionic whorl is reddish.

Type.—Cat. No. 314950, U.S.N.M., was collected by Torre near Banao, in the western part of the Cubitas range, Camaguey Province, Cuba, and measures: Length, 11.75 mm.; greater diameter, 8.75 mm.; lesser diameter, 7.4 mm.; length of aperture within, 4.9 mm., diameter of aperture within, 3.4 mm.

OPISTHOSIPHON (OPISTHOSIPHONA) APERTUM, new species.

Plate 40, figs. 1 and 3.

The shell is ovate-conic, rather solid, umbilicated, decollated, narrowly truncated, leaving four convex whorls, the last being shortly solute. The color is usually a pale straw of bright luster, but some specimens are darker even to rich wine color. The lighter tinted shells have a narrow reddish brown sub-peripheral band. The sculpture consists of fine axial threads, more widely spaced and elevated upon the earlier postnuclear whorls, but more crowded and flatter on the last whorl. Most of the axial threads are expanded into very minute white bulbs at the suture, forming an inconspicuous irregular crenulation. Spiral sculpture confined to nine to ten low inconspicuous cords within the umbilicus. The aperture is vertical, oval, and obtusely pointed above. The double peristome has the inner peritreme scarcely projecting, and the outer peritreme but slightly expanded on the right, but somewhat more so on the left or inner side, though not reflected over the umbilicus nor sufficiently extended to touch the adjoining whorl. Above the posterior angle of the aperture the peristome forms a triangular projection merging into a siphon which recurves and points back toward the adjacent whorl, though not usually forming a contact with it. The siphon communicates with the interior of the shell by a hole just within the aperture. The operculum is typical.

Type.—A female specimen, Cat. No. 314951, U.S.N.M., was collected by Torre at Paso de Lesca in the Cubitas Mountains, Camaguey Province, Cuba, and measures: Length, 12.8 mm.; greater diameter, 9.75 mm.; lesser diameter, 7.4 mm.; length of aperture within, 5 mm.; width of aperture within, 4 mm. A male specimen from the same locality measures: Length, 10.9 mm.; greater diameter, 9 mm.; lesser diameter, 6.4 mm.; length of aperture within, 4 mm.; width of aperture within, 3.5 mm.

This species is characterized by its open umbilicus, moderate expansion of the peristome, inconspicuous sutural crenulation, and its shining surface.

OPISTHOSIPHON (OPISTHOSIPHONA) DALLI Torre and Henderson.

Plate 40, figs. 2, 8, 9.

Opisthosiphon dalli TORRE and HENDERSON, A New Opisthosiphon from Cuba. Privately published June 25, 1920.

Opisthosiphon (*Opisthosiphona*) *dalli* HENDERSON and BARTSCH, Proc. U. S. Nat. Mus., vol. 58, p. 68, 1920.

The shell is turbinate, solid, widely umbilicated, with the apex decollated, leaving three and a half to four convex whorls, the last being solute for a short distance, and carinated at the summit of the solute portion. The shell is of a pale brown color without trace of either bands or spots, the apical portion being conspicuously light reddish. The sculpture consists of densely crowded axial threads which are somewhat more distantly spaced upon the earlier postnuclear whorls. Some of these axial threads are very minutely expanded into denticles at the summit, but not sufficiently so to lend a crenulated appearance to the deeply impressed sutures. The spiral sculpture consists of about ten or twelve low rounded cords within the umbilicus. The vertical aperture is roundly oval with a posterior angle. The peristome is not obviously double as the inner peritreme is but slightly expanded and reflected over and appressed to the outer. The outer peritreme is but slightly expanded on the outer side; on the inner side it is flatly expanded, though not sufficiently so to cover any portion of the umbilicus, nor more than sufficient barely to touch the preceding whorl. At the posterior angle of the aperture the peristome extends into an upward expansion forming an open siphonal tube. The operculum is typical of the genus.

Type.—Cat. No. 314941, U.S.N.M., is from the cave of El Circulo.

Measurements are: Length, 12.5 mm.; major diameter, 11.5 mm.; minor diameter, 8.75 mm.; length of aperture, 5.5 mm.; width of aperture, 4.5 mm.

This species is found at Camaguey Province, Cuba, on rocks about the entrance of La Cueva del Circulo in the eastern portion of the Cubitas Mountains.

This very handsome species is easily distinguished by its hard polished old-ivory surface which, to the naked eye, seems to be sculptureless and smooth, by its globose shape and relatively greater proportion of breadth to length, and, finally, by its reddish tip and entire lack of color bands or spots.

OPISTHOSIPHON (OPISTHOSIPHONA) BIOSCAI, new species.

Plate 40, figs. 4 and 6.

The shell is ovate-oblong, rather thin but strong; apex decollated, leaving three and a half to four moderately convex whorls, the last being very slightly solute. The umbilicus is (*a*) almost wholly closed or (*b*) partially so by an expansion of the inner peristome. The color is of a very light straw ranging through slightly darker yellowish tints to an amber or wine color. A series of brown spots encircles all the whorls, there being five such series on the last whorl of the holotype, but as many as eight in some specimens. In no instance are there solid color bands. The sculpture consists of axial thread-like riblets somewhat arched forward below the suture and never quite regularly disposed. In the typical subspecies these riblets are coarser (five to the millimeter) and these are partially effaced in the middle portion of the whorls, especially on the last two. In another subspecies the axial threads are finer (ten to the millimeter) and are not effaced. At the sutures, which are deeply impressed, most of the riblets, either singly or in tufts, form hollow white bulbs projecting up to touch the next whorl above, thus irregularly crenulating the sutures. A series of spiral cords are present within the umbilicus. These are crossed by the axial threads forming small projecting lamellar processes at the intersections. The vertical aperture is ovate and obtusely angled above. The peristome is double, having an inner peritreme that hardly projects and an outer peritreme which is but moderately expanded on the outer side but widely so on the inner side, even to covering (*a*) almost wholly, or (*b*) partially the umbilical opening above which it spreads over and (*a*) becomes adnate to the adjacent portion of the contiguous whorl or (*b*) merely touches it; it then forms above the aperture a delta-shaped expansion, roughly laminated on its face. This expansion supports and partially merges into a recurving siphon which bends down into the space back of the solute portion of the last whorl. This siphon opens into the shell by a small puncture just back of the aperture.

Measurements are given under the subspecific heads.

This species seems to be more generally distributed throughout the Cubitas range than any other of the group. In the various localities from which it has been taken some divergence in minor details is noted, but the two following subspecies account for the major differences in the shell characters.

OPISTHOSIPHON (OPISTHOSIPHONA) BIOSCAI BIOSCAI, new subspecies.

Plate 40, figs. 4 and 6.

This, the typical subspecies, is determined by the following three characters: The maximum expansion of the peristome, which almost wholly covers the umbilicus, though never quite closing it; the coarser axial riblets (five to the millimeter), which are more strongly developed in the upper and lower portions of each whorl, and, finally, the uniformly larger size of the shell.

Type.—A female specimen, Cat. No. 314952, U.S.N.M., from El Cercado measures: Length, 15 mm.; greater diameter, 9.25 mm.; lesser diameter, 7.5 mm.; length of aperture within, 4.5 mm.; width of aperture within, 3.75 mm. A male specimen measures: Length, 11.75 mm.; greater diameter, 7.75 mm.; lesser diameter, 6 mm.; length of aperture within, 3.75 mm.; width of aperture within, 3 mm.

Specimens were collected at El Cercado and Los Cangilones, San Francisco, Paredones, Paso de la Escalera, de las Cocinas, de las Trincheras, all in the Cubitas Mountains, Camaguey Province, Cuba, by Torre, Henderson, Simpson, Biosca, and Sifontes.

OPISTHOSIPHON (OPISTHOSIPHONA) BIOSCAI TERSUM, new subspecies.

The shell differs from the typical subspecies in being uniformly smaller, in the finer axial sculpture (ten riblets to the millimeter), in the equal prominence of these axial riblets over the entire portion of each whorl and in the lesser expansion of the peristome over the umbilical region. In many cases the expanded peristome hardly more than touches the whorl above and is never adnate to it.

Type.—A female, Cat. No. 314953, U.S.N.M., from "La Providencia" farm, measures: Length, 11.7 mm.; greater diameter, 7.2 mm.; lesser diameter, 6 mm.; length of aperture within, 3.8 mm.: width of aperture within, 3 mm. A male specimen measures: Length, 9.5 mm.; greater diameter, 7 mm.; lesser diameter, 5.5 mm.; length of aperture within, 3.5 mm.; width of aperture within, 2.9 mm.

This subspecies was collected by Torre, Henderson, and Simpson at "La Providencia," El Cercado, entrance to Paso de Lesca, on a small knoll; Camaguey Province, Cuba.

OPISTHOSIPHON (OPISTHOSIPHONA) SALUSTII, new species.

Plate 40, figs. 5 and 7.

The shell is ovate-conic, rather thin but strong, widely umbilicated, the apex decollated, leaving three and a half convex whorls, the last being shortly solute. The color is a pale straw with three to seven series of brown spots encircling the whorls. The sculpture consists of axial sublamellar riblets, four to the millimeter, on the earlier postnuclear whorls and almost double that number on the last whorl, the spaces between being much wider than the riblets. A mere trace of an obsolete spiral sculpture may be detected in some specimens. At the sutures, every second or third riblet ends in a white lamellar expansion which produces an irregular crenulation along the deeply impressed sutures. There are ten to twelve prominent spiral cords within the umbilicus. The aperture is oblong-oval, obtusely angled above. The double peristome consists of a scarcely projecting inner, and a moderately expanded outer, peritreme The greater expansion is on the inner side but is not sufficient to cover, even partially, the umbilicus, nor actually to touch the adjacent whorl above. Over the angle of the aperture the peristome expands into a delta shaped projection supporting a siphon which bends back and down into the space between the solute last whorl and the whorl above. The operculum is typical of the genus.

The type, Cat. No. 314954, U.S.N.M., is a female specimen from "Santa Rita" farm and measures: Length, 11.5 mm.; greater diameter, 8.25 mm.; lesser diameter, 6.5 mm.; length of aperture within, 4 mm.; width of aperture within, 3.25 mm. Another specimen, a male, measures: Length, 8 mm.; greater diameter, 7.25 mm.; lesser diameter, 5.1 mm.; length of aperture within, 3 mm.; width of diameter within, 2.5 mm.

This subspecies was collected by Salustio Garcia and P. Sifonte at "Santa Rita" farm near La Entrada and El Cercado; near Los Cangilones by the banks of the river Maximus, all in the eastern extremity of the Cubitas Mountains, Camaguey Province, Cuba.

OPISTHOSIPHON (OPISTHOSIPHONA) EVANIDUM, new species.

Plate 41, figs. 1–2.

The shell is elongate-conic, with open umbilicus and apex decollated, the last whorl being solute for a distance of 5 mm. The color is white without trace of color markings of any sort in the type, but showing in a subspecies a feeble tendency to encircling rows of spots. The sculpture consists of axial riblets somewhat irregularly disposed and about twice as numerous on the last whorl as upon the earlier postnuclear whorls, in all cases the intervals between the ribs being wider. At the summit of the whorls every second or third riblet is expanded into a small inconspicuous hollow bulb, giving to the suture an irregular crenulation. Within the umbilicus are about ten low spiral cords. The aperture is vertical, oblong and obtusely angled above; the inner peritreme of the peristone is slightly projecting; the outer peritreme is slightly expanded, a trifle more so on the inner side, but not sufficient even partially to conceal the umbilicus nor to touch the whorl above. Above the aperture the outer peritreme is expanded to form a delta-shaped projection and ending in a siphon which bends back and sometimes downward into the space between the solute last whorl and the whorl above. The operculum is typical of the genus.

This species includes two subspecies as follows:

OPISTHOSIPHON (OPISTHOSIPHONA) EVANIDUM EVANIDUM, new subspecies.

Plate 41, figs. 1–2.

This, the typical subspecies, is distinguishable chiefly by its uniformly greater size and by its whiter coloration.

Type.—Cat. No. 314955, U.S.N.M., is from the estate of "La Loma" near El Tuabaguey in the eastern part of the Cubitas Mountains, in the Province of Camaguey, and was collected by Pablo Sifontes, jr. It measures: Length, 13 mm.; greater diameter, 8.5 mm.; lesser diameter, 6.75.; length of aperture within, 4 mm.; width of aperture within, 3 mm.

OPISTHOSIPHON (OPISTHOSIPHONA) EVANIDUM DEGENERATUM, new subspecies.

Plate 41, figs. 3 and 8.

This subspecies is characterized only by its persistently smaller size, but in all other respects it could hardly be separated from the typical subspecies. The spiral cords within the umbilicus are reduced to the minimum, in some specimens being scarcely observable.

Type.—Cat. No. 314956, U.S.N.M., was collected by Torre and P. Sifontes, Sr., at Santa Cruz, a detached hill, on the right bank of the river Maximus opposite "Los Cangilones" in the Province of Camaguey, Cuba. It measures: Length, 11. mm.; greater diameter, 7.25 mm.; lesser diameter, 5.75 mm.; length of aperture within, 3.75 mm.; width of aperture within, 3 mm.

OPISTHOSIPHON (OPISTHOSIPHONA) OCCULTUM, new species.

Plate 41, figs. 4, 6, and 7.

The shell is ovate-conic, spire decollated, leaving three and a half to four moderately convex whorls, the last very slightly solute, the umbilicus being almost wholly covered by an expansion of the peristome. The color ranges from a light straw to a light amber and is always ornamented by encircling rows of elongated chestnut spots which appear upon the reflected portion of the peristome. These spots are often so exposed as to give an appearance of axial rows as well as spiral; in no instances are there solid color bands. The sculpture consists of axial riblets, more widely spaced upon the early postnuclear whorls and more crowded upon the last whorl, where there are five to six to a millimeter. Many of these axial riblets expand into hollow white bulbs at the suture above, imparting to it an irregualr crenulate appearance. Spiral sculpture is confined to the umbilical wall and consists of a series of low cords which are, in perfect specimens, concealed by the expanded peristome covering the umbilicus. The aperture is vertical, oblong-ovate and obtusely angled above; the peristome is doubled, the inner peritreme of which is decidedly projecting; the outer peritreme is broadly expanded and bent forward on the outer or right side of the aperture; it is less broadly expanded but somewhat fluted at the lower portion of the aperture; on the inner or left side of the aperture it is suddenly recurved back, forming a notch and completely covering the umbilicus except for a slight chink behind the notch; it also covers and is adnate to the whorl above; above the posterior angle the outer peritreme is strongly expanded into a projection affixed to the whorl above on its inner and flaring out on its outer side: the face of this projection is roughly, concentrically ribbed. Back of this projection is a small siphon which deflects backwards and downwards into the narrow space between the solute portion of the last whorl and communicating with the axis of the shell. Communication with the interior of the shell is through a small pore near the anterior angle of the aperture. The operculum is typical of the genus.

Type.—A female specimen, Cat. No. 314957, U.S.N.M., from Loma de Borje, measures: Length, 13.8 mm.; greater diameter, 7.8 mm.; lesser diameter, 6.75 mm.; length of aperture within, 4.6 mm.; width of aperture within, 3.5 mm. The smallest specimen observed in a large series has a length of 10.75 mm.

The type lot is from the Loma de Borje, an isolated hill near the eastern end of the Cubitas range, on the right side of the river Maximus, and was collected by Miss Barbara Hubbard. Other lots are from "Santa Cruz" between "Las Minas" and "Los Cangilones" and in "Yaguajay," all localities in a series of isolated hills near "Borje," in the municipality of Nuevitas, Province of Camaguey, Cuba; collected by Torre.

Specimens from "Borje" are usually somewhat larger than those from other localities.

OPISTHOSIPHON (OPISTHOSIPHON) PROTRACTUM, new species.

Plate 41, figs. 5 and 11.

The shell is oblong-ovate, spire decollated, leaving three and a half whorls moderately convex, the last whorl shortly solute, the umbilicus completely closed by an expansion of the peristome. The suture is deeply impressed and crenulated. The color is chestnut, rather shining and with a series of indistinct interrupted color-bands of a darker chestnut. There are seven of these narrow bands on the body whorl of the type specimen. The sculpture consists of axial threads, somewhat wavy and separated by spaces of double their width. These threads are somewhat more numerous upon the last two whorls than upon the earlier postnuclear ones, there being about six to the millimeter. At the summit of the whorls these threads are somewhat tufted, two or three uniting and expanded into hollow whitish bulbs, thus rendering the sutures irregularly denticulate. Spiral sculpture consists of obsolete cords made visible only by slight swellings at their intersections with the axial threads and only observable near the summits of the early postnuclear whorls. Stronger spiral cords are present on the umbilical walls. The aperture is vertical, oblong-ovate, and hardly angled above; the peristome is double, the inner peritreme of which is considerably produced and sculptured upon its outer side in conformity with the surface of the shell; the outer peritreme is but moderately expanded and somewhat recurved backwards; on the inner side it is extended back and covers closely the umbilicus and is adnate to the adjoining whorl; above the aperture it is irregularly expanded into an ear-shaped projection, which supports a siphon which points directly backward and inward, ending in the space between the solute last whorl and the penultimate whorl. This siphon communicates with the interior of the shell through a small puncture within the aperture at its posterior end. The operculum is typical of the genus.

Type.—Cat. No. 314958, U.S.N.M., was collected by Dr. Thomas Barbour in the Sierra de San Juan de los Perros, near Punta Alegre in the northern part of the jurisdiction of Moron, Province of Camaguey, Cuba. It measures: Length, 16.25 mm.; greater diameter, 9 mm.; lesser diameter, 7.75 mm.; length of aperture within, 5.4 mm.; width of aperture within, 4.25 mm.

Some specimens are lighter in color than the type, in which case the color bands are more readily observed. In no cases are these color bands solid, but are broken more or less into elongated spots.

OPISTHOSIPHON (OPISTHOSIPHON) JUDASENSE, new species.

Plate 41, figs. 9, 10.

The shell is elongate-ovate, the spire decollated, leaving three and a half to four moderately convex whorls, the last being very slightly solute. The sutures are deeply impressed and denticulate. The color ranges from chestnut, in the type, to dark straw and is encircled by a series of interrupted narrow color bands of a darker tint than the background, but very indistinct in the darker specimens. These encircling color bands are produced upon the expanded peristome. The sculpture consists of fine axial threads widely spaced upon the early postnuclear whorls and constantly increasing in number upon the later whorls and reaching their maximum number of ten to the millimeter just back of the aperture. About every second or third of these axial threads are expanded at the summit of the whorls into white hollow sublamellar bulbs. The spiral sculpture is reduced upon the outer surface of the shell to obsolete cords rendered visible only upon the early postnuclear whorls by slight swellings of the axial threads. On the umbilical wall are a number of spiral cords. The vertical aperture is oblong-ovate, not angled above; the peristome is double; the inner peritreme very slightly projecting; the outer peritreme is rather widely expanded, flaring forward except over the umbilical portion, where it is sharply deflected backwards and partially covers the umbilicus, above which it again flares forward and is adnate to the preceding whorl; above the aperture it is expanded backwards into a delta-shaped projection, which is coarsely concentrically ribbed upon its face and terminates in a thick short siphon bent back and downward into the space between the solute last whorl and the adjoining whorl. This siphon communicates with the interior of the shell through a large pore within the posterior margin of the aperture. The operculum is typical of the genus.

Type.—Cat. No. 314959, U.S.N.M., was collected by Doctor Barbour at the Sierra de Judas in the jurisdiction of Mayajigua, Province of Santa Clara, Cuba, and measures: Length, 14.4 mm.; greater diameter, 8.8 mm.; lesser diameter, 6.5 mm.; length of aperture within, 5mm.; width of aperture within, 3.9 mm.

This species differs from its nearest ally by its short inner peritreme, its greatly expanded outer peritreme, and its umbilicus but partially concealed. Its sculpture is much finer upon the last whorls, the axial threads being straighter.

OPISTHOSIPHON (OPISTHOSIPHON) DETECTUM, new species.

Plate 42, fig. 1.

The shell is ovate-conic, the spire decollated, leaving three and a half convex whorls, the last shortly solute, openly umbilicated. The color is light brown suggesting bronze, somewhat darker on the first postnuclear whorl and with no color bands or spots whatever. The sculpture consists of widely spaced axial lamellar riblets; these are very thin and sharp and white in color, each riblet being expanded at the suture above into hollow lamellar tubercles and thus crenulating the deeply impressed suture. These axial riblets possess just below the suture a slight thickening which represents an obsolete spiral cord; on the umbilical wall are several low spiral cords. The aperture is vertical, rounded ovate, but without angle above; the inner peritreme is very slightly projecting; the outer peritreme is moderately expanded throughout and slightly fluted on the inner projection; it is not expanded over the umbilicus, but touches the whorl above. Above the aperture it projects upwards and slightly backwards and merges into a sharply recurved siphon which passes down into the the space behind the solute last whorl. The siphon communicates with the inside of the shell through a pore or small opening within the aperture on its posterior margin. The operculum is typical of the genus.

Type.—Cat. No. 314960, U.S.N.M., was collected by Torre at Las Casimbas de las Llanadas, Sierra de Canoa, Mayajigua, Province of Santa Clara, Cuba. It measures: Length, 10 mm.; greater diameter, 6.8 mm.; lesser diameter, 5 mm.; length of aperture within, 3.25 mm.; width of aperture within, 2.75 mm.

OPISTHOSIPHON (OPISTHOSIPHON) OBTECTUM, new species.

Plate 42, figs. 2–3.

The shell is elongate-ovate, the spire decollated, leaving three and a half whorls which are convex and separated by impressed sutures; the last whorl is scarcely solute. The color is a dark straw, somewhat golden, the first postnepionic whorl being often slightly darker; obsolete color spots are faintly distinguishable on some specimens. The sculpture consists of widely spaced, quite regularly disposed, axial riblets which, in the typical subspecies, are sublamellose. Practically all the riblets are expanded into hollow lamellar white bulbs at the summit of the whorls, thus finely denticulating the sutures; obsolete spiral elements are so reduced as to leave slight traces in a thickening of the axial riblets at the points of intersection. These are to be observed only in the first postnuclear whorls and sometimes not to be detected at all. Low, spiral cords are present on the umbilical wall. The vertical aperture is slightly ovate without angle above; the inner peritreme is projecting and slightly bent outward; the outer peritreme is moderately expanded about evenly on all sides; on the inner side it is suddenly reflected backwards and covers the umbilical opening, though not widely extending over the umbilical region; it then touches and is appressed to the whorl above; above the aperture it is moderately expanded and projected backwards, from which projection begins a recurved siphon which points downward into the widened suture behind the aperture. The siphon communicates with the interior of the shell through a small pore just within the aperture on its posterior margin. The operculum is typical of the genus.

Measurements are given under the subspecific titles.

OPISTHOSIPHON (OPISTHOSIPON) OBTECTUM OBTECTUM, new subspecies.

Plate 42, figs. 2–3.

This, the typical subspecies, has the axial riblets somewhat more pronounced. The outer peritreme is more expanded and the general shape of the shell is more slender than in *Opisthosiphon* (*Opisthosiphon*) *obtectum tenuicostatum.*

Type.—Cat. No. 314961, U.S.N.M., was collected by Torre at El Palenque de Taguayabon, near Remedios. It measures: Length, 13.1 mm.; greater diameter, 8 mm.; lesser diameter, 6 mm.; length of aperture within, 4 mm.; width of aperture within, 3.5 mm. Another specimen, a male, measures: Length, 10.5 mm.; greater diameter, 6.4 mm.; lesser diameter, 5 mm.

This subspecies was also found at the Cuevo del Muerto in the Sierra de Meneses, District of Yaguajay, by Torre; also from the Caverna Las Damas by the bank of the river Zazoe, near Guayos, by Goodrich. These localities are all in the Province of Santa Clara, Cuba.

OPISTHOSIPHON (OPISTHOSIPHON) OBTECTUM TENUICOSTUM, new subspecies.

Plate 42, figs. 4, 5.

This differs from the typical subspecies in its somewhat more inflated form, by the more narrowly expanded peristone and its more flattened axial threads. In this subspecies evidences of spiral sculptural elements, except those within the umbilicus, are almost wholly obsolete.

Type.—Cat. No. 314962, U.S.N.M., was collected by Torre at Cerro de La Puntilla, near Remedios, Province of Santa Clara, Cuba. It measures: Length, 11 mm.; greater diameter, 7 mm.; lesser diameter, 6.1 mm.; length of aperture within 3.9 mm.; width of aperture within, 3.4 mm. A male specimen measures: Length, 9 mm.; greater diameter, 6.25 mm.; lesser diameter, 5 mm.

OPISTHOSIPHON (OPISTHOSIPHON) LAMELLICOSTATUM, new species.

Plate 42, figs 6, 7.

The shell is elongate-conic, the apex decollated, having three and a half to four convex whorls, the last nonsolute; the umbilicus closed by expansion of the peristome; the sutures well impressed. The color is yellowish straw, slightly darker on the first postnuclear whorl; no color bands or spots present. The sculpture consists of widely spaced, regularly disposed, lamellar riblets, somewhat more widely spaced on the early postnuclear whorls. At the summit of the whorls these riblets are expanded into hollow, white, bladelike tubercles which rather regularly crenulate the suture. Between these axial riblets and parallel with them is a series of exceedingly minute crinkly lirations, visible only through a lens; the spiral sculpture is obsolete, being merely indicated by bladelike projections on the axial riblets, more apparent upon the earlier whorls. On the umbilical wall are a number of obsolete axial cords also indicated by a series of flat tubercles upon the axial riblets. The aperture is ovate, obsoletely angled above; the peristome is double, the inner peritreme slightly projecting; the outer peritreme is broadly expanded, about equally so all around, somewhat fluted and coarsely, concentrically sculptured with hollow ribs on its face; at the umbilical region it is suddenly deflected backwards and is closely appressed into the umbilicus, completely sealing it. It is adnate to the whorl above and above the aperture is further expanded into a delta shaped projection, deflected backwards terminating in a siphon which is projected downwards into the suture just back of the aperture; the siphon communicates with the interior of the shell by a puncture just within the aperture at its posterior angle. The operculum is typical of the genus.

Type.—Cat. No. 314963, U.S.N.M., was collected by Torre at Boqueron del Tatibonico, on the boundary between the Provinces of Santa Clara and Camaguey. It is a female specimen, and measures: Length, 12 mm.; greater diameter, 7 mm.; lesser diameter, 5.5 mm.; length of aperture within, 3.5 mm.; width of aperture within, 2.75 mm. A male specimen from the same lot measures: Length, 11 mm.; greater diameter, 6.5 mm.; lesser diameter, 5 mm.

EUTUDORA (EUTUDOROPS) PARADOXUM, new species.

Plate 42, figs. 8, 9.

The shell is elongate-ovate, the apex usually decollated, leaving four to four and a half rather convex whorls, the last slightly solute. Sutures deeply impressed; umbilicus closed by an expansion of the peristome. The color is white, sometimes with a slight yellowish cast, and having six to eight encircling bands of light chestnut spots; some specimens having no color markings whatever. The sculpture consists of axial sublamellar riblets, widely spaced upon the earlier postnuclear whorls, and densely crowded upon the last whorl, where they become threadlike; at the summit of the whorls the riblets are expanded in varying degrees into hollow, narrow bulbs and irregularly crenulate the sutures; spiral sculpture consists of more or less obsolete cords, not always to be distinguished, but generally indicated by prominences upon the axial riblets at their points of intersection. On the umbilical wall the spiral cords are more prominent. The vertical aperature is almost round, without angle above; the inner peritreme is strongly projecting; the outer peritreme consists merely of a slightly exaggerated axial riblet, between which and the rim of the aperture are seven or eight normal axial riblets. The outer peritreme is slightly more expanded on the inner side and is suddenly deflected backward to cover and seal the umbilicus well within the umbilical opening, and is adnate to the whorl above; a small expansion above the aperture is bent backward to form a siphon which projects into the space behind the solute portion of the last whorl; the siphon communicates with the interior of the shell through a puncture just within the aperture in its posterior portion. The operculum is typically Tudoroid, the lamellae springing from the chondroid plate being bent outward to parallel the plate and overlapping to form a flat surface, thus forming a double operculum with a deep groove around its margin.

Type.—A female specimen, Cat. No. 314964, U.S.N.M., was collected by Torre and Sifontes at Santa Cruz Mountains, on the right bank of the River Maximus, opposite Los Cangilones, in the Province of Camaguey, Cuba. It measures: Length, 10.8 mm.; greater diameter, 6 mm.; lesser diameter, 5.25 mm.; length of aperture within, 3.25 mm.; width of aperture within, 3 mm. A male specimen from the same lot, with tip present, measures: Length, 10 mm.; greater diameter, 5.1 mm.; lesser diameter, 4.75 mm.

This species, which bears a strong resemblance through all its shell characters to the numerous species herein described from the same region, must nevertheless be placed in the genus *Eutudora* by reason of its operculum, which is typical of that genus. It falls naturally into the group of *Eutudora torquatum* of the subgenus *Eutudorops*, by reason of its sculptural characters.

EXPLANATION OF PLATES.

Plate 38.

Fig. 1. *Opisthosiphon (Opisthosiphona) berryi* Clapp.
2. *Opisthosiphon (Opisthosiphona) berryi* Clapp.
3. *Opisthosiphon (Opisthosiphona) berryi* Clapp.
4. *Opisthosiphon (Opisthosiphona) berryi* Clapp.
5. *Opisthosiphon (Opisthosiphona) berryi semiapertum*, new subspecies.
6. *Opisthosiphon (Opisthosiphona) berryi semiapertum*, new subspecies.
7. *Opisthosiphon (Opisthosiphona) berryi semiapertum*, new subspecies.
8. *Opisthosiphon (Opisthosiphona) berryi semiapertum*, new subspecies, type.
9. *Opisthosiphon (Opisthosiphona) parcdonense*, new species.
10. *Opisthosiphon (Opisthosiphona) paredonense*, new species.
11. *Opisthosiphon (Opisthosiphona) paredonense*, new species, type.

Plate 39.

Fig. 1. *Opisthosiphon (Opisthosiphona) paredonense transitorium*, new subspecies,
2. *Opisthosiphon (Opisthosiphona) paredonense transitorium*, new subspecies, type.
3. *Opisthosiphon (Opisthosiphona) obturatum*, new species.
4. *Opisthosiphon (Opisthosiphona) obturatum*, new species, type.
5. *Opisthosiphon (Opisthosiphona) obturatum*, new species.
6. *Opisthosiphon (Opisthosiphona) obturatum*, new species.
7. *Opisthosiphon (Opisthosiphona) obturatum subobturatum*, new subspecies, type.
8. *Opisthosiphon (Opisthosiphona) obturatum subobturatum*, new subspecies.
9. *Opisthosiphon (Opisthosiphona) obturatum subobturatum*, new subspecies.
10. *Opisthosiphon (Opisthosiphona) obturatum subobturantum*, new subspecies.
11. *Opisthosiphon (Opisthosiphona) obturatum subobturatum*, new subspecies.

Plate 40.

Fig. 1. *Opisthosiphon (Opisthosiphona) apertum*, new species.
2. *Opisthosiphon (Opisthosiphona) dalli* Torre and Henderson.
3. *Opisthosiphon (Opisthosiphona) apertum*, new species, type.
4. *Opisthosiphon (Opisthosiphona) bioscai*, new species, type.
5. *Opisthosiphon (Opisthosiphona) salustii*, new species.
6. *Opisthosiphon (Opisthosiphona) bioscai*, new species.
7. *Opisthosiphon (Opisthosiphona) salustii*, new species, type.
8. *Opisthosiphon (Opisthosiphona) dalli* Torre and Henderson, type.
9. *Opisthosiphon (Opisthosiphona) dalli* Torre and Henderson.

Plate 41.

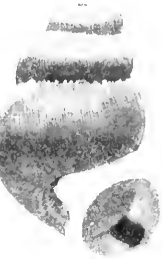
Fig. 1. *Opisthosiphon (Opisthosiphona) evanidum*, new species, type.
2. *Opisthosiphon (Opisthosiphona) evanidum*, new species.
3. *Opisthosiphon (Opisthosiphona) evanidum degeneratum*, new subspecies, type.
4. *Opisthosiphon (Opisthosiphona) occultum*, new species, type.
5. *Opisthosiphon (Opisthosiphon) protractum*, new species.
6. *Opisthosiphon (Opisthosiphona) occultum*, new species.
7. *Opisthosiphon (Opisthosiphona) occultum*, new species.
8. *Opisthosiphon (Opisthosiphona) evanidum degeneratum*, new species.
9. *Opisthosiphon (Opisthosiphon) judasense*, new species.
10. *Opisthosiphon (Opisthosiphon) judasense*, new species, type.
11. *Opisthosiphon (Opisthosiphon) protractum*, new species, type.

PLATE 42.

FIG. 1. *Opisthosiphon (Opisthosiphon) detectum*, new species, type.
2. *Opisthosiphon (Opisthosiphon) obtectum*, new species, type.
3. *Opisthosiphon (Opisthosiphon) obtectum*, new species.
4. *Opisthosiphon (Opisthosiphon) obtectum tenuicostum*, new subspecies, type.
5. *Opisthosiphon (Opisthosiphon) obtectum tenuicostum*, new subspecies.
6. *Opisthosiphon (Opisthosiphon) lamellicostatum*, new species, type.
7. *Opisthosiphon (Opisthosiphon) lamellicostatum*, new species.
8. *Eutudora (Eutudorops) paradoxum*, new species, type.
9. *Eutudora (Eutudorops) paradoxum*, new species.


1


2


3

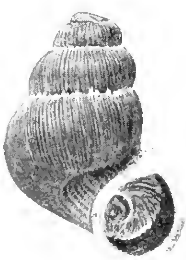

4


5


6


7


8

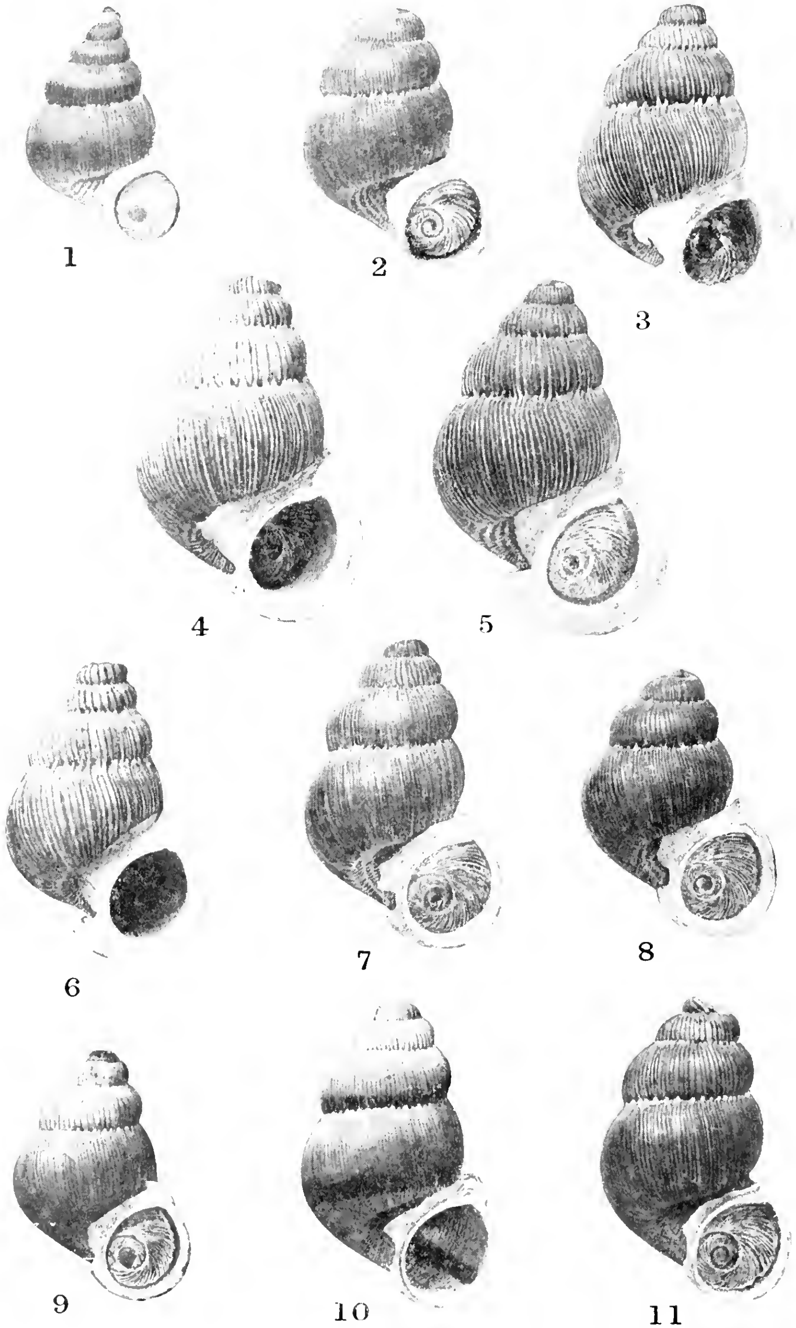

9


10


11

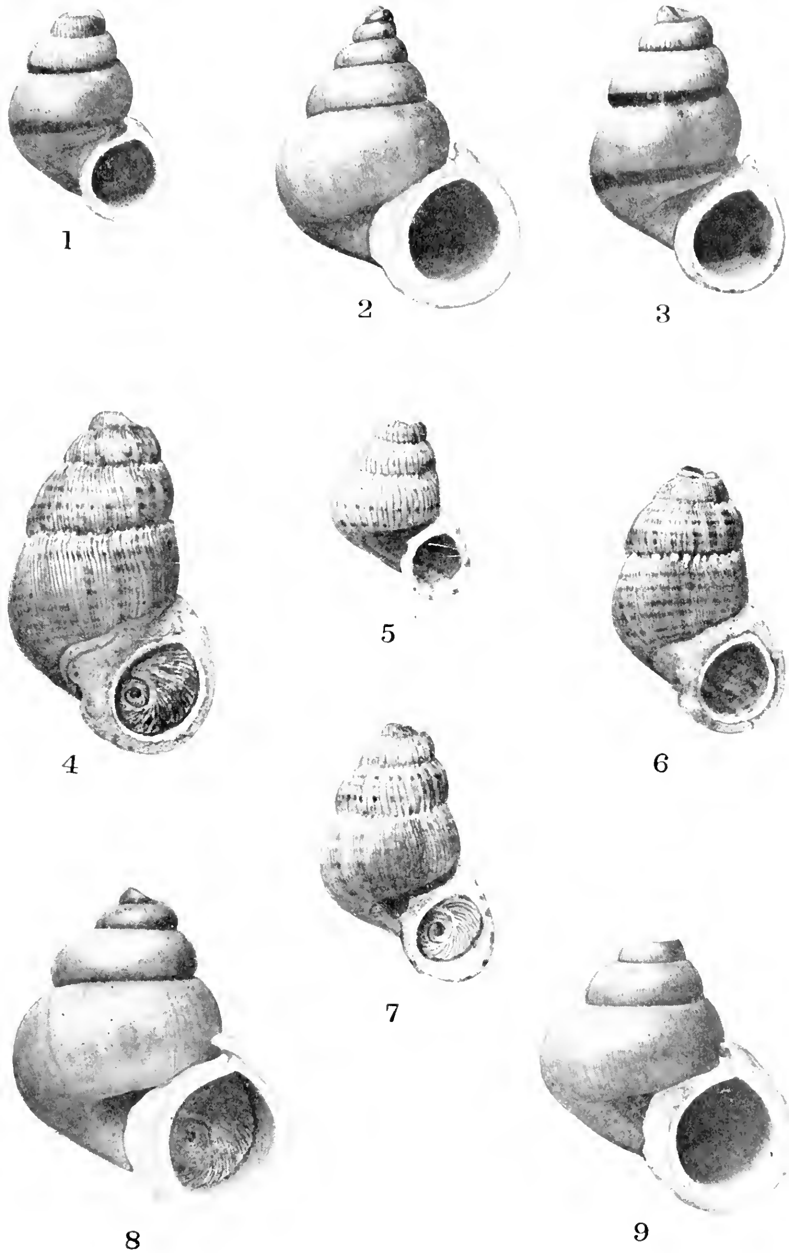
NEW MOLLUSKS FROM CUBA.

FOR EXPLANATION OF PLATE SEE PAGE 267.



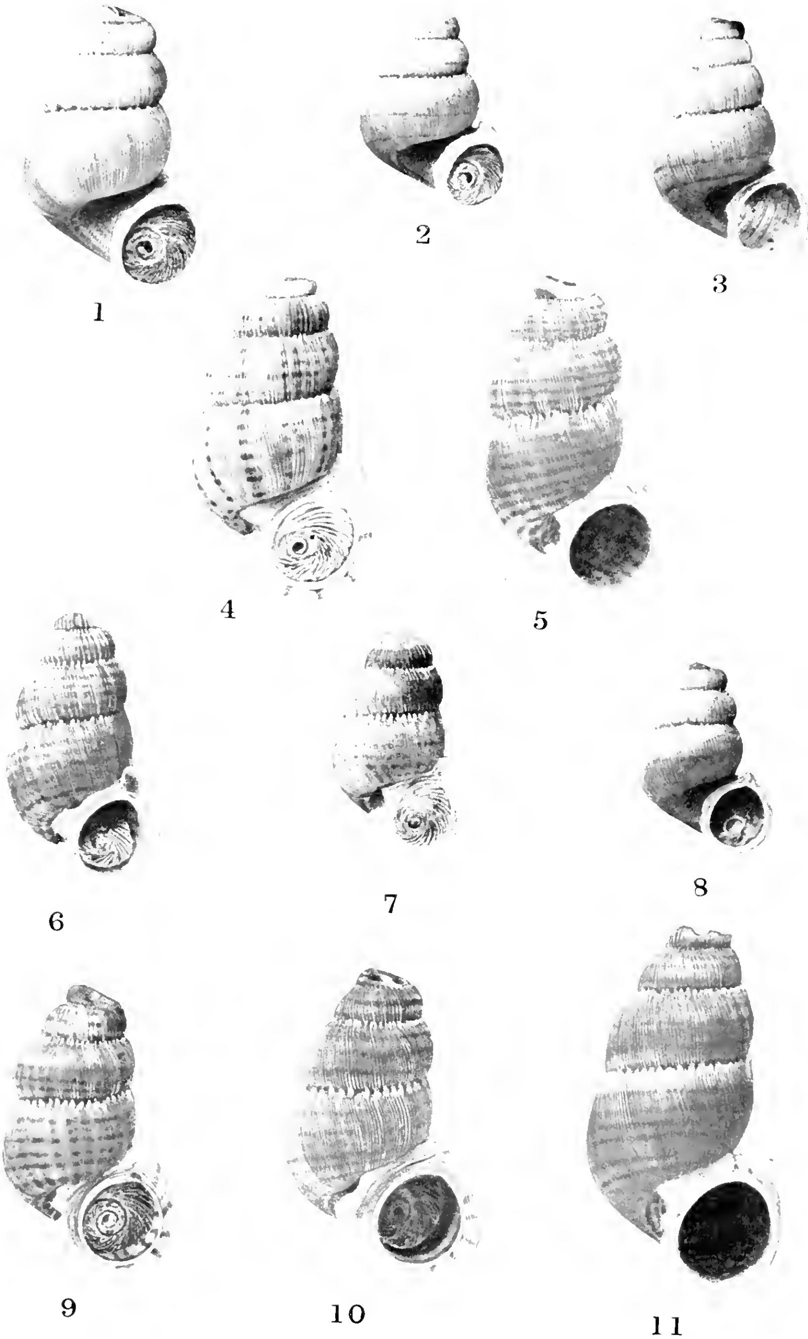
NEW MOLLUSKS FROM CUBA.

FOR EXPLANATION OF PLATE SEE PAGE 267.



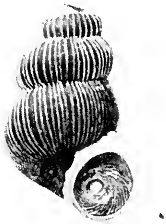
NEW MOLLUSKS FROM CUBA.

FOR EXPLANATION OF PLATE SEE PAGE 267.

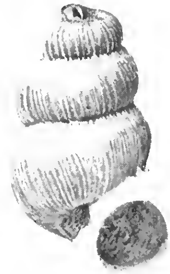


NEW MOLLUSKS FROM CUBA.

FOR EXPLANATION OF PLATE SEE PAGE 267.



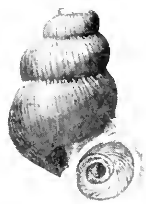
1



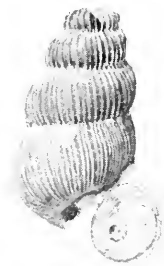
2

3

4



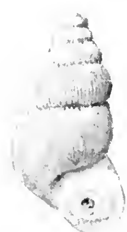
5



6

7

8



9

New Mollusks from Cuba.

For explanation of plate see page 267.

NORTH AMERICAN PREDACEOUS BEETLES OF THE TRIBE TILLINI IN THE UNITED STATES NATIONAL MUSEUM.

By A. B. Wolcott,

Of the Field Museum of Natural History, Chicago, Illinois.

Through the courtesy of Dr. L. O. Howard and Mr. E. A. Schwarz the beetles belonging to the tribe Tillini, of family Cleridae, have been sent to me for study.

Several new species have been found and descriptions of these, as well as records of all the known species contained in the collection, are given in the following catalogue, in which the genera and species (as far as possible) are arranged in what I conceive to be the natural sequence. To make the paper more complete I have included records and have added descriptions of certain new forms from material in my collection. The greater part of this paper is, however, based on the collection of the United States National Museum and all of the material belonging to that collection, which was loaned to me, is catalogued. At the end of the account of each species the number of specimens in the Museum collection is stated.

Family CLERIDAE.

Subfamily Clerinae.

Tribe TILLINI.

Genus MONOPHYLLA Spinola.

MONOPHYLLA TERMINATA Say.

Crescent City, Florida, April, May, bred from bamboo (Hubbard and Schwarz); Herndon, Virginia (Hubbard and Schwarz); Cabin John, Maryland, May 23 (P. R. Myers); Plummer Island, Maryland, July 20 (Barber and Schwarz); Washington, District of Columbia, June 26, July 5 (Hubbard and Schwarz); Pennsylvania (C. V. Riley); Franklinville, Pennsylvania (Hubbard and Schwarz); Louisville, Kentucky (H. Soltau); Iowa, June (Hoffmeister); Missouri, July 10, (J. G. Barlow, C. V. Riley); Onaga, Kansas (Crevecoeur); Wades, Texas, May 21 (E. A. Schwarz); Victoria, Texas, April 8 (E. A. Schwarz); San Diego, Texas (E. A. Schwarz); Dimmit County, Texas (F. G. Schaupp); Texas (J. B. Smith, Belfrage). Seventeen males; eighteen females.

MONOPHYLLA PALLIPES Schaeffer.

Brownsville, Texas, June 4, 9 (Schwarz, Townsend); 2 males; 3 females.

MONOPHYLLA CALIFORNICA Fall.

Los Angeles County, California (A. Koebele, D. W. Coquillett); Santa Cruz Mountains, California (A. Koebele); Panamint Valley, California, April (A. Koebele); Los Gatos, California (Hubbard and Schwarz); Santa Rosa, Lower California, July (G. Beyer); Catalina Springs, Arizona, April 11, on *Prosopis juliflora* (Hubbard and Schwarz); Hot Springs, Arizona, December 5, 1901, reared from dead branch of *Prosopis juliflora* (Schwarz and Barber). Seven males; six females.

Genus TILLUS Olivier.

TILLUS COLLARIS Spinola.

Langdale, Chambers County, Alabama (H. H. Smith); Covington, Louisiana, June 1 (H. Soltau). Two? females.

Genus CALLOTILLUS Wolcott.

CALLOTILLUS ELEGANS Erichson.

Point Isabel, Texas, August 21; Brownsville, Texas, June 5, 8 (E. A. Schwarz); San Diego, Texas, April 29, May 7 (E. A. Schwarz); Nueces, Texas, April 28 (C. L. Marlatt); Santa Rosa, Lower California, July 1 (G. Beyer). Four males; eight females.

CALLOTILLUS VAFER, new species.

Moderately elongate, shining, rather sparsely clothed with long erect white and black pubescence, testaceous, abdomen and apical half of elytra black, a slightly oblique median fascia interrupted at suture, white. Head with front finely, sparsely punctate, very feebly, transversely wrinkled; occiput and region of eyes with a few rather coarse scattered punctures. Prothorax nearly one-half longer than wide, strongly convex both laterally and transversely; sides parallel, suddenly strongly constricted at basal two-fifths, thence slightly convergent to base; subapical transverse impressed line evident, especially at flanks; surface very finely, sparsely punctate. Elytra wider at base than thorax; sides straight, gradually, feebly divergent; apices conjointly rounded; surface with fine, distant, feebly impressed, seriately arranged punctures, becoming obsolete toward the apices; the basal region smooth, almost impunctate. Metasternum sparsely, finely punctate. Abdomen very shining, finely, very sparsely punctate, the punctures dense at middle of third and fourth ventral segments, more broadly so on the latter, from each of the punctures a single, rather short recumbent white hair arises. Length, 3.2 mm.

Type locality.—Fort Yuma, opposite Yuma, Arizona.

Type.—Cat. No. 23119, U.S.N.M.

Described from one female reared in May, 1897, by H. G. Hubbard.

Similar in form to *elegans* Erichson, to which it is nearest related. The form is, however, a little more elongate, the prothorax proportionately longer and more strongly compressed at base, the punctuation throughout more sparse and fine, the median elytral fascia is but very slightly oblique, and finally the color is quite different.

The 15 specimens of *elegans* that I have examined have, without exception, the prothorax quite coarsely and densely punctate and show no tendency to vary in the direction of the species above described.

Genus LECONTELLA Wolcott and Chapin.

LECONTELLA CANCELLATA LeConte.

Texas (Belfrage, Schaupp?); Brownsville, Texas (C. H. T. Townsend); Pennsylvania (Hubbard and Schwarz); Plummer Island, Maryland (R. P. Currie). Fifteen females.

Genus CYMATODERA Gray.

CYMATODERA PUNCTICOLLIS Bland.

Oracle, Arizona, July 4, 5, 8, 11, 12, 18, 1898 (Hubbard and Schwarz); Tucson, Arizona, July 21 (Hubbard and Schwarz); Hot Springs, Arizona, June 26, 1901 (Schwarz and Barber). Four males; three females. (Male sexual characters, plate 43, fig. 1.)

CYMATODERA AEGRA, new species.

Moderately robust, feebly shining, moderately clothed with long recumbent and erect pale yellowish hairs, reddish brown, occiput of head with large black maculation, elytra piceous behind the base with a narrow angulate median fascia pale yellow. Head very sparsely, moderately finely punctuate; eyes prominent; antennae reaching to about basal fourth of elytra, joints two, three and four short, subequal, each shorter than any of the following joints, outer joints gradually incrassate apically, not at all triangular. Prothorax twice as long as wide at base, very feebly constricted at apical third, moderately compressed at basal third; surface finely, sparsely punctuate; antescutellar impression very feeble, scarcely discernable. Elytra twice as wide as thorax at base; humeri distinct, sides parallel to apical fourth; apices conjointly rounded; rows of punctures coarse, deep, extending nearly to apex toward which the punctures are but slightly smaller and feebly impressed, the punctures separated by at least their own diameter; intervals narrower than the punctures, finely, sparsely, irregularly punctate. Body beneath sparsely pubescent; metasternum rather finely, remotely, feebly punctate, the abdomen a little more densely. Legs more densely pubescent than the venter. Length, 4–5.5 mm.

Male.—Fifth ventral segment broadly, feebly, arcuately emarginate; the sixth shorter but broader at base than the last dorsal, sinuately truncate at apex; last dorsal truncate, very feebly emarginate at middle. (Plate 43, fig. 2.)

Female.—Fifth ventral truncate; sixth ventral large, as long as but narrower at base than last dorsal, elongate-oval at tip; last dorsal elongate-oval at tip. (Plate 43, fig. 3.)

Type locality.—Oracle, Arizona.

Type, allotype, and one paratype.—Cat. No. 23120, U.S.N.M.

Described from three specimens, the type and allotype from Oracle, Arizona, July 11 and 18, 1898 (Hubbard and Schwarz), and a female labeled "Arizona, Morrison," from the Hubbard and Schwarz collection.

Related to *delicatula* Fall, from which *aegra* may be known by the much larger size, the longer rows of elytral punctures, the narrower intervals, the elytral fascia median, narrow, strongly so toward the suture where it is interrupted, the prothorax more feebly constricted at apical third and the different sexual characters. Readily separated from *puncticollis*, to which it bears some resemblance, by the structure of the antennae and the elytral punctures coarser, deeper, and more remote.

CYMATODERA DELICATULA Fall.

Hot Springs, Arizona, June 25 (Schwarz and Barber); two females.

CYMATODERA TURBATA Horn.

Dimmit County, Texas (F. G. Schaupp); Alice, Texas, June 15, 1904 (H. S. Barber); Texas (J. B. Smith); Hot Springs, Arizona, June 22, 26, 1901 (Schwarz and Barber). Four males; eleven females.

Doctor Horn in the original description states "I am unable to detect any sexual differences in the specimens before me, the last abdominal segments of the dorsal and ventral aspect being oval at tip." Both sexes are before me and, as Doctor Horn evidently had only the female sex, I give the characters for both sexes.

Male.—Fifth ventral segment broadly, feebly arcuately emarginate; sixth ventral short, as broad at base but elsewhere much narrower and slightly shorter than last dorsal, subtruncate at apex; last dorsal semicircular, truncate at apex. (Plate 43. fig. 4.)

Female.—Fifth ventral segment truncate at apex, sixth ventral smaller than last dorsal, semicircular; last dorsal semicircular. (Plate 43, fig. 5.)

CYMATODERA PALLIDA Schaeffer.

Chiricahua Mountains (Cave Creek Canon), Arizona, July 3, 1897 (H. G. Hubbard). (Male sexual characters, plate 43, fig. 6.)

CYMATODERA SUBSIMILLIS Wolcott.

Oracle, Arizona, July 11, 1898 (Hubbard and Schwarz).

This species was based upon the female only. The specimen above mentioned being a male, the opportunity is afforded of giving the abdominal sexual characters of that sex.

Male.—Fifth ventral segment broadly, rather feebly emarginate; sixth ventral segment small, transverse, broader at base than last dorsal, broadly but distinctly emarginate; last dorsal much longer than last ventral, feebly emarginate at apex. (Plate 43, fig. 7.)

CYMATODERA MITIS, new species.

Slender, shining, sparsely pubescent, the intervals with long erect hairs, pale reddish brown, body beneath paler, elytra with a narrow, somewhat irregular ante-median fascia narrowly interrupted at the suture pale yellow. Head very finely and sparsely punctate, more densely on occiput; eyes moderately prominent; antennae extending to basal fourth of elytra, joints two, three and four subequal, each distinctly shorter than any of the following joints, joints six to ten moderately serrate, joint eleven one-half longer than the tenth, distinctly compressed. Prothorax three-fourths longer than wide, distinctly constricted at apical third, strongly compressed at basal fourth, surface minutely and remotely punctate, the punctures slightly coarser and a little closer on the flanks; ante-scutellar impression very feeble. Elytra twice as wide as thorax at base; humeri distinct; sides feebly divergent; apices conjointly rounded; rows of punctures moderately coarse, gradually becoming feebly impressed behind the fascia, the punctures separated by about half their own diameter; intervals near suture wider than the punctures, slightly narrower toward the sides, finely, sparsely and irregularly punctulate. Body beneath sparsely pubescent; metasternum minutely, remotely punctate; abdomen moderately coarsely, sparsely punctate. Legs sparsely clothed with moderately long pale hairs. Length, 5.75 mm.

Male.—Unknown.

Female.—Fifth ventral segment feebly sinuate; sixth short, subtruncate, much smaller than last dorsal; last dorsal semicircular. (Plate 43, fig. 8.)

Type locality.—Williams, Arizona.

Type.—Cat. No. 23121, U.S.N.M.

Described from one female, collected June 2, 1901, by Schwarz and Barber.

This species is allied to *subsimilis* Wolcott, and *pallida* Schaeffer, from both of which the posteriorly broader elytra, the color and markings, and abdominal sexual characters will readily separate it.

CYMATODERA UNIFORMIS Schaeffer.

Williams, Arizona, reared from *Cowania mexicana* in 1901 (Schwarz and Barber).

The female of this species was unknown to Mr. Schaeffer at the time of his making the species known.

Female.—Fifth ventral segment truncate; sixth ventral smaller than last dorsal, semicircular; last dorsal semicircular. (Plate 43, fig. 9.) One female and one with abdomen destroyed.

CYMATODERA PUBESCENS Wolcott.

Texas (Belfrage).

The abdominal characters of the female of this species have not been made known. Three specimens of that sex are now before me, enabling these characters to be recorded.

Female.—Fifth ventral segment truncate at apex; sixth short, rounded, smaller than the last dorsal; last dorsal oval at tip. (Plate 43, fig. 10). Three females.

CYMATODERA SCHWARZI, new species.

Elongate, shining, sparsely pubescent, intervals with short erect hairs, piceous brown; labrum, four basal joints of antennae, palpi, an antemedian fascia which reaches neither suture nor side margin, under surface of head, legs and entire underside of body pale yellowish; outer joints of antennae varying from pale yellowish brown to piceous brown. Head finely, sparsely, punctate, a little closer and coarser on occiput; front with an oblique impression each side; eyes prominent; antennae slightly longer than head and thorax, joints two, three, and four small, third joint slightly longer than the second, fourth joint slightly shorter than the second, each much shorter than joint five or any of the following joints. Prothorax one-third longer than wide, moderately constricted at apical third, strongly compressed at basal third; surface very finely transversely rugulose, moderately finely and sparsely punctate; ante-scutellar impression small and feebly impressed. Elytra twice as wide as thorax at base; humeri distinct; sides moderately divergent posteriorly; apices conjointly rounded; punctures rather coarse and closely placed in basal half gradually becoming finer, more remote and less impressed terminating at apical fourth; apex irregularly, scarcely perceptably punctate; intervals very slightly convex, with a single row of sparse, fine punctures, near suture twice as wide as the punctures, wider toward the sides. Body beneath sparsely pubescent; metasternum smooth, impunctate, near posterior margin a few minute scattered punctures, sides with scattered slightly coarser punctures; abdomen moderately coarsely very sparsely punctate. Legs sparsely clothed with moderately long hairs. Length, 4.5–5.3 mm.

Male.—Fifth ventral segment broadly not deeply emarginate; sixth broadly emarginate, the angles rounded; last dorsal broader and longer than last ventral, truncate at apex. (Plate 43, fig. 11.).

Female.—Fifth ventral segment truncate at tip; sixth semicircular; last dorsal broader and longer than last ventral, the sides sinuately narrowing to the very feebly, broadly emarginate apex. (Plate 43, fig. 12.)

Type locality.—Madera Canon, Santa Rita Mountains, Arizona.

Type, allotype, and paratype.—Cat. No. 23122, U.S.N.M.

Described from eleven specimens, seven males and four females, all of which are from the Santa Rita Mountains, Arizona, May 27, 29, 31, 1898 (Hubbard and Schwarz).

A very distinct species; differs from *pubescens* Wolcott, to which it is nearest related; by the proportionately shorter prothorax, the wider elytra at base, the finer sculpture of elytra, the finer punctuation of the metasternum, color, and abdominal sexual characters of both sexes.

Named in honor of Mr. E. A. Schwarz.

CYMATODERA LONGICORNIS LeConte.

Chiricahua Mountains, Arizona, June 11, 1897 (H. G. Hubbard), (Male sexual characters, plate 43, fig. 13.) One male.

CYMATODERA TOROSA Wolcott.

Fort Grant, Arizona, July 19, 1897 (H. G. Hubbard); Williams, Arizona, July 24, 1901 (Schwarz and Barber); Arizona (Morrison). Four males; one with defective abdomen.

CYMATODERA LATEFASCIA Schaeffer.

Fort Grant, Arizona, July 12 to 21, 1897 (H. G. Hubbard); Oracle, Arizona, July 11, 1898 (Hubbard and Schwarz); Hot Springs, Arizona, June 21, 1901 (Schwarz and Barber); Chiricahua Mountains, Arizona, July 1, 4, 1897 (H. G. Hubbard); Tuba, Arizona (plate 43, figs. 14, 15). Sixteen males; four females.

CYMATODERA USTA LeConte.

Chiricahua Mountains, Arizona, June 20, 1897 (H. G. Hubbard); Sulphur Spring Valley, Arizona, June 27, 1897 (H. G. Hubbard); Arizona (Morrison). Five females.

CYMATODERA MYSTICA, new species.

Robust, pale yellow, head, antennae, thorax, apical third of femora, and basal portion of tibiae piceous; elytra pale yellowish with a broad post-median fascia which scarcely attains the lateral margins and is broadly interrupted at the suture, black, the anterior margin of fascia distinct and but slightly irregular, posteriorly gradually becoming paler and leaving the apices a dull testaceous; shining; moderately clothed with whitish pubescence, which is longest on head and prothorax. Head with front moderately coarsely, not very densely, somewhat rugosely punctate, occiput finely punctate and very finely rugulose; eyes moderately prominent; antennae half as long as body, rather stout; joints two and three short, obconical, equal in length, joint three more slender than joint two, together just visibly longer than joint four; joints four to ten elongate, subequal, feebly serrate, joint eleven one-third longer than tenth. Thorax one-half longer than wide at apex, base narrower than apex, subapical constriction feeble, at basal fourth strongly compressed; antescutellar impression feeble, an obtuse tubercle each side of impression; surface finely rugulose, distinctly so at middle of disk. Elytra twice as wide at base as thorax at base; humeri distinct; sides straight, feebly divergent to apical fourth, thence arcuate to apex; apices conjointly rounded; disk feebly convex, with rows of coarse punctures in basal half, the punctures abruptly much reduced in size and depth behind the middle and becoming obliterated at apex; intervals nearly flat, near suture subequal in width to punctures, narrower toward the flanks, finely, irregularly punctulate, a fine hair arising from each puncture. Metasternum rather finely, feebly, sparsely punctate, the punctures separated by four or five times their own diameter, a little closer at the middle. Abdomen minutely, very densely punctulate. Length, 5.9–6.2 mm.

Male.—Fifth ventral segment broadly feebly arcuately emarginate; sixth ventral short, broadly rounded, arcuately emarginate at apex; last dorsal much larger than last ventral, sides narrowing to apex, which is broadly sinuate-truncate. (Plate 43, figs. 16, 17.)

Female.—Fifth ventral truncate at apex, a small distinct fovea at middle of apical margin extends onto basal portion of sixth ventral, the latter short, truncate at apex; last dorsal semicircular, larger than last ventral. (Plate 43, figs. 18, 19.)

Type locality.—Springdale, Utah.

Type.—In author's collection, No. 1145; *paratype* in Mr. Warren Knaus' collection.

Described from two specimens sent me by Mr. Warren Knaus. The type, a male, Springdale, Utah, June 16, 1919 (Tom Spaulding); paratype, a female, St. George, Utah, 2,800 feet, May 22–June 12, 1919 (W. Knaus).

Closely allied by antennal structure to *isabellae* Wolcott, of which species at first sight it was thought to be a variety; however, further study revealed too many points of structural difference to permit of this conclusion. The robust form, the presence of an ante-scutellar impression, the proportionately longer thorax, the coarser elytral punctuation, with the abrupt reduction in size of the punctures behind the middle, the narrower elytral intervals, and the sexual characters of the male will serve to distinguish this species from *isabellae* and the allied *usta*.

CYMATODERA SIRPATA Horn.

San Diego, Texas, May 1 to 25, 1895 (E. A. Schwarz); Victoria, Texas, April 8 (E. A. Schwarz). Six males; three females; one defective.

The emargination of the male fifth ventral segment is somewhat variable, sometimes very feeble indeed, again very distinct, but never very deep, and always broad. The sixth ventral is said by Horn to be "deeply longitudinally sulcate at middle." This I find is not a constant character, only one specimen out of a series of six well-preserved males has a median sulcation and in this it extends obliquely, showing that this is due to shrinkage. (Plate 43, fig. 20.)

In *sirpata* female the fifth ventral is truncate, the sixth distinctly smaller (even at base) than the last dorsal; last dorsal more nearly semicircular than in var. *spatiosa*. (Plate 43, fig. 21.)

CYMATODERA SIRPATA, variety SPATIOSA, new variety.

Differs from the typical form as follows: Form broader, elytra more depressed, the intervals rather finely, moderately closely, irregularly punctate (a single row of rather coarser punctures in *sirpata*).

The sexual characters of the male and female are sufficiently distinct to render the separation of the variety easily possible.

Male.—Fifth ventral segment truncate; sixth short, rounded, as broad at base as last dorsal, very feebly, subtriangularly emarginate at apex; last dorsal longer than last ventral, semicircular, very feebly emarginate-truncate at tip. (Plate 43, fig. 22.)

Female.—Fifth ventral truncate; sixth large, nearly semicircular, broader at base and but little shorter than last dorsal; last dorsal broad, obtusely rounded at apex. (Plate 43, fig. 23.)

Type locality.—Texas.

Four paratypes.—Cat. No. 23123, U.S.N.M.

Described from five specimens, two males (one in my collection, No. 55) and three females. The males are without precise locality, being labeled "Tex.," at least one of them having been collected by Belfrage. One of the females is labeled "Tex.," collection J. B. Smith, and may have been collected by Schaupp. The other females are from San Diego, Texas, May 19, 1895 (E. A. Schwarz), and Victoria, Texas, May 25 (E. A. Schwarz).

CYMATODERA TUTA Wolcott.

San Simon, Arizona, July 5, 1897 (H. G. Hubbard); Oracle, Arizona, July 9, 1898 (Hubbard and Schwarz); San Augustine (near Las Cruces), New Mexico,, August 28 (C. H. T. Townsend). Two males; one female.

CYMATODERA BICOLOR Say.

Mountain Lake, Virginia (H. Ulke); Afton, Virginia (Hubbard and Schwarz); Oakland, Maryland, July 11 (Hubbard and Schwarz); Plummer Island, Maryland, June 7, 1906; May 19, 1912 (Schwarz and Barber); Buffalo, New York (C. V. Riley); New York (J. B. Smith); Pennsylvania (Melsheimer in Hubbard and Schwarz collection); Detroit, Michigan, June (Hubbard and Schwarz); Michigan; Canada (J. B. Smith); Kansas.

In occasional specimens of this species, especially from Michigan, Canada, and the north, the prothorax is entirely black with the exception of the prosternum anterior to the coxae. Eight males; thirteen females; two with damaged abdomen.

CYMATODERA INORNATA Say.

Plummer Island, Maryland, July 12, 19, 1905 (D. H. Clemmens and E. A. Schwarz); Long Island, New York (M. L. Linell); Pennsylvania (J. B. Smith); Detroit, Michigan, June (Hubbard and Schwarz); Missouri (Barlow). Four males; six females; two indeterminate, abdomen defective.

CYMATODERA CALIFORNICA Horn.

Reddington, Arizona (W. Barnes); Los Angeles County, California (D. W. Coquillett); San Bernardino Mountains, California (C. C. Zeus); California (Belfrage). One male; four females.

CYMATODERA HORNI Wolcott.

Santa Catalina Mountains, Arizona. One female.

CYMATODERA KNAUSI, new species.

Moderately elongate, feebly shining, pale reddish brown, a narrow irregular rather indistinct median elytral fascia paler, moderately clothed with rather long erect, and semi-recumbent pale yellowish hairs. Antennae slender, longer than head and thorax; joint two slightly shorter than joint three; three to ten subequal in length, elongate, feebly serrate; eleventh one-half longer than the tenth. Head moderately densely not very coarsely punctate; eyes feebly prominent. Thorax subcylindrical, one-fourth longer than wide at apex; base slightly narrower than apex; sides feebly constricted subapically, more strongly compressed behind the middle; antescutellar impression distinct; surface moderately coarsely not densely punctate. Elytra three times as long as thorax, much wider at base than thorax at widest part; humeri distinct; sides nearly parallel; apices sinuate-truncate; disk convex; each elytron with ten rows of coarse quadrate punctures, the first lateral row extending to slightly behind the middle, the three sutural to the middle, the remaining rows longer and obliterated at apical fourth, the punctures of apical portion fine and confused; intervals very feebly convex, narrower than the punctures, and finely irregularly punctulate. Meso- and metasternum with a few moderately coarse scattered punctures; abdomen finely rather densely punctate. Length, 8.2 mm.

Male.—Fifth ventral segment deeply, broadly arcuate-emarginate at apex; sixth ventral broader than long, sides feebly sinuate, the angles slightly produced, between which the apex is bisinuate-emarginate, longitudinally carinate at middle and at the sides, that of the middle extending to basal third, the lateral carinae nearly to the middle; fifth dorsal broadly and deeply incised at apex, narrower than corresponding ventral; last dorsal narrower and longer than last ventral, sides strongly oblique, rapidly narrowing to apex, the latter prolonged and strongly furcate at apex. (Plate 43, figs. 24, 25.)

Type locality.—Santa Rita Mountains, Arizona.

Type.—In author's collection, No. 1110.

Santa Rita Mountains, Arizona, 5,000–8,000 feet. Collected by Mr. E. G. Smyth and presented to me several years ago by Mr. Warren Knaus, to whom it gives me great pleasure to dedicate this very distinct species.

The very peculiar sexual characters separate this at once from any known species in our fauna. It is closest allied to *morosa*, from which it may be readily distinguished by the sinuate-truncate elytral apices as well as the unique sexual characters.

CYMATODERA MOROSA LeConte.

Oracle, Arizona, July 8 to 10, 1898 (Hubbard and Schwarz); Catalina Springs, Arizona, April 12, 1898 (Hubbard and Schwarz); Chiricahua Mountains, Arizona, June 1, 1897 (H. G. Hubbard); Pine Dale, Arizona, July 18; Williams, Arizona, July 1 (Schwarz and Barber); Chaves, New Mexico, June 8 (Townsend); Alameda County, California, August (A. Koebele).

CYMATODERA UMBRINA Fall.

Los Angeles County, California (Coquillett); Tuscon, Arizona, July 21 (Hubbard and Schwarz); Fort Grant, Arizona, July 23, 1897 (H. G. Hubbard); Oracle, Arizona, July 30 in *Cylindropuntia*, July 6, 7, 12 (Hubbard and Schwarz); Winslow, Arizona, July 31, 1901 (Schwarz and Barber); Hot Springs, Arizona, June 25, 1901; Williams, Arizona, June 10–July 29, 1901 (Schwarz and Barber); Prescott, Arizona, June 19, 1901 (Schwarz and Barber); Mesilla, New Mexico, May 5 (Cockerell); Deming, New Mexico, July 22 (E. A. Schwarz). Seven males; twenty-five females.

CYMATODERA BELFRAGEI Horn.

Texas (Belfrage); San Antonia, Texas. Three females.

CYMATODERA LONGULA, new species.

Elongate, feebly shining, clothed with long coarse hairs; brown to piceous; antennae dark ferrugineous; labrum, tarsi, a narrow irregular median fascia and abdomen yellow. Head with front coarsely, densely punctate, vertex a little finer, occiput granulate; eyes feebly prominent; antennae slightly longer than head and thorax, joints two to ten subequal in length, joints five to ten feebly serrate, eleventh joint one-third longer than the tenth. Prothorax twice as long as wide, very feebly constricted both in front and behind the middle, base as wide as apex; ante-scutellar impression small but distinct with a feeble tubercle each side; surface very coarsely and densely punctate. Elytra nearly twice as wide as the throax at base; humeri distinct; sides subparallel, very feebly divergent posteriorly, apices conjointly rounded; punctures coarse, deep, closely placed becoming finer and somewhat confused at apex; intervals flat, with an irregular row of moderate punctures, wider than the punctures near suture, narrower at the sides. Body beneath sparsely pubescent; metasternum very coarsely, sparcely punctate, the pubescence very long, recumbent; abdomen coarsely, moderately sparsely, not deeply punctate, second, third, and fourth ventral segments very finely and densely punctate. Legs sparsely but conspicuously clothed with long, coarse hairs. Length, 8–9 mm.

Male.—Fifth ventral segment deeply, broadly emarginate; sixth ventral wider and subequal in length to last dorsal, sides nearly straight, strongly narrowing to apex which is obtusely rounded with a small, deep emargination at middle; last dorsal truncate at apex, the angles rounded.

Female.—Unknown.

Type locality.—Catalina Springs, Arizona.

Type and paratype.—Cat. No. 23124, U.S.N.M.

Described from two males. The type from Catalina Springs (Gibbon's ranch, 13 miles northeast of Tucson, 2,800 feet altitude), Arizona, April 10, 1898 (Hubbard and Schwarz); the paratype from Santa Rita Mountains (Madera Cañon, 4,000–4,500 feet altitude), Arizona, June 8, 1898 (Hubbard and Schwarz).

The form is nearly that of *belfragei.* The distinctly granulate occiput, the prothorax equal at base and apex and the abdominal sexual characters of the male make this an easily recognizable species. In the type the suture is narrowly of a paler color than the general color; the base narrowly and irregularly, the apex rather obscurely, and the flanks before the fascia from the fifth stria to margin also somewhat pale. The paratype is similar to the type in all respects except that the entire side before the fascia is not paler than the general tone, the pale color being confined to the sixth, seventh, and eighth intervals.

CYMATODERA RUDIS, new species.

Form very similar to that of *ovipennis*, but a little more slender and the elytra somewhat wider at base. Subopaque, conspicuously clothed with long, coarse, pale yellowish hairs; pale brown to piceous brown, head, prothorax, and mesosternum darker, labrum, palpi, and antennae pale; elytra with a broad, vaguely limited, oblique median fascia yellowish-testaceous; abdomen yellow. Head coarsely very densely, front more finely very sparsely punctate; eyes moderately prominent; antennae very slightly longer than head and thorax, joints two to ten subequal in length, joints five to ten moderately serrate, joint eleven nearly one-half longer than joint ten, obtuse at apex. Prothorax twice as long as wide at apex, feebly constricted at apical third, rather strongly compressed behind the middle; base distinctly narrower than apex; ante-scutellar impression moderately distinct with surface broadly but feebly elevated each side; surface coarsely, deeply, densely punctate, more finely less deeply in apical third. Elytra at base less than one-half wider than thorax at apex; sides strongly divergent to about apical fourth; apices conjointly rounded; punctures coarse, rounded, perforate, closely placed, behind the median fascia suddenly becoming much finer and more distant extending without perceptible change in size to the extreme apex where they are somewhat confused; intervals much narrower than the punctures in basal half, wider in apical half, each with a single row of moderately fine punctures. Body beneath clothed with long coarse hairs; meso- and metasternum coarsely punctate, the former densely, the latter sparsely at sides but more finely and densely at middle; abdomen feebly, coarsely, sparsely punctate, the fourth and fifth segments very finely, very densely punctate and densely clothed with fine, short, yellowish pubescence. Legs conspicuously clothed with short and long coarse hairs. Length, 5–8 mm.

Male.—Fifth ventral segment broad, subparabolically emarginate; sixth ventral wider and subequal in length to last dorsal, obtusely rounded at apex, middle of the apex narrowly but distinctly emarginate; last dorsal elongate, obtusely rounded at apex.

Female.—Fifth ventral segment with a small distinct U-shaped emargination at apex; sixth ventral short, rounded, wider and but slightly shorter than last dorsal, the latter nearly semicircular.

Type locality.—Catalina Springs, Arizona.

Type, allotype, and five paratypes.—Cat. No. 23125, U.S.N.M.

Described from seven specimens from Catalina Springs (Gibbon's ranch, 2,800 feet altitude), Arizona, three males April 8, 22, 30 and four females April 7, 30, 1898 (Hubbard and Schwarz).

Very closely allied to the preceding species by the sexual characters of the abdomen in the male; there is, however, a slight but constant difference in the form of the last dorsal in the two species.

Longula is a larger, more parallel species, with nearly cylindrical prothorax, and there are several other differences, perhaps the most conspicuous of these being that in *rudis* the elytral punctures change abruptly in size at posterior edge of the fascia, while in *longula* there is no such sudden change, the large punctures continuing well toward the apices.

CYMATODERA COMANS Wolcott.

Mesilla Park, New Mexico (C. N. Ainslie); San Simon, Arizona, July 5, 1897 (H. G. Hubbard). One male; two females.

CYMATODERA FUSCULA LeConte.

Catalina Springs, Arizona, April 10, 12, 1898, on *Prosopis juliflora* (Hubbard and Schwarz); Tucson, Arizona, January 5 (H. G. Hubbard). One male; two females.

CYMATODERA FUSCULA, var. TEXANA Gorham.

Dimmit County, Texas (F. G. Schaupp); Burnett County, Texas (Schaupp); Texas (Belfrage). Two males; eight females; three indeterminate.

This variety only differs from the typical form by possessing a pale ante apical spot on each elytron.

CYMATODERA UNDULATA Say.

Plummer Island, Maryland, September 2, 1911 (in freshet drift), September 8, 1904, October 30, 1912 (Schwarz and Barber); Bladensburg, Maryland, August 10 (Hubbard and Schwarz); Washington, District of Columbia, August (Hubbard and Schwarz); New York (J. B. Smith); Marietta, Ohio (Hubbard and Schwarz); Ohio (Hubbard and Schwarz); Evansville, Indiana (H. Soltau); Middlesboro, Kentucky, August 28, 1904 (H. S. Barber); Kirkwood, Missouri, October 20, 1896 (bred from stems of *Bidens bipinnata*) (M. Murtfeldt); Missouri; Texas (Belfrage). Four males; eighteen females.

CYMATODERA CONFUSA, new species.

Color, markings, and general form similar to *balteata*, but with elytra much broader at base. Sparsely, finely pubescent; body winged. Head large, coarsely, closely, somewhat rugosely punctate; eyes moderately prominent; antennae extending to basal fifth of elytra, structure as in *balteata*. Prothorax twice as long as wide at apex, moderately constricted at apical third, rather strongly constricted behind the middle, narrower at base than apex; ante-scutellar impression distinct; surface coarsely, deeply punctate, slightly variable in regard to density but usually close, rarely sparse. Elytra one-third wider than prothorax at base, three times as long as wide at base; humeri distinct; sides subparallel, very slightly divergent posteriorly; apices separately rounded; rows of punctures coarse in basal half, becoming finer posteriorly and obsolete at apical fourth, punctures separated by about half their own diameter; intervals flat, as wide or nearly as wide as the punctures, finely, irregularly, sparsely punctulate. Body beneath very finely, sparsely pubescent; mesosternum coarsely, not closely punctate; metasternum with a few moderately coarse, scattered punctures; abdomen with segments one to four coarsely punctate, closely at the sides, more sparsely at middle of first and second and finely and densely at middle of third and fourth segments, the fifth segment in its entire width finely and densely punctate. Legs moderately sparsely clothed with short fine yellowish pubescence. Length, 9.25–13.25 mm.

Male.—Fifth ventral segment parabolically emarginate; sixth ventral wider than long, the sides strongly sinuate, narrower at base than at apex, apex subtruncate, with a broad, deep U-shaped emargination, each apical angle of which is furnished with a long, dorsally reflexed tooth, middle deeply sulcate from emargination nearly to base. Last dorsal narrower but much longer than last ventral, sides subparallel but feebly sinuate, apex strongly sinuate, with a narrow but deep triangular emargination.

Female.—As in *balteata.*

Type locality.—North Carolina.

Three paratypes.—Cat. No. 23126, U.S.N.M.

Described from four specimens. The type, a male, from North Carolina (B. Gerhard), in my collection, No. 60; paratypes, a male from St. Louis, Missouri, May 11 (H. Soltau); a male from central Missouri, July (C. V. Riley); a female from Laredo, Texas, May 28 (E. A. Schwarz).

This species simulates *balteata* so closely that no doubt it stands in many collections as that species; it differs from that species by having the body fully winged and the elytra proportionately broader at base; the sexual characters of the male are also quite unlike those of *balteata.* The female is only separable by the fact that the wings are not aborted.

CYMATODERA, species.

Two females, one (No. 68) in my collection from Mississippi (R. J. Weith) and one in museum collection from Crescent City, Florida, are similar to the female of the preceding species, but differ somewhat in abdominal sexual characters; while these very probably represent a new species, I think it best to wait until male specimens of the form are at hand before publishing a description of this species.

CYMATODERA BALTEATA LeConte.

Brownsville, Texas, June 27 (C. H. T. Townsend); LaGrange, Texas, August 17 (E. A. Schwarz); Columbus, Texas, June 2 (E. A. Schwarz); San Antonio, June 23 (H. Soltau); Texas (J. B. Smith). Three males; five females.

CYMATODERA OVIPENNIS LeConte.

Los Gatos, California (A. Koebele); Martinez, California, December 2, 1882 (Turner); Sisson, California (A. Koebele); San Mateo County, California, August (A. Koebele); Lake Tahoe, California, July 14 (H. G. Hubbard); Los Angeles, California (Coquillett); Santa Cruz Mountains, California (A. Koebele); Placer County, California, September (A. Koebele); Siskiyou County, California (A. Koebele); Nevada County, California, September 14, 1885 (A. Koebele); Oregon (Hubbard and Schwarz). Six males; fifteen females.

CYMATODERA ANGUSTATA Spinola.

Los Angeles County, California (A. Koebele); Santa Cruz Mountains, California (A. Koebele); Hood River, Oregon, May 19 (Hubbard and Schwarz). Two males; three females.

PROVISIONAL TABLES OF THE NORTH AMERICAN SPECIES OF CYMATODERA GRAY.

Table of groups.

Antennae with joints two, three, and four short, subequal, each shorter than any of the succeeding joints .... *Puncticollis* group, p. 284.
Antennae with joints two and three equal, small, together distinctly shorter than joint four, usually about two-thirds length of joint four .... *Longicornis* group, p. 285.
Antennae with joints two and three unequal, together as long as joint four. *Latefascia* group, p. 285.
Antennae with joints two and three equal, together not, or but little, longer than joint four .... *Usta* group, p. 285.
Antennae with joint two short, usually little if at all longer than half the length of joint three .... *Xanti* group, p. 286.
Antennae with joints two to ten similar and nearly equal, joint eleven longer.
  Body winged, base of elytra broader than base of thorax.
    Last ventral segment in both sexes smaller than the last dorsal, and never deeply emarginate in the males .... *Bicolor* group, p. 286.
    Last ventral segment broader than the last dorsal, the sides of the former reflexed partly inclosing the latter.
      Elytral striae arranged in pairs, alternate intervals broader, sutural angle sometimes prolonged .... *Hopei* group, p. 286.
      Elytra striae equidistant .... *Knausi-morosa* group, p. 287.
    Last ventral segment broader than the last dorsal in the male, smaller than the last dorsal in the female .... *Confusa* group, p. 288.
  Body apterous, or at least with wings abortive; elytra at base little, or not at all, wider than the thorax .... *Angustata* group, p. 288.

SYNOPSES OF GROUPS.

PUNCTICOLLIS group.

Elytral intervals with rows of long, erect or suberect, coarse hairs.
  Intervals near suture equal to or narrower than the punctures; prothoracic puncturing sparse and fine.
    Antennal joints subcylindrical, joints five to ten very feebly incrassate apically .... *puncticollis* Bland.
    Antennal joints gradually incrassate apically, outer joints not at all triangular.

Elytral fascia narrow, angulate, narrower toward and interrupted at the suture.. *aegra* Wolcott.
Elytra fascia broad not at all narrowed or interrupted at the suture *delicatula* Fall.
Antennal joints distinctly incrassate apically, outer joints slightly compressed and subtriangular.............................. *turbata* Horn.
Intervals near suture distinctly wider than the punctures.
Prothorax finely and sparsely punctate.
Elytra uniformly yellowish testaceous................ *pallida* Schaeffer.
Elytra pale yellowish, markings rather indistinct..... *subsimilis* Wolcott.
Elytra pale reddish brown with an ante-median fascia narrowly interrupted at the suture............................ *mitis* Wolcott.
Prothorax coarsely punctate.
Elytra with a more or less complete pale fascia, prothorax closely punctate...................................... *decipiens* Fall.
Elytra uniformly dark brown, prothorax not very closely punctate *uniformis* Schaeffer.
Elytral intervals with erect hairs short, inconspicuous, not or but little longer than remainder of pubescence.
Elytra uniformly dark brown............................ *pubescens* Wolcott.
Elytra dark brown with an ante-median pale yellowish fascia always interrupted at the suture................................... *schwarzi* Wolcott.

LONGICORNIS group.

Elytra brown sometimes testaceous in about basal half, head and thorax finely and sparsely punctate, ante-scutellar impression distinct.......... *longicornis* LeConte.
Elytra uniformly brown, head and thorax coarsely and densely punctate.
Thorax one-half longer than wide, ante-scutellar impression wanting; antennal joints two and three obconical; punctures of first lateral stria extending nearly to apex, intervals slightly narrower than the punctures..*soror* Wolcott.
Thorax nearly twice as long as wide at apex, ante-scutellar impression present but feeble; antennal joints two and three conical; punctures of first lateral stria scarsely attaining the middle, intervals as wide as the punctures..*torosa* Wolcott.

LATEFASCIA group.

Elytra uniformly dark brown; metasternum densely, rather coarsely punctuate *antennata* Schaeffer.
Elytra testaceous, usually darker at base, a broad pitchy black fascia behind the middle; metasternum sparsely, rather coarsely, not deeply punctate *latefascia* Schaeffer.

USTA group.

Size larger (8.5–9.5 mm.); antennae with joints two and three together slightly longer than joint four; elytra, legs and abdomen uniformly pale brown....*usta* LeConte.
Size smaller (5.8–6.2 mm.).
Robust; antennae with joints two and three together very slightly longer than joint four; ante-scutellar impression present but feeble; elytral punctures coarse, abruptly reduced in size behind the middle; intervals not wider than the punctures.. *mystica* Wolcott.
Slender; antennae with joints two and three together not longer than joint four; ante-scutellar impression wanting; elytral punctures fine, not abruptly reduced in size; intervals three times as wide as punctures............ *isabellae* Wolcott.

XANTI group.

Second joint of antennae equal to one-half the length of the third joint.
 Form moderately robust, thoracic punctuation fine and sparse.
  Elytra pale castaneous; thorax one-fourth longer than broad....*xanti* Horn.
 Form slender, thoracic sculpture coarse.
  Thorax longer than broad, ante-scutellar impression wanting; elytra brown with an oblique yellowish fascia at middle reaching the seventh striae, the sixth interval yellowish from the humerus to the fascia. *obliquefasciata* Schaeffer.
  Thorax nearly twice as long as wide, ante-scutellar impression feeble; elytra testaceous with piceous fasciae, intervals with a single row of fine punctures..*sirpata* Horn.
   Form slightly broader, the elytral intervals sparsely, irregularly punctate......................................var. *spatiosa* Wolcott.
Second joint of antennae equal to two-thirds the length of third joint; thorax finely, sparsely punctate, sometimes nearly impunctate.
 Front of head biimpressed; antennae with joints five to ten subequal in length, the outer joints slightly broader.
  Thorax yellow, somewhat infuscate at apex, finely, sparsely, but distinctly punctate; elytra parallel, pale yellowish with an irregular maculation or incomplete fascia at apical two-fifths fuscous, apex pale; antennae reaching basal fourth of elytra....................................*tuta* Wolcott.
  Thorax reddish brown, slightly infuscate at sides, almost impunctate, the punctures evident at sides and apex, elytra yellowish with markings nearly as in *sirpata* but tips of elytra black; antennae scarcely longer than head and thorax.....................................*laevicollis* Schaeffer.
 Front of head normal; antennae with joints five to ten gradually descreasing in length, equal in width, elytral markings unique........*peninsularis* Schaeffer.

BICOLOR group.

Head finely and sparsely punctate.
 Prothorax usually in part reddish yellow, rarely entirely black (the prosternum anterior to the coxae excepted); elytra black, rarely with an indistinct pale median fascia...*bicolor* Say.
Head rather coarsely and densely punctate.
 Elytra uniformly brown, legs paler, antennae ferruginous..........*inornata* Say.
 Elytra piceous with humeral callus and a narrow very indistinct median facia dull testaceous, legs bicolored, antennae brownish.................*aemula* Wolcott.
 Elytra pale piceous with a median yellow band, the humeri testaceous, the callus piceous, legs testaceous, antennae ferruginous...............*fascifera* LeConte.

HOPEI group.

Prothorax one-fourth longer than wide; size smaller (9.5–12 5 mm.) *snowi* Wolcott.
Prothorax very nearly twice as long as wide at base; size larger (19–23 mm.).
 Elytra with a very broad median band and apex reddish yellow, the apex and band sometimes confluent at lateral and sutural margins, apex of elytra entire. *hopei* Gray.
 Elytra with a narrow median fascia yellow, aspices piceous.
  Last dorsal with median carina terminating abruptly (female) apices of elytra sinuate in both sexes, sutural angle sometimes prolonged..*californica* Horn.
  Last dorsal with median carina terminating in an elevated posteriorly curving point; apices of elytra rounded (female). Male unknown. *horni* Wolcott.

KNAUSI-MOROSA group.

Elytra sinuate-truncate at tip.................................... *knausi* Wolcott.
Elytra rounded at tip.
Legs brownish, piceous or black.
Body and legs rather sparsely pubescent.
Prothorax in part red, elytral fascia yellowish white, abdomen black. *tricolor* Skinner.
Prothorax brown or piceous, sometimes slightly paler at apex and base.
Elytra with an indistinct, slightly *ante-median* fascia; ante-scutellar impression rather feeble.......................... *morosa* LeConte.
Elytra with a more or less distinct *median* fascia.
Prothorax shorter, nearly one-half longer than wide.
Fifth ventral feebly emarginate; sixth ventral oval, without distinct angles laterally, feebly emarginate at apex; last dorsal subtruncate at apex (male); last dorsal broadly triangularly emarginate at apex (female). Abdomen subrugosely punctate..................... *cognata* Wolcott.
Fifth ventral segment deeply subparabolically emarginate; sixth ventral with prominent lateral angles, the points bent downward; last dorsal notched at middle of apex (male); last dorsal acutely notched at apex (female). Abdomen finely, sparsely punctate........ *umbrina* Fall.
Prothorax nearly twice as long as wide.
Slender, head coarsely punctate........... *aethiopa* Wolcott.
More robust, head more finely punctate. *santarosae* Schaeffer.
Elytra with an irregularly angulate, narrow, median fascia yellow, below this and also near base and around humeri a few more or less distinct pale streaks...................... *flavosignata* Schaeffer.
Elytra with a distinct, moderately broad, slightly *post-median* fascia; thorax rather finely and sparsely punctate at apical fourth, basal three-fourths very finely and sparsely punctate; ante-scutellar impression strong, the surface each side strongly elevated. *belfragei* Horn.
Body and legs conspicuously clothed with long, coarse hairs.
Elongate; elytra nearly twice as wide as prothorax at base, sides nearly parallel; prothorax subcylindrical, as wide at base as at apex. *longula* Wolcott.
Rather robust; elytra scarcely one-half wider at base than the prothorax, sides strongly divergent posteriorly; prothorax slender, base distinctly narrower than apex....................................... *rudis* Wolcott.
Legs pale testaceous.
Elytra dark with a pale median or post-median fascia sometimes indistinct.
Elytral fascia postmedian............................. *punctata* LeConte.
Elytral fascia median.
Thorax and elytra coarsely punctate.
Elytral apices separately rounded; ante-scutellar impression wanting...................................... *fuchsii* Schaeffer.
Elytral apices conjointly rounded; ante-scutellar impression. distinct....................................... *comans* Wolcott.
Thorax and elytra rather finely punctate.
Thorax elongate, elytral striae evident only at base; scutellum slightly emarginate at tip........................ *oblita* Horn.

Thorax robust, elytral striae extending distinctly to about the middle, the outer rows longer................*fuscula* LeConte.

Elytra brownish with a median fascia and a spot on apices pale. *fuscula*, var. *texana* Gorham.

Elytra brownish with three irregular pale fasciae, often more or less interrupted at the suture, sometimes covering greater part of surface, apex dark. *undulata* Say.

Elytra brown with a lateral, pale median spot........var. *arizonica* Schaeffer.

Elytra brown, markings wanting......................var. *brunnea* Spinola.

CONFUSA group.

Cymatodera confusa Wolcott is the only species of this group.

ANGUSTATA group.

Head and thorax varying from pale brown to piceous; never with metallic luster.

Elytra pale testaceous, the fasciae piceous varying in number from one to three; head, thorax and elytra at base very coarsely punctate........*balteata* LeConte.

Elytra brown with one or more rather indistinct pale fasciae.

Thorax very densely and rather coarsely punctate.

Body rather robust; thorax distinctly rugose.........*ovipennis* LeConte.

Body slender, elongate.

Head smaller, eyes very prominent; thorax strongly constricted before the middle, strongly compressed posteriorly. *vandykei* Schaeffer.

Head larger, eyes less prominent; thorax very feebly constricted anteriorly, not strongly compressed posteriorly; elytra usually with three fasciae.............................*angustata* Spinola.

Thorax very sparsely and finely punctate................*cephalica* Schaeffer.

Head and thorax blue, with distinct metallic luster; thorax finely and sparsely punctate, feebly transversely wrinkled...............................*purpuricollis* Horn.

Mr. Schaeffer[1] states that the specimen upon which the description of *soror* Wolcott, was based was a male and not a female and places *soror* as a synonym of his *antennata*. Mr. Shaeffer's statement is correct as far as it applies to the sex of the type specimen, but he is in error in assuming them to be identical species. While the two species are very similar in general appearance, they are in reality quite distinct, differing in antennal structure and in the secondary sexual characters of the abdomen. I have before me two males, one from Baboquivari Mountains, Arizona, the other from Ramsey Cañon, Huachuca Mountains, Arizona, which agree perfectly with the type of *soror* in all details. A comparison of these with a male specimen of *antennata* from Nogales, Arizona, shows that in *soror* the second and third antennal joints are equal and together distinctly shorter than the fourth joint; in *antennata* the second and third joints are unequal and together as long as the fourth joint. The apical (eleventh) joint is also much longer and more slender in *soror*. In the latter species the fifth ventral segment of abdomen is distinctly arcuate at apex, whilst it is truncate in *antennata;* the

[1] Journ. N. Y. Ent. Soc., vol. 25, 1917, p. 129.

sixth ventral is very short and arcuately emarginate at apex in *soror*, in *antennata* the same segment is much longer and scarcely emarginate, the last dorsal is much longer and more broadly truncate than in *soror*.

Cymatodera brevicollis Shaeffer,[2] described from a single female specimen from Arizona, I have been unable to place in the table of species. It is unknown to me in nature, and the characters given in the original description give no hint as to what position it should be given. It closely resembles *oripennis* LeConte, but can not be associated with that species as it is fully winged. Mr. Schaeffer gives as other distinguishing characters the longer antennal joints, shorter prothorax, and the more narrowly rounded apices of elytra. Mr. Shaeffer, in a letter, says that this species should be placed preceding the *angustata* group.

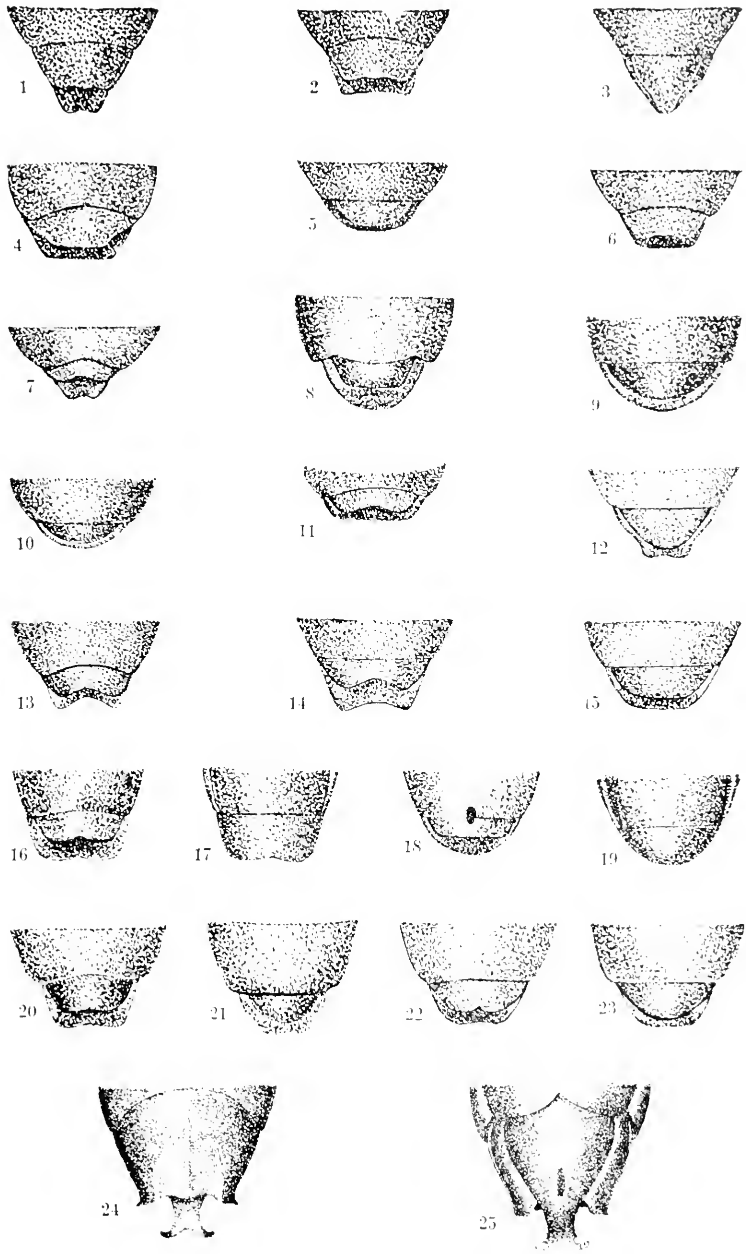
Cymatodera pilosella LeConte is merely a small form of *oripennis* possessing no distinctive characters so far as I can perceive other than that of size. Hence it is not included in the table.

[2] Journ. N. Y. Ent. Soc., vol. 25, 1917, p. 130.

EXPLANATION OF PLATE 43.

Fig. 1. *Cymatodera puncticollis* Bland. Ventral view of male fifth and sixth and apex of last dorsal segment.

2. *C. aegra* Wolcott. Ventral view of male same as in 1.
3. *C. aegra* Wolcott. Ventral view of female; fifth and sixth and apex of last dorsal segment.
4. *C. turbata* Horn. Ventral view of male same as 1.
5. *C. turbata* Horn. Ventral view of female same as 3.
6. *C. pallida* Schaeffer. Ventral view of male same as 1.
7. *C. subsimilis* Wolcott. Ventral view of male same as 1.
8. *C. mitis* Wolcott. Ventral view of female same as 3.
9. *C. uniformis* Schaeffer. Ventral view of female same as 3.
10. *C. pubescens* Wolcott. Ventral view of female same as 3.
11. *C. schwarzi* Wolcott. Ventral view of male same as 1.
12. *C. schwarzi* Wolcott. Ventral view of female same as 3.
13. *C. longicornis* LeConte. Ventral view of male same as 1.
14. *C. latefascia* Schaeffer. Ventral view of male same as 1.
15. *C. latefascia* Schaeffer. Ventral view of female same as 3.
16. *C. mystica* Wolcott. Ventral view of male same as 1.
17. *C. mystica* Wolcott. Dorsal view of male fifth and sixth segments.
18. *C. mystica* Wolcott. Ventral view of female same as 3.
19. *C. mystica* Wolcott. Dorsal view of female fifth and sixth segments.
20. *C. sirpata* Horn. Ventral view of male same as 1.
21. *C. sirpata* Horn. Ventral view of female same as 3.
22. *C. sirpata*, var. *spatiosa* Wolcott. Ventral view of male same as 1.
23. *C. sirpata*, var. *spatiosa* Wolcott. Ventral view of female same as 3.
24. *C. knausi* Wolcott. Ventral view of male same as 1.
25. *C. knausi* Wolcott. Dorsal view of male apex of fifth, sixth, and portion of last dorsal segments.



PREDACEOUS BEETLES OF THE TRIBE TELLINI.

FOR EXPLANATION OF PLATE SEE PAGE 290.

DESCRIPTIVE CATALOGUE OF THE COLLECTION OF BUDDHIST ART IN THE UNITED STATES NATIONAL MUSEUM.

By I. M. Casanowicz,

Assistant Curator, Division of Old World Archeology, United States National Museum.

INTRODUCTION.

The collection described in this catalogue includes material from Further India and the Far East. That from the former region consists chiefly in a collection of about 200 specimens coming from the Laos, a division of the widespread Thai or Shan race and ethnographically related to the Siamese, in Indo-China. The contributions from the Far East are divided between China, Japan, and Tibet. The greater part of the specimens from the last-named country has been described by the late William Woodville Rockhill in Notes On The Ethnology of Tibet.[1] They are included in the present catalogue for the sake of completeness.

A special collection of objects of Buddhism from Burma, a deposit of Mr. S. S. Howland, was described under the title of The S. S. Howland Collection Of Buddhist Religious Art in the National Museum, by I. M. Casanowicz.[2]

INTRODUCTION.

THE FOUNDER OF BUDDHISM.

Buddhism arose at the end of the sixth or beginning of the fifth century B. C. as a schism or reformation of Brahmanism in India. Its founder, known by the names of Gautama, Sakyamuni, and Buddha, was Siddhartha, son of Suddhodanna of the family Gautama, rajah, or chieftain, of the Sakya clan, who were settled in the Ganges Valley, along the southern border of Nepal and the northeast part of Oude (Oudh), about a hundred miles north-northeast of Benares, with Kapilavastu as capital. Gautama, then, is the family name which the Sakyas assumed after one of the Vedic seers (Rishis), Sakya-Muni, means sage of the Sakyas, while Buddha is not a proper or personal name, but a title.

Later tradition has woven around the person and career of the founder a mass of myths and legends. So, for instance, that before

[1] Report of the U. S. National Museum for 1893, pp. 730, etc.

[2] Report of the U. S. National Museum for 1904, pp. 735-744, with 17 plates.

his last life on earth he had gone through hundreds of rebirths in all forms of existence; or that for ages he had lived in Tushita, the heaven of the happy gods, and in the fullness of time was born in a supernatural way, having entered the body of his mother Maya in the guise of a white six-tusked elephant; that he was prompted to renounce the world and his career of a prince through the sight of sickness, old age, and death; that he was tempted by the fiend Mara who tried to divert him from his mission of a savior, and other similar myths. The simple facts of his career, so far as they can be freed from the later legendary accretions, may be said to be about as follows: Siddhartha, who was of a reflective and contemplative turn of mind and deeply impressed with the vanity and misery of life, retired from the world at the age of 29, after 10 years of married life and the birth of a son. This is called the "great renunciation." For six years he led the life of a wandering ascetic sage (*muni*), devoting himself to the study of the various systems of philosophy and theology of the times, and to severe ascetic practices, without finding in either a solution of the riddle of existence. In his thirty-fifth year he passed through a second mental crisis. While sitting in meditation under the famous Bo-tree (a species of *Ficus religiosa*, pipala) at Bodhi Gaya, south of the present Patna, he attained to the state of a Buddha—that is, of an "enlightened one," or "awakened one"—having found the cause of the evils of existence and the way of deliverance from them.

For 45 years Buddha went about from place to place in the valley of the Ganges, proclaiming his good tidings and gathering around him a small band of faithful followers, the earliest members of his afterwards famous order, and finally died at the age of 80, in the midst of his disciples, at Kusinagara, the modern Kasia, in the district of Gorakhpur, his body being cremated, and the relics distributed among the clans of the adjoining districts.

BUDDHA'S DOCTRINES (THE DHARMA).

The substance of the teaching of Buddha is expressed in the "four excellent truths": (1) Existence is inseparable from sorrow. Birth is sorrow, age is sorrow, sickness is sorrow, death is sorrow, clinging to earthly things is sorrow. (2) The causes of sorrow are our passions and desires which result in new birth with its consequent old age, sickness, death, and other miseries. For the present life of the individual is not the first one. Innumerable births have preceded it in previous ages. The attachment to life and its pleasures produces a new being, and the moral character of the thoughts and actions of the former existences fixes the condition of the new being. This is called the law of cause and effect, or *Karma*. The term properly means "doing," or "action," and comprises the doctrine of the everlasting effect of an act. It is the aggregate result of all previous acts in unbroken succession from the beginning of existence, which in the Buddhist conception of man, constitutes his character, his real self, his ego, as it were. This alone endures when an individual existence has come to an end, and if the thirst of living and the fire of passions are not entirely extinguished, it gathers around itself, as a kind of transmigration of character, new elements and results in a new sentient being, whose nature, condition, and fortune it determines. Individuals are merely the present and temporary links in a long chain of cause and effect. Each link is the summarized result of the various activities of all that have gone before, and is, in its turn, part and parcel of all that will follow. By the theory of Karma, Buddhism explains the mystery of fate in the apparent unequal distribution here of happiness and woe, entirely independent of moral qualities. What a man reaps, Buddhism teaches, that he must himself have sown, as whatsoever a man sows that shall he also reap. (3) The cessation of sorrow through the extinction of the passions, of evil desires and the attachment to material objects, which destroys the power of the senses so that they no longer give birth to new beings. (4) The way to cessation by following the eight-fold path: (1) Right views (that is, freedom from superstition or delusion), (2) right resolve (high and worthy of the intelligent earnest man), (3) right speech (kindly, open, truthful), (4) right conduct (peaceful, honest, pure), (5) right way of earning a livelihood (causing hurt to no living being), (6) right endeavor (in self-training and in self-control), (7) right mindfulness (the active and watchful mind), (8) right contemplation (earnest thought on the mysteries of life). Each of these terms is a summary of the manifold energies of thought, feeling, and will in various combinations and applications, and the whole may be characterized—to use a modern designation—as a system of "ethical culture." The general philosophical presuppositions of Gautama's system are: The inevitable connection of desire and suffering; the nonreality of any abiding ego-principle or self, and the impermanence of all individual existence. The ethical teachings of Buddha are founded on a definite method of self-culture and self-discipline which would lead to the extinction of the "three-fold fire" of self-deception, desire, and malevolence and to a release at once from suffering and becoming—*Nirvana*. The term nirvana, which literally means "going out" (like the flame of a candle), is used with three distinct significations: (1) Eternal blissful repose, the peace which puts an end to all striving (something like the "beatific vision" conceived by Christians); (2) extinction and absolute annihilation; (3) to Buddha it seemingly meant the dying down or going out of the fires of lust, hatred, anger, and delusion or dullness, the cardinal sins of Buddhism, and a consequent passionless calm beyond reach of temptation. By thus uprooting all desire, and by perfect detachment from life and its attractions, cessation of the renewal of existence will be attained. "Whence comes peace?" (Buddha is made to say) "When the fire of desire is extinguished, when the fire of hate is extinguished, when the fire of illusion is extinguished, when all sins and all sorrows are extinguished, then comes peace." So that one may "enter Nirvana" while still on earth. What might be the after-death state of such a released being Gautama refused to discuss. Buddhism thus proclaimed a mode of salvation in which every man may be his own savior, without reference to God or gods, to priest or ritual. It is the first universal religion addressing itself to all men and to every nation; the first religion which had the ambition to embrace all men, to gather the whole of mankind into a great unity. "Go into all lands and preach this gospel; tell them that the poor and lowly, the rich and high, are all one, and that all castes unite in this religion as unite the rivers in the sea."

THE BUDDHIST COMMUNITY (THE SANGHA).

The Buddhist community in the strict sense consists of an order of monks and nuns (*Bhikshus* and *Bhikshunis*) who, as a rule, live in monasteries and are vowed to celibacy, poverty, and obedience. The following ten commandments were given to members of the order: (1) Not to kill or even injure any sentient being, (2) not to steal, (3) not to commit adultery, (4) not to lie or use any manner of improper speech, (5) not to use intoxicating drinks, (6) not to take repasts at improper times (that is, after midday), (7) not to attend dances, plays, and public spectacles, (8) not to wear costly raiment and garlands, or use perfumes, (9) not to use high seats and beds, and (10) not to receive gold or silver. But already in Buddha's lifetime it was impracticable for all his adherents to retire from the world and join the order. On these lay-believers (*Upasakas*) only the first five of the ten injunctions are obligatory. Among the virtues recommended to the masses are reverence to parents and teachers, care for wife and children, submission to authority, control over self, patience, forbearance, humility and contentment, alms giving, respect for the life of sentient creatures, and care for the welfare of all living things.

Buddha, his doctrine, and the community form the triad (the "three jewels," *triratna*) of Buddhism, and the formula of confessing fellowship with Buddhism is: I take my refuge in the Buddha, in the Dharma, and in the Sangha.

DIVISIONS OF BUDDHISM.

Buddhism is divided into two great schools, which are themselves subdivided into many sects and subsects. The first, the Hinayana, or lesser vehicle (comparing the religion of Buddha to a vessel which carries men across the agitated and restless ocean of existence, *samsara* to the haven of Nirvana), which pretends to have preserved the original teachings of Buddha in greater purity and simplicity, prevails in Ceylon, Burma, and Siam, although even there Buddhism is overlaid and interwoven with animistic notions and practices; the second, the *Mahayana*, or "greater vehicle," which arose in the second or first century B. C. in India and spread northward to Nepal. Tibet, China, Mongolia, and Japan, adopted many popular elements of mysticism and magic and is permeated with metaphysical speculations. After the regions in which the Hinayana and Mahayana are dominant, they are also termed the southern and northern school, respectively. Some of the distinctive doctrines between the Hinayana school and that of the Mahayana are: (1) As regards the endeavor of the believer, the aim in the former is individual salvation by becoming an *Arhat*, or a perfected saint. Through contemplation on the four excellent truths and by following the eight-fold path he is freed from lust and desire and thus from undergoing rebirth; in the latter the believer strives to emulate Buddha to save others by becoming a Budhisattva, an aspirant to Buddahood. For according to the Buddhist doctrine, Gautama Sakyamuni, the historical founder of Buddhism, was only one of many Buddhas who appear in the world at intervals of many ages (*Kalpas*), when there is special cause for their presence, and they depart again when they have fulfilled the purpose for which they came, have set in motion the wheel of the law which they proclaim, and have founded an order destined to last for some period of time. With each there is a period in which the doctrine flourishes, then a gradual decline, when it is overthrown till a new teacher appears and once more establishes the lost truths. (2) In the Mahayana vehicle the founder was transformed from a man who could be born and die into a supermundane self-existent and everlasting being, surrounded by vast multitudes of Bodhisattvas, numerous as "the sands of Ganges," who occupy various heavens as their habitations. This is developed in the doctrine of the Adi-Buddha, that is, the first, or primary Buddha, the Buddha unoriginated, the principle and ultimate postulate of existence. By five acts of contemplation (*dhyani*) he produced the five Buddhas of contemplation (Dhyani-Buddhas), the celestial prototypes or counterparts of the five human Buddhas (*Manushi* Buddhas), of whom Gautama was the fourth, and the fifth, Matreya, the Buddha of love, is still to appear (at the end of the present age). By the twofold power of knowledge and contemplation they give birth to Bodhisattvas of contemplation (Dhyani-Bodhisattvas). These celestial Bodhisattvas are charged with the providence of the world and with carrying on the work of an earthly (Manushi) Buddha after his demise until the arrival of a successor. The most known and most worshiped Dhyani-Buddha is Amitabha—endless light—the celestial counterpart of Sakya Muni, and president of the Sukhavati heaven, the Paradise of the West, and therefore plays a great part in the belief and ritual of Tibet, China, and Japan as funeral divinity. His Dhyani-Bodhisattva is Avalokitesvara or Padmapani, ruler of the present period and protector and patron of Tibet. In China and Japan he was transformed into, or identified with, Kuan-yin and Kuanon, respectively, the goddess of compassion and mercy.[3]

	Human Buddhas.	Dhyani Buddhas.	Dhyani Bodhisattvas.
1	Krakuchanda	Vairochana	Sammantabhadra.
2	Kanakamuni	Akshobya	Vajrapani.
3	Kasyapi	Ratnasambhava	Ratnapani.
4	Gautama	Amitabha	Avalokitesvara or Padmapani.
5	Maitreya	Amogasiddha	Visvapani.

The opinion of the Mahayana adherents that every leader in their religious circles, every teacher distinguished for sanctity of life, was a Bodhisattva, besides introducing a crowd of deities from Hinduism and a multitude of attendant spirits and demons, opened the door to a flood of superstitious fancies, to a whole pantheon of gods, angels, saints, which appealed more strongly to the half-civilized races among which the Mahayana doctrine was propagated.

HISTORY OF THE SPREAD OF BUDDHISM.

Already at the death of Buddha the number of Buddhists seems to have been considerable. About the middle of the third century B. C., King Asoka, also called Piyadasi, grandson of Chandragupta, the Sandrokottos of the Greek historians, adopted Buddhism, and from the third century B. C. to the fourth century A. D. it was the dominant religion of India. But then its decline set in, and towards the end of the eleventh century A. D. it was entirely suppressed in India itself, the land of its origin. But meanwhile it spread, through the zeal of its missionaries, south and north. It was adopted by the kings of Ceylon in the third century B. C., a son of Asoka being the first missionary, and it is here that Buddhism is found almost in its pristine purity. From thence it was carried in the fifth century A. D. to Burma and in the seventh to Siam. Buddhism entered China in the first century A. D., but not until the fourth century did it obtain there any strong footing. It is found there in two sects—Foism, which was introduced from India; and Lamaism, which came from Tibet—side by side with Taoism and Confucianism. The preponderant rôle in Chinese Buddhism belongs to the celestial (Dhyani) Buddha Amitabha (Chinese, Omitofoh), the inspirer (*spiritus rector*) of Sakyamuni; and the Bodhisattva, Avaltokitesvara,

[3] Following is a synopsis of the five human or *Manushi* Buddhas of the present period of the world's existence (*Kalpa*) and their corresponding mystic or celestial counterparts (*Dhyani-Buddhas*), and their mystic successors (*Dhyani-Bodhisattvas*):

who is here transformed into the female goddess of pity, Kuan-yin; and Manjusri (Chinese, Uenchu), the incarnation of science. But there also figure many Hindu deities under Chinese names in the Buddhist pantheon of China, besides numerous indigenous spirits and demons.

The same characteristics can be predicated of the Buddhism of Japan, where it penetrated from Korea in the sixth century A. D. It adopted also there many elements of Shintoism, the native religion of Japan, into its system, transforming the principal deities (Kami) of the Shintos into manifestations of Buddha and Buddhist saints.

Buddhism is supposed to have first entered Tibet from Nepal in the fourth century A. D. But it was only in the seventh century under the patronage of King Srongtsan-Gambo that it took root in the country and became its established religion. It was already on its arrival in Tibet penetrated with many beliefs and rites of Hinduism and was still more corrupted by assimilating many elements of the native religion, called *Bon*, which probably was some kind of demonism and Shamanism. In the fifteenth century the monk Tsong-khapa undertook a reform of the Buddhism of Tibet to free it from its superstitions and abuses; but his efforts seem to have had little success or duration. The Tibetan Buddhism is a mixture of Hindu polytheism and mysticism and native demonolatry and sorcery. The genuine Buddhist doctrines as taught by Gautama Buddha play a little part in it. It has worked out an elaborate ritual with tonsured priests, processions, masses, holy water, incense, rosaries, confession, exorcism, and so forth, and by means of its powerful hierarchy it contrived to gain also political supremacy of the country. It developed into a hierarchical monarchy under the suzerainty of China. At the head of this church-state stands the Dalai Lama as abbot of the monastery of Gedun Dubpa near Lhasa, the capital and holy city ("God's place") of Tibet. Next to him in dignity is the Panchen Lama, head of the monastery of Tashi Lhunpo, which is situated about 70 miles west of Lhasa, to the right of the river Brahmaputra.[4] These dignitaries, the first of whom has always held the highest rank in the Tibetan hierarchy, are believed to be incarnations of the Dhyani-Bodhisattva Avalokitesvara (Cenresi), the special patron and protector of Tibet, and of the Dhyani-Buddha Amitabha (Odpadmed or Ts'e-pa-med), respectively. On the death of the temporary incarnation of the Bodhisattva, that is, of the Dalai Lama, the spirit of the latter passes over to a child, the identity of whom

[4] The title dalai, meaning "vast," literally, "ocean," was given to the grand lama of Lhasa by the Mongol prince Gusri Khan of Koko-Nor, who in 1640 A. D. conquered Tibet and made a present of it to the grand lama. The Tibetans call the Lhasa grand lama Gyalwa Rinpoche, "the gem of majesty" or "victory." The Tashi Lhunpo grand lamas are entitled Panchen Rinpoche, "the precious great doctor," or "great gem of learning," or Gyalgon Rinpoche, "the precious lordly victor." See L. A. Waddell the Buddhism in Tibet, London, 1895, pp. 227 and 235.

being decided by divination. But also the abbots of the greater monasteries (*chutuktus*) are looked upon as incarnations of Bodhisattvas. Besides these quasi deified mystical persons, there are in the Tibetan church other hierarchical ranks and degrees. "The word 'lama,' written *bla-ma* and meaning 'the superior one,' is that given by Chinese and foreigners generally to the members of the Buddhist monastic order in Tibet. In Tibet, however, this word is reserved for those monks who have not only taken the highest theological degrees, but who have also led a saintly life and become famed for their knowledge. The word *draba* is used by Tibetans as a generic term for all persons connected with the order, monks as well as lay brethren."[5]

Buddhism wherever it went was modified by the national characteristics and inherited beliefs of its converts, so that fundamental doctrines were often overshadowed, sometimes destroyed, and it developed into strangely inconsistent and even antagonistic beliefs and practices. In accommodating itself to the genius and the habits of widely diversed peoples it was obliged to submit to various far-reaching compromises. It took on the color of any local condition and absorbed the native cults. In its development and expansion it gathered up into itself, like a snowball, all that it found in its way and changed even its essentials. But for all that, the impress of Gautama's lofty teachings has not been blotted out. They became a vehicle of a superior civilization, and their influence in the realms of art, philosophy and religion has been profound. In the field of art, in particular, it may be said that Buddhism was creator and originator. It gave the keynote to painting, sculpture, and architecture of the East for many centuries much like Christianity did for the art of the West.

THE COLLECTION.

For the purpose of the descriptive catalogue the collection may be divided into:

I. The Buddhist Pantheon: (1) Images of Buddha; (2) images of Bodhisattvas and other divine beings.

II. The Buddhist Scriptures (*Dharma*).

III. The Buddhist Congregation (Sangha): (1) Saints and priests and their appurtenances; (2) religious edifices and their paraphernalia.

IV. Miscellanous: Magic, divination, etc.

[5] W. W. Rockhill, Notes on the Ethnology of Tibet, p. 730. The political authority of the Dalai Lama is confined to Tibet itself, but he is the acknowledged spiritual head of the Lamaist Buddhists throughout Mongolia and China, as also by the Buriats and Kalmuks in Russia.

I. THE BUDDHIST PANTHEON.

1. IMAGES OF BUDDHA.

In the early period of Buddhism no image of Buddha appears. It seems that the Buddhist artists deliberately abstained from attempting to model or depict the human form of the divine founder of their religion. His presence was indicated by certain signs of his activity, or symbols which referred to the main events or crises of his life, as the footprints which he left behind him; the sacred tree beneath which he obtained enlightenment; the wheel, which was adopted by his disciples as the symbol of his doctrine. It was about the beginning of the Christian era—four or five centuries after Buddha's decease—that his effigy was brought into common use, and soon became the leading feature of Buddhist decoration.[6]

After the Buddha image was once created, it was considered a meritorious and salutary act to represent as many Buddha figures as possible. Rows of Buddha figures were employed in the decoration of temple façades; whole rocks were turned into terrace-reliefs adorned with Buddhas, and caves were filled with thousands of Buddha statues of all sizes, and millions of Buddhists carry an image of him about their persons.

The most general orthodox type of Buddha images, which is probably the result of a long course of experiment,[7] is that of a Hindu Yogi ascetic, sitting cross-legged in meditation, clad in a mendicant's garb, without any ornaments. The face, usually of Aryan cast of features, and unbearded, wears a placid and benign expression of passionless repose and serene dignity.[8] The head is bare and roughly tonsured, the ragged contour of his cropped hair being ascribed to his having on his great renunciation cut off his tresses with his sword. His short locks are represented by Indian artists in the shape of sea-shells, perhaps following the tradition that once snails came out to shelter Buddha's head from the rays of the sun. In China and Japan the short locks sometimes take the form of round beads or sharp spikes. Among the 32 superior marks of beauty (*mahapurusha-lakshanas*) and the 80 smaller marks (*annuvyanjana-lakshanas*) ascribed to Buddha, as the most perfect form of man, are a protuberance (*ushnisha*) on the crown or vertex of the head, being the "hump of perfect wisdom;" a bead or little ball (*urna*) between the

[6] The same conditions appear in early Christian art. For three centuries there were no pictures of Christ, but only symbols, as the fish, the lamb, the dove The catacombs of St. Callistus contained the first picture of Christ, the date being 313 A. D. Rabulas in 586 first depicted the crucifixion in a Syriac Gospel. Images come in vogue with the development of cult and ritual. The spirit of adoration necessitates a visual icon; purely abstract symbols can not long content an adoring worshiper

[7] The type of Christ was long a fluctuating one until that of Byzantium became universal.

[8] "There is no image so familiar in the East as his (Buddha's); he sits everywhere, in monastery, pagoda, and sacred place, cross-legged, meditative, impassive, resigned, the ideal of quenched desire, without any line of care or thought to disturb the ineffable calm or mar the sweetness of his unsmiling, yet gracious face." A. M. Fairbairn, Philosophy of the Christian religion, p. 270.

eyebrows; long ear lobs, sometimes reaching to the shoulder; long arms, which in the East is a mark of noble birth (recall Longimanus, epithet of Artaxerxes I). The robe is usually thrown over the left shoulder, leaving the right bare, except when he is represented preaching or walking abroad in public. The throne upon which he sits or stands is formed of a lotus flower (*padmasana*), which is sometimes supported by lions, elephants, or other animals, as a sort of heraldic shield. Behind his head is often displayed a nimbus or halo, frequently in form of a fig leaf, in remembrance of the tree (*Ficus religiosa*) under which he attained to Buddahood.

A prominent part in Buddhist iconography is played by the position of the hands (*mudra*), illustrating different incidents or favorite scenes in Buddha's life. They are in the main:

1. The attitude of meditation (*dhyana-mudra*), which occurs only in seated images. The legs are firmly locked and the soles directed fully upwards, while the hands are placed in the lap, one over the other.

2. The witness or earth touching posture (*bhumisparssa-mudra*). It marks the moment when Gautama sitting upon the diamond throne (vajrasana, so-called on account of its stability and indestructibility) under the bodhi-tree, was assailed by Mara, the Satan of Buddhist theology, challenging him to prove his qualification for Buddhahood, Gautama laid his hand upon the earth, calling upon the earth goddess (Prithivi) to bear testimony to his pious acts in his previous existences. Instantly the Earth goddess appeared and addressed the saint, saying: I am your witness. This posture is therefore used to indicate the *bodhi*, or enlightenment which immediately followed the "temptation," as Mara's assault is commonly called. The Buddha is invariably seated with the right-hand pendant over the throne, pointing to the earth. It is the most common form of all seated statues, almost the only one in vogue with Southern Buddhism (Burma, Ceylon, and Siam).

3. The attitude of preaching, or "turning the wheel of the law" (*dharmachakra-mudra*). The two hands are held in front of the breast, the thumb and forefinger of the right hand being joined and touching the middle finger of the left hand, or the right index finger turning down the fingers of the left hand. This posture of the hands is likewise confined to sedent statues.

4. Granting protection (*abhaya-mudra*). The right hand is raised at the level of the right shoulder, with palm of hand turned outwards. The left hand usually clasps the end of the upper robe, which is turned round the left arm so as to form a sleeve. This mudra is found both in standing and seated images.

5. The gift-bestowing attitude (*varada-mudra*). The right arm is stretched out downwards with the open palm of the hand turned to the front. This posture is associated only with standing figures.

The features of the Buddha images described in the preceding are in greater part also extended to those of most of the Bodhisattvas or mythical Buddhas. It is therefore not always possible to determine whether an image represents Buddha or a Bodhisattva. For on the one hand individual Bodhisattvas are often given the rank of Buddhas, though not yet attained by them, and depicted in the Buddha type. On the other hand, the young princely figures elegantly draped and decked with ornaments instead of the plain monk's robe, which are the characteristics of Bodhisattvas, may as well represent Sakyamuni as Bodhisattva, before his attaining Buddhahood.

1. *Buddha.*—Made of bronze. Seated in meditation. The hands resting in the lap are disposed in such a way that the thumbs of both hands touch one another. The meditative repose is emphasized by the nearly closed eyes and the dreamy look of the countenance. The protuberance of the head is nearly hemispherical. There is a bead (*urna*) both on the head above the forehead, and below between the eyebrows. The ears are long and pierced. Behind the head is a circular halo of wood. The robe covers both shoulders, but leaves the breast bare, waves from the left round the lower part of the body and falls in ample folds over the feet. On the back of the figure is engraved a Japanese inscription in 13 lines which has been rendered as follows:

This bronze image of "The Buddha of Five Wisdoms," was made by Saburobiyoye Katsutane, son of the great caster, Yoshitane Tsuji of the Fujiwara clan, whose title was Tajima no Kami, Anson, who lived at the Port of Yasuno in the Province of Seishiu (Ise).

He respectfully cast it for Shichirouyemon Tadanori Takamine, who lives in the town of Matsuzaka in the district of Jidaka, Seishiu (Ise), whose religious name and the religious name of his wife are given, and "Who desire the blessings of future life for (the souls of) their Fathers, Mothers, and of six unnamed relatives, and for themselves."

It was respectfully offered by them to the temple of Joshozan Soan in Yamada, Seishiu (Ise), on the 15th day 9th month of the 1st (rat) year of the Period of Keian—October 30th, 1648, when it was reverently consecrated by Shonin (Rev'd) Kwanseikudatsu, of the Society of Benren (Distinguished pure Lotus), twenty-first Priest of the temple of Sanyenzan Zojo, in the district of Shiba, Yedo, Province of Bushiu (Musashi).

Height, 38¾ inches. Cast in Ise, Japan, 1648 A. D. (Plate 44, Cat. No. 12965, U.S.N.M.) [9]

2. *Buddha.*—Made of teak wood, black lacquered and gilt. Standing on a lotus pedestal, the right hand raised to the bosom, the left hand clasping the upper garment, the pose of granting protection. The robe covers the left shoulder, leaving the right shoulder and

[9] A brief sketch of Japanese bronze work in connection with a description of this figure is found in the Report of the U. S. National Museum, 1888–1889, pp. 729–735, under the title "On a bronze Buddha in the U. S. National Museum." By Charles de Kay.

arm bare. Around the forehead is a sort of diadem studded with colored stones. The latter also decorate the upper seam of the robe and the girdle round the waist, which terminates in a sash reaching to the ankles.

The lotus (*Nelumbium speciosum*) is the queen of Indian flowers, to which a special sanctity is attached in the eyes of Buddhists and Hindus alike, and both Hindu and Buddhist divinities are usually represented standing or seated upon a lotus pedestal. With the Buddhist in particular it is a favorite object owing to its resemblance, when full blown, to the wheel, the symbol of the Buddhist doctrine (*dharma*). See also below under No. 300.

Height, 6 feet 3 inches. Burma. (Plate 45, Cat. No. 129902, U.S.N.M.)

3. *Buddha.*—Made of wood. Sitting in meditation. Body and robe are painted yellow, the locks of small cones are black, the lips and insides of the nostrils and of the piercings of the ears are red. The eyes wide open, the mouth with full lips wears a faint smile, the face is round and rather short. The mendicant's robe is thrown over the left shoulder and comes down in ringed folds over the left arm and the legs. In place of a halo, five-forked flames issue from the crown of the head. This is common to Buddha statues of Ceylon and Siam and vary in the number of the flames from three to five and seven. On the palm of the right hand are painted in red, blue, and green colors (not seen on the plate) an open and closed lotus and conch shells, while the sole of the right foot is adorned, in the same colors, with wheels, lotuses, and the figures of an elephant and lion. The general signification of the lotus in Buddhist symbolism has been touched upon in the preceding No. 2. The wheel with "a thousand spokes" under the soles of the feet is one of the marks (*lakshanas*) of a Buddha. The symbolism of the wheel in India meant universal dominion, the great circle of power and rule. The "thousand-rayed wheel" on the soles of the feet of a child when born indicated that he will either be a *chakravarti*, that is, a universal monarch, whose wheel *chakra*, that is, chariot, rolls unresisted over all the world, or a perfect Buddha. The wheel then marks Buddha as a spiritual *chakravarti*. Legend has it that Buddha as soon as he entered this world walked seven steps to each of the cardinal points, taking, as it were, spiritual possession of the universe. In the picturesque language of the ancient Buddhist writings "turning of the wheel-of-the-law" stands for preaching the doctrine destined to traverse the world like the chariot wheels of a conquering monarch, and the wheel (*dharma-chakra*) has been adopted as a symbol of Buddha's doctrine and is often represented on the throne of statues, sometimes between two deer, in memory of the first sermon delivered by him, after he attained enlightenment, in the Deer Park at Sarnath, near Benares, when he

"set rolling the royal chariot wheel of a universal empire of truth and righteousness."

The elephant is the symbol of sovereignty and one of the "seven jewels" which the chakravarti possesses, while the lion was the emblem of the Sakya clan from which Buddha sprung. Buddha himself bears the epithet Sakyasimha, "the lion of the Sakya race." Height to the summit of the flames, 7 feet 2 inches; to the crown of the head, 6 feet 7 inches. Ceylon. (Plate 46, Cat. No. 154977, U.S.N.M.)

4. *Buddha.*—Wood, lacquered and gilt. Represented standing on an hourglass-shaped base of a double lotus. The arms hanging flat by the sides. From the protuberance of the head (*ushnisha*) proceed five rays of flames, over which rises a metal umbrella. The figure is marked by stiffness and anatomical awkwardness. Height, 27 inches. Laos, Further India. (Cat. No. 517560, U.S.N.M.)

5. *Buddha.*—Bronze, lacquered and gilt. Represented in the gift bestowing attitude walking, the right foot advancing, the raised left foot resting on the toes. The lotus throne is set on a triple octagonal base. From the head rise the five flames. The base is rather rudely cast, while the figure shows better work. Height, 26 inches. Laos, Further India. (Cat. No. 217506, U.S.N.M.)

6. *Buddha.*—Alabaster, red lacquered and gilt. Rudely executed. The *ushnisha* is covered with a headdress resembling a stupa which is characteristic of many Siamese and Burmese figures. The right hand points to the earth—the witness pose. The throne is supported by three elephants. Height, 17½ inches. Laos, Further India. (Plate 47, Cat. No. 217613, U.S.N.M.)

7. *Buddha.*—Old bronze. Represented in the witness pose. Round the throne is a frieze in relief of thirteen elephant heads, the middle one facing front while the six on either side of him face one another. Height, 12 inches. Laos, Further India. (Cat. No. 217503, U.S.N.M.)

8. *Buddha.*—Old bronze, lacquered and gilt. Represented in the witness position on a triple base, with the five rays issuing from the *ushnisha*. Fine work, but the head is broken off. Height, 21 inches. Laos, Further India. (Cat. No. 217505, U.S.N.M.)

9. *Buddha.*—Wood, lacquered and gilt. Seated in meditation on a high throne of a triple lotus which is inlaid with pieces of colored glass. The base of the five-forked flame on the head is studded with colored stones. Height, 21½ inches. Laos, Further India. (Cat. No. 217567, U.S.N.M.)

10. *Buddha.*—Bronze. Standing in the gift-bestowing attitude. The head is slightly bent forward, with an intent gaze of the wide open eyes downward. Around the brow is a circle of colored stones. The right hand is broken off. Height, 20 inches. India. (Cat. No. 158323, U.S.N.M.)

11. *Buddha.*—Bronze. Standing with the hands crossed, right over the left, in front; a rare position. Height, 17 inches. Laos, Further India. (Cat. No. 217524, U.S.N.M.)

12. *Buddha.*—Bronze. Standing in the attitude of granting protection. The locks of the head are arranged in spirals. On the forehead between the eyebrows is the precious jewel (*urna*). The robe is fitted round the neck, covering both shoulders, and coming down in waved folds. The cast of the countenance as well as the arrangement of the drapery show influence of Greek art, which left an indelible impress on the religious art of Asia from Gandhara in northwest India to Japan. Height, 29 inches. Japan. (Plate 48, Cat. No. 95037, U.S.N.M.)

13. *Buddha.*—Bronze. Similar to the preceding No. 12, only smaller in size. Height, 12 inches. Japan. (Cat. No. 158320, U.S.N.M.)

14. *Buddha.*—Wood, lacquered and gilt. Seated in witness position on lotus. Well-executed workmanship. Height, 15½ inches. Laos, Further India. (Cat. No. 217565, U.S.N.M.)

15. *Buddha.*—Bronze. Standing in the gift-bestowing attitude, on crown of the head five rays. Height, 15 inches. Laos, Further India. (Cat. No. 217523, U.S.N.M.)

16. *Buddha.*—Wood, lacquered and gilt. Advancing figure on a double base, with arms hanging flat on the sides. Height, 13 inches. Laos, Further India. (Cat. No. 217602, U.S.N.M.)

17, 18. *Buddha.*—Wood, lacquered and gilt. Seated in witness position. The bases are adorned with conventional floral designs in gold on a black lacquered ground. Height, 10½ and 10 inches. Laos, Further India. (Cat. Nos. 217583–217584, U.S.N.M.)

19. *Buddha.*—Wood, gilded. Represented standing on a lotus which rests on an hourglass-shaped base, the left hand holding up the robe, the right hanging down flat. The base is inlaid with small round pieces of colored glass. Height, 11¼ inches. India. (Cat. No. 158325, U.S.N.M.)

20. *Buddha.*—Bronze. Standing in the gift-bestowing attitude. An excellent grade of bronze combined with superior workmanship. The right hand is missing. Height, 13¼ inches. Laos, Further India. (Cat. No. 217521, U.S.N.M.)

21. *Buddha.*—Bronze, gilt. Standing in the attitude of granting protection, with the usual five rays on the head. Height, 13 inches Laos, Further India. (Cat. No. 217522, U.S.N.M.)

22. *Buddha.*—Old bronze. Seated in witness position. The throne is raised on three legs. Height, 11 inches. Laos, Further India. (Cat. No. 217508, U.S.N.M.)

23. *Buddha.*—Old bronze. Similar to the preceding No. 22. The base is adorned with lotus buds in open work. Height, 12 inches. Laos, Further India. (Cat. No. 217528, U. S. N. M.)

24. *Buddha.*—Old bronze. Similar to No. 22. Height, 11 inches. Laos, Further India. (Cat. No. 217502, U.S.N.M.)

25. *Buddha.*—Wood, lacquered and gilt. Standing with left hand on bosom, the right hanging down. Height, 14⅜ inches. Laos, Further India. (Cat. No. 217593, U.S.N.M.)

26. *Buddha.*—Wood, lacquered and gilt. Seated on a double base in witness position. On back of the base is an inscription in Pali. Height, 11⅞ inches. Laos, Further India. (Cat. No. 217605, U.S.N.M.)

27. *Buddha.*—Wood, gilt. Standing with his right hand resting on a begging bowl (*patra*), the left hand holding some indeterminate object. The legend relates that the first food offered to Buddha after the attainment of supreme knowledge was by two merchants and consisted of honey and wheat. But Buddha reflecting that he must have an almsbowl, the four kings of the four quarters of the world (*lokapalas*) brought each one of gold, which he refused; then they brought silver, emerald, and ruby dishes, which were also refused; lastly, each brought an earthenware bowl, and Buddha causing them to unite in one, lest there should be jealousy, accepted the one from all. This bowl is now said to be kept in a palace at the bottom of the sea, but on the advent of Maitreya, the next Buddha of the present world age, it will divide into the original four, each of which is to be guarded by one of the four regents, as it is the palladium of Buddhism. Height, 9½ inches. Laos, Further India. (Cat. No. 217606, U.S.N.M.)

28. *Buddha.*—Bronze. Similar to No. 22. Good workmanship. Height, 10½ inches. Laos, Further India. (Cat. No. 217509, U.S.N.M.)

29. *Buddha.*—Old bronze. Seated in witness position. With inscribed base. Height, 10½ inches. Laos, Further India. (Cat. No. 217510, U.S.N.M.)

30. *Buddha.*—Bronze. Seated in the witness position. With seven rays issuing from the crown of the head. Height, 9 inches, Laos, Further India. (Cat. No. 217514, U.S.N.M.)

31. *Buddha.*—Bronze. Similar to preceding No. 30. Height, 10½ inches. Laos, Further India. (Cat. No. 217525, U.S.N.M.)

32. *Buddha.*—Bronze, richly gilded and chased. Seated in witness position on an ornamental triple throne. The robe, which is thrown over the left shoulder, is adorned in chased work with lotuses and other designs and studded with colored stones. On the front of the throne is a sort of shield, or perhaps intended to represent a cover hanging down. Height, 7 inches. Laos, Further India. (Plate 49, fig. 1, Cat. No. 217536, U.S.N.M.)

33. *Buddha or Bodhisattva.*—Bronze, richly gilded and chased. Standing on a triple base. The hands are raised in the attitude of

veneration. The dress is decorated in chased work. From the wrists are suspended some ornaments in open and filigree work. On the shoulders, close to the neck, are similar ornaments. The *ushnisha* is surmounted by a spire. Height, 9 inches. Siam. (Plate 49, fig. 2, Cat. No. 168501, U.S.N.M.) Collected by Gen. John A. Halderman.

34. *Buddha or Bodhisattva.*—Bronze, richly gilded and chased. Seated on a rock, western fashion; that is, both legs pendant (the "Maitreya pose"), with the hands resting in the lap. The dress is adorned as in No. 33. On the left of the seat a baby elephant is holding up a vessel with water for Buddha to drink, on the right a bear cub is presenting a honey comb. Fine specimen of bronze work. Height, 8¼ inches. Laos, Further India. (Plate 49, fig. 3, Cat. No. 217535, U.S.N.M.)

35. *Buddha.*—Old bronze. Seated in meditation. Heavy and careless casting. Height, 10½ inches. Laos, Further India. Cat- No. 217507, U.S.N.M.)

36. *Buddha.*—Wood, red lacquered and gilt. Standing on the lotus, with the arms hanging flat on the sides. Rude work. Height, 9⅝ inches. Laos, Further India. (Cat. No. 217579, U.N.S.M.)

37. *Buddha.*—Wood, lacquered and gilt. Similar to the preceding No. 36. On the base is an inscription. Height, 9½ inches. Laos, Further India. (Cat. No. 217581, U.S.N.M.)

38. *Buddha.*—Carved, of ivory and gilt. Standing with the posture of the arms the same as in No. 36. Height, 6 inches. Laos, Further India. (Cat. No. 217629, U.S.N.M.)

39. *Buddha and the earth goddess.*—In two parts. On the upper portion Buddha seated in meditation. The top of his head is covered with a head dress resembling a stupa. Beneath, on the base, is represented, in high relief, the goddess of the earth wringing her hair. In the contest of Mara with Buddha, when the latter invoked the earth goddess as witness for his merits (see p. 300), the goddess, squeezing her hair, caused a huge river to issue therefrom, which swept away Mara and his hordes. Wood, lacquered and gilt. Height, 9 inches. Laos, Further India. (Plate 50, fig. 1, Cat. No. 217559, U.S.N.M.)

40. *Buddha and the nagas.*—Bronze relief, representing Buddha seated in a shrine in the witness attitude. This is set in a lacquered and gilt wooden plaque which is framed by eight intertwined *nagas*. The nagas belong to the category of demigods in the syncretistic system of later Buddhism. They are serpents having the power to assume human form, fabled to reside under the Trikuta rocks supporting Mount Meru, the center of the universe in Buddhist cosmology, and also in rivers, lakes, etc., watching over treasures, causing rain and certain maladies, and becoming dangerous when in anger. They have been converted by Buddha and showed great

veneration and zeal for him and his doctrine. Nagas are represented on sculptures as giving the infant Gautama his first bath, immediately after his birth. Muchilinda, the King of the Nagas, protected Buddha from the rain after his enlightenment. In Buddhist art they are represented either in their animal form, as on this shrine, or, more ususal, in human form with a serpent placed over the head, or rather springing from behind the neck, as an ornament. Sometimes both forms are combined, the upper part being human with the heads crowned with serpents' hoods, while the lower part of the body, from the hips downward, is purely animal. Height, 11 inches; width, 6⅝ inches. Laos, Further India. (Plate 50, fig. 2, Cat. No. 217595, U.S.N.M.)

41. *Buddha with disciples.*—Wood, lacquered and gilt. Buddha seated in meditation, as in No. 39. Around the base are, in high relief, eight disciples kneeling, with hands joined, in the attitude of adoration. Height, 6½ inches. Laos, Further India. (Plate 50, fig. 3, Cat. No. 217594, U.S.N.M.)

42. *The earth goddess.*—Octagonal plaque, red lacquered, representing, in high relief, the earth goddess wringing her hair. See above, under No. 39. Height, 10½ inches; width, 8½ inches. Laos, Further India. (Cat. No. 217564, U.S.N.M.)

43. *Buddha and nagas.*—Carved of horn, lacquered and gilt. Buddha, in the witness posture, is sheltered by three nagas in the shape of cobras rising above his head, their coils forming his throne. See above under No. 40. Height, 5¼ inches. Laos, Further India. (Cat. No. 217630, U.S.N.M.)

44. *Buddha and disciples.*—Wood, lacquered and gilt. Buddha in the witness attitude, the throne set on an octagonal hourglass-shaped base. Upon the base are, crudely carved in the round, eight disciples kneeling with uplifted hands in adoration, surrounding the throne. Compare No. 41. Height, 8¾ inches. Laos, Further India. (Cat. No. 217604, U.S.N.M.)

45. *Buddha.*—Wood, lacquered and gilt. Seated in the witness position. The head covering is in form of an open lotus, from which proceed seven rays. The figure with its base is socketed into a throne formed of a crouching demoniac figure wound with the coils of two serpents, the tails of which he holds in his mouth. Perhaps intended for the Garuda, the mythical bird of India, who, like the Nagas (serpents), has the faculty of assuming human form, but is their deadly enemy, killing and injuring them whenever he can. Height, 15 inches. Laos, Further India. (Plate 51, Cat. No. 217566, U.S.N.M.)

46. *Buddha.*—Wood, lacquered and gilt. Seated in the witness attitude, with inscription on front of the base. Height, 7¼ inches. Laos, Further India. (Cat. No. 217570, U.S.N.M.)

47. *Buddha.*—Bronze. Seated in the witness posture on lotus throne, which rests on a base. Height, 9 inches. Laos, Further India. (Cat. No. 217517, U.S.N.M.)

48. *Buddha.*—Wood, lacquered and gilt. Seated in witness position on a double lotus. The robe in form of a folded shawl covers his left shoulder. Height, $8\frac{3}{8}$ inches. Laos, Further India. (Cat. No. 217561, U.S.N.M.)

49. *Buddha.*—Wood, lacquered and gilt. Standing. The head is surmounted by seven rays. Fine work, but both arms are broken off. Height, 8 inches. Laos, Further India. (Cat. No. 217580, U.S.N.M.)

50. *Buddha.*—Bronze. Seated in witness position. The robe is folded over the left shoulder, falling over the knees. Height, $5\frac{1}{2}$ inches. India. (Cat. No. 158324, U.S.N.M.)

51. *Buddha.*—Bronze, gilt. Similar to No. 47. Height, 10 inches. Laos, Further India. (Cat. No. 217534, U.S.N.M.)

52. *Buddha or Bodhisattva.*—Bronze. Seated. The head is bent forward and is covered with a high-peaked crown. The arms are adorned with armlets and bracelets. The hands, with fingers bent, are held one over the other. Height, $6\frac{1}{4}$ inches. Japan. (Plate 52, fig. 1, Cat. No. 220138, U.S.N.M.) Lent by Miss Eliza R. Scidmore

53. *Buddha.*—Bronze. Seated in meditation on an ebony chair carved with lotus in openwork. The protuberance (*ushnisha*) on the head is gathered to a knot or tuft and is surrounded with a sort of diadem in openwork. The robe is fitted around the neck, covering both shoulders, incasing the arms in wide sleeves and falling down in ample folds over the knees. Height, $9\frac{1}{2}$ inches. China (Plate 52, fig. 2, Cat. No. 281273, U.S.N.M.) Gift of Mrs. Belle Bushnell.

54. *Buddha.*—Bronze chased. Seated on an ornamental throne, with something like a shield in front, similar to No. 32. The right hand is holding a rice ball, while the left rests on the knees. It is the custom of the temple service in Laos to place a vessel of steamed rice and a vessel of water before the image of Buddha. Height, $5\frac{1}{2}$ inches. Laos, Further India. (Plate 52, fig. 3, Cat. No. 217515, U.S.N.M.)

55. *Buddha or Bodhisattva.*—Bronze, originally gilded, but the gilding has largely disappeared. Seated in meditation. The form of the protuberance, the arrangement of the robe, and the mural crown or diadem are the same as in No. 53. This figure is, in addition, adorned with necklaces and pendants and holds in the hands a mace or scepter. Height, $7\frac{1}{2}$ inches. China. (Cat. No. 236805, U.S.N.M.) Lent by August Wall.

56. *Buddha.*—Soft stone. Seated, with the hands resting squarely on the knees. The head is covered with a low, flat cap. The robe

covers both shoulders and falls in folds over the knees. Height, 13½ inches. Torai, Korea. (Cat. No. 151600, U.S.N.M.)

57. *Buddha.*—Bronze. Seated in witness position. The throne is raised on three legs. Height, 6¾ inches. Laos, Further India. (Cat. No. 217518, U.S.N.M.)

58–59. *Buddha.*—Wood lacquered and gilt. Seated in witness position on an hourglass-shaped base. Height, 7¾ inches. Laos. Further India. (Cat. No. 217568–9, U.S.N.M.)

60. *Buddha.*—Wood, lacquered and gilt. Seated with hands folded in the robe in lacquered and gilt shrine. Height, 5¾ inches. Japan. (Cat. No. 311798, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

61. *Buddha.*—Wood, gilt. Standing in the gift-bestowing attitude. The left hand is broken off. Height, 4¾ inches. Japan. (Cat. No. 154271, U.S.N.M.)

62. *Buddha.*—Wood, lacquered and gilt. Standing in the gift-bestowing attitude. Height, 6 inches. Kobe, Japan. (Cat. No. 154822, U.S.N.M.)

63. *Buddha.*—Wood, lacquered and gilt. Seated in the witness posture. Height, 5½ inches. Laos, Further India. (Cat. No. 217587, U.S.N.M.)

64. *Buddha.*—Bronze. Seated in witness position. Height, 7¼ inches. Laos, Further India. (Cat. No. 217519, U.S.N.M.)

65. *Buddha.*—Bronze, gilt. From the top of the head issue three rays. The base on which the lotus throne rests is adorned with a frieze of openwork in which are set five figurines in pointed arches. Perhaps intended for the five Buddhas of the present world-age (*Kalpa*), of whom Gautama was the fourth, and the fifth is still to appear as Maitreya, the Buddha of love. Height, 6¼ inches. Laos, Further India. (Cat. No. 217520, U.S.N.M.)

66. *Buddha.*—Wood, lacquered and gilt. Standing in the attitude of gift bestowing. Height, 4¾ inches. Japan. (Cat. No. 127274, U.S.N.M.)

67. *Buddha.*—Marble. Seated in the witness position. The robe, in form of a folded shawl, is thrown over the left shoulder. Height, 6 inches. Burma. (Plate 53, fig. 1, Cat. No. 151432, U.S.N.M.)

68. *Buddha.*—Gray alabaster. Seated in the witness position. The head is surmounted by a stupa-like crown, with a sort of halo behind it, while the arms are adorned with armlets. Height, 7¼ inches. Burma. (Plate 53, fig. 2, Cat. No. 129543, U.S.N.M.)

69. *Buddha.*—Gray alabaster. Seated in the witness position. Height, 8 inches. Burma. (Plate 53, fig. 3, Cat. No. 175192, U.S.N.M.)

70. *Buddha.*—Gray alabaster. Seated in the witness position. Height, 4¾ inches. Burma. (Cat. No. 311813, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

71, 72. *Buddha.*—White limestone. Seated in the witness position. Height, 8¾ inches each. Burma. (Cat. Nos. 175191, 175192 U.S.N.M.)

73. *Buddha.*—White alabaster, red lacquered and gilt. Seated in the witness position, the lotus resting on a high base which is inscribed on the back. The garment is folded on the left shoulder. On the head is the high-peaked crown and round the neck three bands. Height, 17⅝ inches. Laos, Further India. (Cat. No. 217612, U.S.N.M.)

74–84. *Buddha.*—White alabaster. Similar to No. 73. These alabaster figures are rather crudely carved. The eyes and mouth are indicated by mere lines, the dress is represented by a gilded band or sash on the left shoulder. But they are highly valued by the Loas Buddhists on account of their being white, which is believed to be due to a Deva (semidivine being) guarding the figures and keeping them white and pure. During a drought they are carried in procession to cause a rainfall. Height, 4 to 8¼ inches. Laos, Further India. (Cat. Nos. 217614–217624, U.S.N.M.)

85. *Buddha.*—Wood, lacquered and gilt. Standing on a double lotus, which is surrounded by an hexagonal railing, resting on a richly carved and gilt triple base. There is a double *urna* (precious bead) over the forehead and between the eyebrows, as in No. 1. The robe covers both shoulders and comes down in graceful folds to the feet. The cast of the face and the arrangement of the drapery exhibit strong Greek influence. The halo, in form of a fig leaf, rises from the lotus base and terminates in a sharp point overarching the head. The arms, which probably were in the posture of affording protection are missing. Height, of the figure, 12 inches; of the base, 6 inches. Japan. (Cat. No. 154271, U.S.N.M.)

86. *Buddha.*—Wood, black lacquered and gilt. Seated in the witness position. Height, 5½ inches. Laos, Further India. (Cat. No. 217591, U.S.N.M.)

87. *Buddha.*—Bronze, gilt. Seated in the witness position. Height, 5¼ inches. Laos, Further India. (Cat. No. 217608, U.S.N.M.)

88. *Buddha or Bodhisattva.*—Bronze, richly gilt with various adornments. Much oxidized. Height, 3 inches. Laos, Further India. (Cat. No. 217529, U.S.N.M.)

89. *Buddha.*—Wood, lacquered and gilt. Witness position, with the posture of the hands reversed; that is, the left hand is pointing to the earth, instead of the right. Rudely carved. Height, 3½ inches. Laos, Further India. (Cat. No 217586, U.S.N.M.)

90. *Buddha.*—Old bronze relief. Buddha walking, stepping out with the left foot. The head is facing front, while the body is slightly turned to the left. The left arm is raised to the breast, while the right hangs flat on the side. Shows Greek influence. Height, 4⅝ inches. Loas, Further India. (Cat. No. 217530, U.S.N.M.)

91. *Buddha.*—Wood, lacquered and gilt. Seated in meditation. Rude carving, and there is no throne or base. Height, 2½ inches. Laos, Further India. (Cat. No. 217588, U.S.N.M.)

92. *Buddha.*—Made of a gummy substance, lacquered and gilt. Seated in meditation. Height, 3¾ inches. Laos, Further India. (Cat. No. 217590, U.S.N.M.)

93. *Buddha.*—Wood, lacquered and gilt. Seated in witness position. Height, 2⅝ inches. Laos, Further India. (Cat. No. 217589, U.S.N.M.)

94. *Buddha.*—Bronze, lacquered and gilt. Seated in witness position. Height, 2⅞ inches. Laos, Further India. (Cat. No. 217531, U.S.N.M.)

95. *Buddha.*—Bronze, gilt. Seated in meditation. Crude work. Height, 3½ inches. Laos, Further India. (Cat. No. 217532, U.S.N.M.)

96. *Buddha.*—Bronze, lacquered and gilt. Seated in the witness position. Height, 2¼ inches. Laos, Further India. (Cat. No. 217533, U.S.N.M.)

97. *Buddha.*—Seated in the witness position. The head is of silver; the body and base of a gummy substance which has been overlaid with a casing of silver foil, most of which has disappeared. The base is traced with a net pattern and checkers. Height, 6 inches. Laos, Further India. (Cat. No. 217609, U.S.N.M.)

98. *Buddha.*—Similar to the preceding No. 97. On the base are tracings of a net pattern and floral designs. Height, 5 inches. Laos, Further India. (Cat. No. 217610, U.S.N.M.)

99–104. *Buddha.*—Seated in the witness position. Made of a gummy substance, overlaid with silver foil. The bases are decorated with a tracing of geometrical designs. Height, 2 to 2½ inches. Laos, Further India. (Cat. Nos. 217553–217558, U.S.N.M.)

105. *Buddha.*—Brass. Seated in meditation in lacquered and gilt shrine. Height, 3¾ inches. Japan. (Cat. No. 77125, U.S.N.M.)

106. *Buddha.*—Wood, lacquered and gilt. Seated in the witness position. Height, 4½ inches. Laos, Further India. (Cat. No. 217592, U.S.N.M.)

107, 108. *Buddha.*—Bronze relief, gilt. Seated in the witness position on a double lotus throne within an arch which rests on columns. Height, 4 inches; width, 1⅞ inches. Laos, Further India. (Cat. Nos. 217641 and 217643, U.S.N.M.)

109. *Buddha.*—Carved flat shrine or niche, black and red lacquered, set with beads of colored glass. In the recess of the niche is a bronze

relief representing Buddha seated under a canopy in the witness posture. In the background is seen the sacred Bo tree under which Gautama attained to Buddhahood. Height, 8½ inches. Laos, Further India. (Cat. No. 217576, U.S.N.M.)

110. *Buddha in a niche or shrine.*—Similar to he preceding (No. 109), only that in this the attitude is of meditation. The head of the Buddha figure is broken off. Height, 8 inches. Laos, Further India. (Cat. No. 217577, U.S.N.M.)

111. *Buddha.*—Bronze relief, representing Buddha seated in the witness posture on a double throne with a halo in shape of a fig leaf. Height, 3½ inches; width, 1½ inches. Laos, Further India. (Cat. No. 217692, U.S.N.M.)

112. *Buddha.*—Antique ivory carving, in form of a pointed cone, gilt and mounted. Obverse, two seated Buddhas, one above the other, the upper in meditation, the lower in the witness attitude; reverse, the sacred Bo tree. Height, 9½ inches. Laos, Further India. (Cat. No. 217627, U.S.N.M.)

113. *Buddha.*—Antique ivory carving, in form of a pointed cone, gilt and mounted. On both sides, Buddha in the witness position under the Bo tree. Height, 6½ inches. Laos, Further India. (Cat. No. 217628, U.S.N.M.)

114. *Buddha.*—Terra-cotta relief. Buddha, in the attitude of gift bestowing, standing on a lotus which rests on an elaborately carved base. The dress, which covers the whole body, is adorned with horizontal bands modeled of floral designs in relief. On the arms are bracelets. On either side of the figures are richly carved columns which closed on to an arch which has broken away. The relief is of ancient Cambodian workmanship and was apparently removed from the wall decorations of a temple. Height, 7¾ inches; width, 3¼ inches. Laos, Further India. (Cat. No. 217638, U.S.N.M.)

115. *Buddha.*—Terra-cotta relief (fragment), showing Buddha seated in meditation. Over his head is an umbrella, and on the sides lotus buds (?). Height, 5 inches; width, 3½ inches. Laos, Further India. (Cat. No. 217632, U.S.N.M.)

116–119. *Buddha.*—Old terra-cotta reliefs, representing Buddha in the witness position. Height, 2½ to 2¼ inches. Laos, Further India. (Cat. Nos. 217634–217637, U.S.N.M.)

120. *Buddha.*—Clay plaque, rounded at the top, with a raised rim all around. Inside is a miniature figurine of Buddha in the center, surrounded by some 50 still smaller figurines of disciples. Height, 4½ inches; width, 3¾ inches. India (?). (Cat. No. 276834, U. S.N.M.)

121. *Plaster cast of the face of Buddha.*—From an ancient statue in Korea. Height, 9¼ inches. Korea. (Cat. No. 129594, U.S.N.M.)

122. *Buddha.*—Bust, made of a gummy substance, lacquered and gilt. Height, 5 inches. Laos, Further India. (Cat. No. 217611, U.S.N.M.)

123. *Bronze head of Buddha.*—From a statue found in the ruins of the Wat-Pra-Shan-Tan temple, near Lakawu Lampang. The face shows a noble tranquil expression. From the crown of the head issue five rays. Traces of gilding are discernible. Height, 6 inches Laos, Further India. (Cat. No. 217511, U.S.N.M.)

124. *Terra-cotta head of Buddha.*—From a statue found in the ruins of Wat-Yaphra-Khaw, "the temple of the women of the white cloth." Fine work. Laos, Further India. (Cat. No. 217639, U.S.N.M.)

125. *Buddha figurines in clam shell.*—These images on a shell are made by the natives of China by taking a large kind of clam (*Alasmodonta*) and gently attaching leaden images of Buddha under the fish, after which it is thrown back into the water. Nacre is deposited over the lead, and after a few months the shells are retaken, cleaned, and sent abroad as proofs of the power and presence of Buddha. $6\frac{1}{2}$ by $4\frac{3}{4}$ inches. Ningpo, China. (Plate 54, Cat. No. 127111, U.S.N.M.)

126. *Parinirvana.*—Buddha dying, or, as the Buddhist ritual expresses it, entering nirvana. Alabaster. Length, 34 inches. India. (Plate 55, Cat. No. 158322, U.S.N.M.)

127. *Parinirvana.*—Buddha entering nirvana. Wooden canopy, red and gold lacquered. It consists of a square base around the edges of which are set uprights and at one end is a panel carved in open work, while the roof has extended eaves. On the platform is a figure of Buddha lying on the right side, the head resting on some low support, surrounded by eight disciples. Of these one holds a vase (with medicine, or the ambrosia of nirvana), another is weeping, and the hands of the rest are in the posture of adoration. One of the disciples is missing. Height, 21 inches; length, 13 inches; width, 9 inches. Laos, Further India. (Plate 56, Cat. No. 217668, U.S.N.M.)

128–131. *Parinirvana.*—Buddha entering nirvana. Antique bronzes, representing Buddha lying on his right side, his head resting on a round pillow. Height, 4 inches: length, 7 to $8\frac{1}{2}$ inches. Laos, Further India. (Cat. Nos. 217512, 217516, 217526, 217527, U.S.N.M.)

132. *Parinirvana.*—Buddha entering nirvana. Terra-cotta relief, gilt. Length, $4\frac{1}{4}$ inches. Laos, Further India. (Cat. No. 217633, U.S.N.M.)

133. *Horns of Buddha.*—Bronze, lacquered and gilt. According to the tradition preserved in the Jatakas, which form a part of the Buddhist sacred literature, Gautama had passed through 550 existences in all created forms—as God, as man, as animal—till in his last incarnation, as the son of Suddhodanna, he appeared as the savior of mankind. These horns are believed by the Laos to be the

actual horns of Buddha from a former incarnation as a bull. They were found at a relic shrine (stupa) claimed to have been erected on the spot where this bull is said to have died. The shrine and the lake near by still bear the name of this bull and are regarded as a sacred spot. On the front of the horns is carved in archaic style Buddha in the witness position; on the back, standing with the arms hanging flat on the sides. Height, 7¾ inches; length of the base, 8¾ inches. Laos, Further India. (Plate 57, Cat. No. 217625, U.S.N.M.)

134. *Buddha's footprint* (*Buddhapada*).—Cast from the original at Buddhagaya, Magadha, India. Supposed footprints of Buddha are found in various Buddhist countries, to which devout Buddhists make pilgrimages and present offerings. Most celebrated are the footprints on the gateways of the tope of Sanchi, in Bhopal (central India), on which are marked beside the wheel 108 compartments, each occupied by some sacred object (as a trident, a flower, a candle, a book, angels, the planets, etc.).[10] Length, 25½ inches. India. (Plate 58, Cat. No. 76219, U.S.N.M.)

2. IMAGES OF BODHISATTVAS AND OTHER DIVINE BEINGS.

135. *Amitabha* (?).—Wood, lacquered and gilt. Seated in the "easy pose" (*lalita sana*), the left leg hanging down with inclination slightly inwards, the right drawn up and loosely bent. The ushnisha is gathered to a knot or tuft. The forehead was adorned with a metal ornament resembling a diadem, which has fallen off. The dress is elaborate and ornate. The right hand holds a wand or scepter, the object which was in the left hand is missing. Behind the head is a circular halo and another one behind the body, both with a beaded border and set in a fig leaf-shaped aureole carved with scrolls in open work. The seat represents a rock round which is coiled a dragon, the emblematic mythical animal of China and Japan. Amitabha, or as the Japanese name him, Amida, is one of the five celestial meditation (*dhyani*) Buddhas, who rules over the Sukhavati heaven of the west. He is the celestial reflex or counterpart of Gautama Buddha. He is the "Buddha of infinite light," and is in the entire northern Buddhism the most popular divinity and his image the most widely spread. The identification of this figure as that of Amitabha is, however, tentative. Height of the figure, 25 inches; of the base, 19 inches; length of the base, 20 inches; width, 16 inches. Japan. (Plate 59, Cat. No. 154964, U.S.N.M.)

---

[10] Most famous is the footprint on Adam's Peak in Ceylon, which Buddha is said to have left on the occasion of his mythical visit to Ceylon. The cavity of about 5 feet long on the summit of the peak has been claimed by the Buddhists for Buddha, by the Sivaites for Siva, by the Christians for St. Thomas, who, according to tradition, had carried Christianity to India, and by the Mohammedans for Adam, who alighted on it when he was expelled from Paradise. The name Adam's Peak was given to the mountain by the Portuguese, who called it *Pico de Adam*.—The Portuguese authorities were divided between the conflicting claims for the footprint of St. Thomas and the eunuch of Queen Candace, mentioned in Acts viii, 27. The footprint of Buddhagaya is now worshipped as that of Vishnu.

136. *Amitabha* (?).—Wood, lacquered and gilt. Seated in meditation on a full-blown lotus throne which is supported by a lion couchant on a rock which rests on a plinth, in a wooden shrine. The head wears an elaborate crown, in a filigree work. On the ears are similarly worked ornaments from which a necklace or chain hangs down over the breast. Height of the figure, 12½ inches; of the shrine, 24 inches. Shei Sheiva, Japan. (Cat. No. 154293, U.S.N.M.)

137. *Tse-pa-med* (*Sanskrit Amitayus*).—Bronze, chased and gilt. Amitayus with the Tibetan Buddists is the active spiritual reflex of Amitabha and is worshipped as the Buddha of long life (while Amitabha is the Buddha of "boundless light"). The Chinese confuse him with Amitabha. He is represented seated on a double lotus, holding before him in his right hand a bowl (often a skull) filled with water of life, which is one of the eight luck-compelling symbols of ancient India, the left hand rests with upturned palm in his lap under the right. The head is painted in blue.[11] Height, 8 inches. Dolon Nor, Tibet. (Cat. No. 130400, U.S.N.M.)

138. *Kuan-Yin*.—Porcelain, seated on a lotus around which is coiled a dragon; the right hand holds a child, the left rests on her knee, and on the sides are a male and female suppliant. Kuan-Yin, in Japan, Kuannon, her full name being Kuan-Shai-Yin, signifying, "a being who hears or perceives the cries of man," is in both countries the goddess of mercy and the female transformation of Avalokitesvara ("the one who looks down from above," namely, upon suffering humanity with compassion), the emanation or contemplation (*dhyani*) Bodhisattva of Amitabha, of whom Gautama Buddha was the earthly embodiment. Avalokitesvara has, therefore, charge of the world until Gautama's successor, the next Buddha in the person of Maitreya appears. Kuan-Yin is bodily healer as well as conveyor of the souls to the Paradise of Amitabha in the "bark of salvation." Seven cases of distress are generally specified in which she is ready to extend her hand of mercy: Dangers caused by the sword; fetters or chains; fire; water; demons; goblins; and an enemy. Sometimes danger by storm is added, to make four couples complete. As child bestowing, she is represented carrying a male infant in her arms and is invoked by women desiring offspring. Her worship is most widely extended in China and Japan. Height, 8½ inches. Foochow, China. (Plate 60, Cat. No. 216026, U.S.N.M.) Gift of Gen. G. W. Bailey.

139. *Kuannon*.—Wood painted and decorated. Standing on a blue base, holding an infant in the left hand. Face, hands, bosom, and

[11] "Copper is found both native and in the form of pyrites in Tibet, where it is wrought with uncommon perfection. Several localities are well known for their famous founderies, which supply the whole of the Buddhist east with statuettes of divinities. Lhasa has a special reputation for small figures in gilt copper, which are esteemed the more the smaller they are. The statuettes made by the monks and craftsmen of Tashilumppo are equally esteemed. Most of the bronze statuettes come from the workshops of the Tsang and Khams Provinces. The bronzes from the region last named are famous for the perfection of their execution in details and their wonderful patina."—Vincent A. Smith, A History of Fine Arts in India and Ceylon, Oxford, 1911, p. 198.

infant are painted white, the lower dress, brownish green with broad gold border; the upper, blue. Height, 6 inches. Kobe, Japan. (Plate 61, Cat. No. 154824, U.S.N.M.)

140. *Kuannon.*—Lead, bronzed, standing in a shrine of plain wood on a green lotus, holding in her right hand a sort of scepter (*ju-i*), in the left, the precious ball (*mani*). Height, 7½ inches. Shigisan, Jamato, Japan. (Cat. No. 150581, U.S.N.M.)

141. *Kuan-Yin.*—Wood, painted. Holding infant. Faces, hands, and feet are painted white; the dress, brown. Height, 6 inches. Foochow, China. (Cat. No. 216027, U.S.N.M.) Gift of Gen. G. W. Bailey.

142. *Kuan-Yin (?).*—Pewter, red lacquered and gilt. Seated in meditation. Height, 9½ inches. China. (Cat. No. 311805, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

143. *Kuan-Yin.*—Copper, silvered. Statuette without base. The hands are wrapped in the voluminous folds of the dress, which, however, do not conceal the necklace with three pendants. The veil is drawn over the head and hangs down behind. Height, 4½ inches. China. (Cat. No. 311808, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

144. *Tshen-ju-Kuannon* (*thousand-handed Kuannon*).—Relief of indurated clay, representing the goddess with many arms standing on a lotus. The distinctive attribute of the goddess, namely, mercy, is illustrated in this realistic manner by an image with many hands that are ever ready to help the needy. Height, 3 inches. Kobe, Japan. (Plate 62, fig. 1, Cat. No. 116220, U.S.N.M.)

145. *Kuannon.*—Wooden statuette painted and gilt, with six arms seated in lacquered shrine. Height, 4 inches. Japan. (Plate 62, fig. 3, Cat. No. 154272, U.S.N.M.)

146. *Kuanti, Chinese god of war.*—Sandal wood, carved. Standing on a mythical animal with two attendants, Kuanti, one of the deities of Taoism, was admitted into the temples of pacificistic Buddhism because as god of war he was considered as a valuable champion to enlist on the side of the true religion, and also because he was the tutelary deity of Manchu dynasty. Height, 5 inches. China. (Plate 62, fig. 2, Cat. No. 158284, U.S.N.M.)

147. *Kuanti, Chinese god of war.*—Wood, carved, painted, and gilded. Height, 28 inches. China. (Cat. No. 158312, U.S.N.M.)

148. *Kuanti.*—Relief carved of basaltic lava, with an inscription in intaglio. Height, 15 inches; width, 9 inches. Yokohama, Japan. (Cat. No. 75060, U.S.N.M.)

149. *Tien-How.*—Indurated clay. Woman seated, holding in her right arm an infant, in the left hand a lotus. Originally a Taoist divinity, the "queen of heaven," Tien How is worshiped in China as the mother of Buddha, whom she had miraculously conceived. She

laid her cloak upon an island when she bathed in the sacred Ganges. On returning she found a lotus bud in the garment and, having eaten it, she conceived Buddha. Perhaps it was this divinity which gave rise of the coordination of Avalokitesvara with Kuan-Yin. Height, 4¾ inches. China. (Cat. No. 130815, U.S.N.M.) Gift of Mrs. J. G. Bruff.

150. *Maitreya.*—Wood lacquered and silvered. Seated in meditation. Maitreya is the Bodhisattva of Gautama Buddha and the next and last Buddha to appear on earth during the present world-age (*kalpa*). He is the only Bodhisattva known to southern Buddhism (Burma, Ceylon, Siam). He is sometimes represented seated in European fashion, that is, with the legs let down, with the attributes of a vase (of ambrosia) and a wheel and lotus. Height, 9½ inches. Laos, Further India. (Cat. No. 217582, U.S.N.M.)

151. *Maitreya* (?).—Wood. Seated figure on a throne, wearing a crown, with the feet resting on a footstool. The right hand is resting on the knee, the left on the breast, and beneath it is a carved mask of a monster. Height, 10 inches. China. (Cat. No. 216029, U.S.N.M.) Gift of Gen. G. W. Bailey.

152. *Jambyang* (*Sanskrit, Manjusri*).—Bronze, gilt and polished. The name Manjusri means something like "having a lovely brilliance." He is the Bodhisattva of the celestial Buddha Akshobhya, and is the representative of transcedental wisdom. He is represented seated, holding in his right hand the sword of knowledge with which he cleaves the clouds of mental darkness. His other attribute is a book which rests upon a lotus rising behind his left arm. The high diadem is painted blue. His principal temple is at Wu-tai-shan in the Chinese Province of Shanhsi. Height, 8 inches. Lhasa, Tibet. (Cat. No. 130396, U.S.N.M.)

153. *Bodhisattva* (?).—Wood, carved, gilt and encrusted with pieces of colored glass. Standing on a base, holding a long stalk extending from the feet to above the head and probably terminated in a lotus bud, which is broken away. The robe, richly carved with bands of floral designs and beaded lines, reaches down to the feet, ending in a train behind. Over this is a short, closely fitted coat, descending to the hips, while from the arms hang folded scarfs. The head is covered with a diademed cap, from which rises a conical crown. The rather small ears have red stones attached to the lobes and are set in a triangular ornament. On the bosom is an ornament, formed of four lozenge-shaped pieces of glass with a boss in the center. Height, 19¾ inches. Burma or Siam. (Plate 63, fig. 1, Cat. No. 311804, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

154. *Bodhisattva* (?).—Bronze, cast and chased, gilt and polished. Standing on a base. The robe, descending to the feet, with a sort of waist held by a belt, is finely chased with floral designs. The

hands, with the fingers bent and placed the right over the left, would indicate that had held something like a wand or scepter, which is missing. Height, 9½ inches. China or Mongolia. (Plate 63, fig. 2, Cat. No. 311807, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

155. *Drolma* (*Sanskrit, Tara*).—Bronze, gilt and polished; Tara, the name meaning "savioress," is the female energy or counterpart (*sakti*) of the compassionate Avalokitesvara and like him she shows her gracious disposition towards mankind by her right hand being stretched out in the gift-bestowing gesture, while the left holds a lotus stalk. An ornamental fillet with a crest in the middle adorn the forehead. The other ornaments are large circular earrings, a double necklace, a long string of beads fastened between the breasts, richly studded armlets, bracelets, and anklets, and an elaborate girdle. The headgear is painted dark-green. Behind the left arm rises a lotus. Height, 6½ inches. Chamdo, Eastern Tibet. (Cat. No. 130395, U.S.N.M.)

156. *Drolma* (*Sanskrit, Tara*).—Brass. Similar to preceding No. 155. With a fig leaf-shaped halo. Crude workmanship. Height, 5¾ inches. Thibet. (Cat. No. 311792, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

157. *Fudo*.—Wood, carved and gilt. Seated in the easy position (*lalita sana*) on a rock, holding a sword in the right hand and a snare in the left, with a flame-shaped halo in open work, in a lacquered, gilt shrine. Fudo (the name meaning, "without movement") is considered as the Bodhisattva of Vairochana, the celestial reflex or meditation Buddha of Krakuchanda, the assumed first earthly (*manushi*) Buddha of the present world period. Fudo's function is to combat evil in the world, and his attributes are a sword and a snare to catch and bind the wicked and smite the guilty. In the funeral ritual of the Shingon sect of Japanese Buddhism a Fudo sword is placed in front of the celebrant in the belief that he takes charge of the soul after death. Fudo is also patron of soldiers. Height, 6½ inches. Japan. (Plate 64, Cat. No. 311,812, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

158. *Tamdrin, or Tamdin* (*Sanskrit, Hayagriva*).—Bronze, gilt and polished, Hayagriva-Tamdrin is one of the eight dreadful gods, united by the Tibetans in the group of Dragshed ("terrible slayer"). They are Hindu or local Tibetan gods brought into the Buddhist system as protectors of the true faith against the demons of their several spheres. They are represented as beings of ferocious aspect, with broad and hideous heads, protruding tongues, and huge teeth. Their limbs are enormously strong, but short, and their bodies are misproportioned; they are surrounded with flames or smoke, and on their forehead they bear a third eye (the "eye of wisdom)." In the present figure Hayagriva-Tamdrin is represented kneeling on

his left knee, with three faces of hideous expression, and on his head a crown of flames (painted red). Around his waist is a girdle of leaves, and a large rosary hangs around his neck. He has six arms. In his upper right hand he holds a snare to catch the demons, and in the lower an arrow; in his upper left hand is a three-leaved flower (?) and in his lower left a bow. The middle right hand which he holds before him has in it the vajra (Tibetan dorje), the thunderbolt of Indra, the Hindu god of the atmosphere; the middle left hand is empty, the thumb touching the second and third fingers, the index and little finger held extended. He is horse-necked and frightens the demons by his neighing. For this reason the Mongolians consider him protector of horses. Height, 8 inches. Lhasa, Tibet. (Cat. No. 130398, U.S.N.M.)

159. *God of riches* (*Jambala or Kubera, Tibetan, Gunkar Yizin Norbu*).—Bronze, gilt and polished. The god of riches is one of the Dragsheds (for which see No. 158). He also appears as one of the four world guardians (*Lokapalas*), who dwell around Mount Meru, the reputed center of the Buddhist world. He is three-faced, with a crown of flames (painted red), standing on two elephants. He has six arms adorned with anklets and bracelets. The middle hands are held before him with offerings in them. The upper right hand holds a *vajra* (dorje, the thunderbolt of Indra), the upper left a three-forked club, perhaps intended to represent the *trisula*, or trident, the scepter of the Hindu god Siva. The lower right a small hand drum (*damaru*), and the lower left a snare. Height, 4½ inches. Lhasa, Tibet. (Cat. No. 130399, U.S.N.M.)

160. *Gandharva*.—Wood, red lacquered and gilt. Human kneeling figure in the attitude of adoration, set on wings. The Gandharvas belong to the Devas, secondary deities or attendants. In the Hindu system, whence they were introduced into Buddhism, they are the musicians of Indra, who with their master serve and worship Buddha. They are sometimes represented with a human bust on the body of a bird, playing a musical instrument. Height, 6 inches. Laos, Further India. (Cat. No. 217607, U.S.N.M.)

161. *Maha Upakut*.—Wooden figure, lacquered and gilt. Represented with the hands pressed on the prominent abdomen, wearing a flat red cap in form of an open lotus and red garment thrown on the left shoulder. The Laos describe the Maha Upakut as a son of Buddha, who was born in the water of the river god. His skin is rough in imitation of a fish's scales. They believe that touching his figure after it has been dedicated to a temple will cure pains of the stomach. Height, 10 inches. Laos, Further India. (Plate 65, Cat. No. 217596 U.S.N.M.)

162–166. *Maha Upakut*.—Wood, lacquered and gilt. Similar to the preceding No. 161. Height, 2¼–6½ inches. Laos, Further India. (Cat. Nos. 217597–217601, U.S.N.M.)

167. *Daikoku.*—Wood, lacquered and gilt. Daikoku is one of the Japanese seven gods of good fortune (*Shichi-fuku-jin*), which are derived from Hinduism, Buddhism, Taoism, and Shintoism, and form a sort of popular appendage to Japanese Buddhism. They are, in the order of their popularity, as follows:

1. *Daikoku* (the "great black one") is Mahakala of the Hindus. But while the Hindu god is one of the most destructive and awe-inspiring deities of the Hindu pantheon, his Japanese counterpart is the smiling god of wealth. He is usually represented as a sturdy figure habited in the ancient dress of a well-to-do Chinese burgher, with a flat cap. In his right hand he holds the magic hammer, a single stroke of which gives wealth, while his left hand grasps the mouth of a sack that is slung across his shoulder. He stands or sits upon a well-filled pair of rice bales. The mallet being the attribute of miners, and the rice the product of agriculture, are emblematic of the two principal sources of the wealth of ancient Japan. Sometimes he also carries a turnip. His picture is frequently found at the entrance door to the house.

2. Ebisu (the "stranger") is, notwithstanding his name, an indigenous product of Japan. He was the younger brother of the Shinto sun goddess Amaterasu (from whom the emperors of Japan derived their descent). He somehow incurred the displeasure of his family and was expelled to the western sea, where he spent his remaining life as a fisherman. He is, accordingly, represented with a fishing rod in his right hand and a fish (*Pagrus cardinalis* or *major*, which is considered by the Japanese the most delicious provision on the table). He is the patron of merchants and tradesmen and is usually in the company of Daikoku, the patron of the farmers.

3. Benzaiten (popularly abbreviated to Benten) is identified with Sarasvati, the spouse of Brahma, the Hindu goddess of eloquence and learning, and her character has remained the same in Japan. She is also the popular goddess of love and beauty and everything that adorns life. In Hindu mythology she is depicted as riding on a peacock as her vehicle (*vahan*). In Japan she is often represented as standing or sitting on a dragon and holding a musical instrument.

4. Bishamonten (Bishamon) is the Hindu Kubera or Vaisravana, the god of riches and the Buddhist Maharaja of the northern quarter of Mount Meru (see above under No. 159). In Japan he is the god of strength and wealth, but also the patron of knowledge. He is usually represented as a stately knight, holding a model of a castle or tower and a spear and standing on a conquered foe, which symbolise his function as guardian warrior god.

5. Hotei ("linen bag") is believed to have been a Chinese priest who lived in the tenth century A. D., celebrated for his fatness, his love of children, and especially for always carrying a large linen bag,

from which his name is derived. In China he is worshiped under the name of Pu-tai as an incarnation of Maitreya, the Buddha of the future. He is a sort of a Japanese Santa Claus, the god of mirth and laughter.

6. Jurojin ("old venerable man") is of Chinese origin. He symbolizes longevity. His attributes are a stag or crane, both (together with the peach and tortoise) being emblems of longevity.

7. Fukurokuju ("bliss, wealth, longevity"). His most prominent physical mark is his tall head, being at least twice as long as his face, as if an ordinary-sized cranium was not large enough to hold all his virtues, knowledge, and happiness. He is the companion of Jurojin, and their names and attributes are often interchanged.

Height of the Daikoku figure, 13 inches. Japan. (Plate 66, Cat. No. 130458, U.S.N.M.)

168. *Daikoku*.—Lead, silvered. Height, 3 inches. Kobe, Japan. (Cat. No. 154827, U.S.N.M.)

169. *Ebisu*.—Lead, silvered. Height, 3 inches. Kobe, Japan. (Cat. No. 154826, U.S.N.M.)

170. *Jurojin*.—Sitting beside a stag. Bronze, black lacquered. Height, 2½ inches. Japan. (Cat. No. 311809, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

171. *Fukurokuju*.—Bronze. Height, 6¾ inches. China or Japan. (Plate 67, Cat. No. 311811, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

172. *Fukurokoju*.—Miniature mask, brass, gold plated. Height, 1½ inches. China or Japan. (Cat. No. 311863, U. S.N.M.) Bequest of Miss Elizabeth S. Stevens.

II. THE BUDDHIST SCRIPTURES (DHARMA).

The sacred books supposed to embody the word of Buddha, are considered by Buddhists as forming the second member of the *Triratna*—the three precious ones—to whom the pious Buddhist daily takes his refuge. The books themselves receive divine honors. They are held materially sacred, are placed in high places and worshipped.

The two main divisions of Buddhism, the Hynayana and Mahayana, or the southern and northern schools, respectively (compare the introduction, p. 294), have different canons of scriptures. The southern canon is written in the Pali language, and contains on the whole the older and purer exposition of Buddha's doctrines, though it already shows a considerable development. The scriptures of the Mahayana, or northern school, which are written parts in Sanskrit and in a mixed dialect of Sanskrit and Middle Indian or the Gatta dialect, parts in Chinese, Tibetan, Mongolian, and Japanese, are in their contents more or less influenced by Hinduism, and contain not only what is found in the Pali scriptures but a great deal more. The southern canon is about twice as large as the English Bible, and is assumed to have been fixed in the third century B. C., and reduced to writing in Pali in the first century B. C. The northern canon is about a hundred times larger than the Pali canon. Thus, the Chinese scriptures are seven hundred times the amount of the New Testament, comprising 5,000 books, which represent 1,662 differen works. The Tibetan canon, called Ka-gyur (Kan-jur) contains 100 or 108 volumes of about 1,000 pages each and representing 1,083 different works.

The Buddhist scriptures go by the name of the *Tripitaka* (three baskets) because when the scholars classified the sacred writings, which were written on palm leaves, the books were put into baskets. Another explanation expresses the idea of how the scriptures were handed down from one generation to another. In the Orient it is a common custom to have workmen stationed in a line who hand from man to man a series of baskets filled with something to be removed from one place to another. In the case of the scriptures it expresses figuratively the long line of teachers who handed down to generation after generation the teachings of the founder.

173. *Sacred writings of the southern Buddhists* (*Tripitaka*).—Printed edition in 39 volumes, in the Pali language (the sacred language of the southern Buddhists) and in the Siamese alphabet. The three "baskets" contain:

1. The Vinaya-pitaka, the collection of rules and precepts especially intended for the monks (vols. 1–8).

2. The Suttanta-pitaka, or Sutras, containing discourses, proverbs, hymns, and legends for general instruction (vols. 9–28).

3. The Abhidhamma-pitaka, devoted to the metaphysics of Buddhism (vols. 29–39).

Bangkok, Siam. (154,989.)

Presented by His Majesty Somdetch Phra Paramindr Maha Chulalonkorn Phra Chula Chom Klao, King of Siam, in commemoration of the twenty-fifth anniversary of his reign, March 20, 1895.

174. *Prajna Paramita* (*Tibetan, Shirab*).—Tibetan manuscript, written on 366 ornate cardboards, consisting of several layers of paper pasted together and varnished over with a black pigment, in gold letters, and held between two covers of lacquered and gilt wood. The Prajna Paramita, or "transcendental wisdom," properly, "the means of arriving at the other side of wisdom," consists of mythical discourses attributed to Buddha and addressed mostly to supernatural hearers on the Vulture's Peak at Rajagriba (the modern district of Patna, Bengal). It is the most sacred book of the Mahayanist scriptures. It is ascribed to Nagarjuna, a converted Brahmin

philosopher to Buddhism, who possibly lived in the second century A. D., and who is counted the fourteenth of the twenty-eight patriarchs of the Mahayana hierarchy. Nagarjuna alleged that he received the book from the Nagas, who dwell in the ocean (for which see above under No. 40), and they received it from the mouth of Gautama and kept it until a generation arose which was capable of understanding it. Height, 10 inches; width, 17½ inches; thickness, 7 inches. Tibet. (Cat. No. 237929, U.S.N.M.) Collected by Lieut. Col. L. A. Waddell, archeologist of the Indian Government expedition to Tibet in 1904–5, and presented by the Government of India.

175. *Printing block of wood in Manchu and Chinese characters.*—From the library of the Temple of the Colossal Buddha in the palace grounds of Peking. Length, 25 inches; width, 8 inches. Peking, China. (Cat. No. 222152, U.S.N.M.) Lent by Miss Eliza R. Scidmore.

III. THE BUDDHIST CONGREGATION (SANGHA).

1. SAINTS AND PRIESTS AND THEIR APPURTENANCES.

176–177. *Pair of arhats.*—Wood, lacquered. Seated figures. The term *arhat* (Chinese, *lohan*, Japanese, *rohan*) is in a specific sense applied to the original disciples of Buddha, the apostles, who are variously counted from 10 to 500. More generally it designates a disciple or follower of Buddha who has attained the highest degree of perfection and completed the chain of existence so that he need not be born again. In a still wider sense it is applied to any virtuous and learned saint. The chief apostles or missionaries are usually provided with some attribute or emblem, such as a book or scroll, a fly whisk and vase, as seen on these figures, a jeweled snare, a crown, and so on, and receive worship in the temples. Height, 19½ inches. Tokio, Japan. (Plate 68, Cat. No. 130460, U.S.N.M.)

178. *Arhat.*—Bronze, gilt. Seated figure, with hands joined in the attitude of veneration. Height, 4 inches. Laos, Further India. (Cat. No. 217668, U.S.N.M.)

179. *Arhat.*—Wood, red lacquered and gilt. Kneeling figure, with hands joined. Height, 4¾ inches. Laos, Further India. (Cat. No. 217575, U.S.N.M.)

180. *Arhat.*—Bronze. Seated figure, with hands raised in reverence. The inscription on the base states that it was dedicated in the year 1151 of Buddha. Height, 4½ inches. Laos, Further India. (Cat. No. 217513, U.S.N.M.)

181. *Arhat.*—Wood, lacquered and gilt. Kneeling figure, with hands folded in adoration. Height, 5¼ inches. Laos, Further India. (Cat. No. 217562, U.S.N.M.)

182. *Arhat.*—Wood, lacquered and gilt. Kneeling figure, holding begging bowl, or medicine vase, with both hands of the outstretched

arms. Height, 6¾ inches. Laos, Further India. (Cat No. 217563, U.S.N.M.)

183. *Tibetan saint, supposed to represent Ch'os-bjin jamba.*—Bronze, gilt and chased. Seated in meditation, clothed in a mantle falling over the arms. The base is chased with floral designs. Height, 7¼ inches. Kumbum, Sifan, near the western frontier of China. (Cat. No. 167270, U.S.N.M.)

184. *Holy man, probably Chinese saint.*—Bronze, gilt. Seated in western fashion. Height, 6½ inches. Kumbum, Tibet. (Cat. No. 167269, U.S.N.M.)

185. *Saint.*—Terra-cotta figurine, seated, holding begging bowl in front. Height, 3¾ inches. Tibet (?). (Cat. No. 311810, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

186. *Maha Krachai.*—Porcelain figure of a saint, apparently of Chinese make. It is called by the Laos Maha Krachai and regarded by them as a learned saint. It is the only figure outside of Buddha found in Laos temples. Height, 4 inches. Laos, Further India. (Cat. No. 217626, U.S.N.M.)

187–190. "*Neophytes.*"—Wood, red lacquered and gilt. Kneeling figurines with heads bowed to the ground and joined hands to the right side of the head in the attitude of adoration. Height, 2½ to 3 inches. Laos, Further India. (Cat. Nos. 217571–217574, U.S.N.M.)

191. *Chinese Buddhist ecclesiastic.*—Wooden seated statue, clad in the regulation dress of Buddhist monk. These consist (1) of the lower garment (*antavarasatta*), fastened by a girdle at the waist; (2) the middle robe (*uttarasanga*); (3) the outer shawl (*sanghati*), a strip of yellow cloth, 10 to 20 feet long and 2 to 3 feet broad. It is thrown over the left shoulder and passed under the right arm, leaving the right shoulder bare. But both shoulders and the chest are covered by an inner vest on entering the house of a layman. And over all is thrown a plaited cloak or cape, crescentic in shape. Height, 50 inches. China. (Plate 69, Cat. No. 127562, U.S.N.M.). Gift of the Chinese Centennial Commission, 1876.

192. *Buddhist priest's robes.*—Consisting of strips of yellow cloth. Ceylon. (Cat. No. 154979, U.S.N.M.)

193. *Buddhist ecclesiastic.*—Wood, painted. Seated in a chair in ceremonial robes. Height, 40 inches. China. (Plate 70, Cat. No 216028, U.S.N.M.) Gift of Gen. G. W. Bailey.

194. *Buddhist ecclesiastic.*—Wood, painted and gilt. Seated in ceremonial robes on a carved and gilt double base. Height, 3½ inches. Kobe, Japan. (Plate 71, fig. 1, Cat. No. 154823, U.S.N.M.)

195. *Buddhist monk.*—Model carved in wood. Represented with fan, staff, beads, and vessels for receiving rice, all of which a Buddhist monk carries when begging. Height, 5¾ inches. Burma. (Plate 71 fig. 2, Cat. No. 176647 U.S.N.M.) Gift of M. A. Tribolet.

196. *Miniature of a Tibetan Buddha.*—Statuette of bronze, gilt, inclosed in a small shrine. Height of image, 2½ inches; of shrine, 3½ inches. Shanghai, China. (Plate 71, fig. 3, Cat. No. 158309, U.S.N.M.)

197. *Kammaracham.*—Ordination service of a Buddhist monk. Manuscript written on strips of palm leaf, written on both sides in the Pali language in the Laos characters. The writing is done by means of a sharp stylus, and then ink is rubbed over so as to make the markings with the stylus visible. Gilt on the edges, inclosed by two wooden tablets secured by a cord passing through them. At the end of the cord is a fish carved of wood and a bundle of bamboo rings. The fish as a symbol was adopted by the Buddhists from Hinduism. In Hindu mythology a fish, that was the disguise of Brahma or Vishnu, was the savior of Manu (the Hindu Noah) in the great flood. The first incarnation of Vishnu was in the form of a fish (*the matsya avatar*), and generally is the fish considered symbol of good luck and favorable omen. In the late Mahayana texts Buddha is compared to a fisher. Length, 23½ inches; width, 2½ inches. Laos, Further India. (Cat. No. 217669, U.S.N.M.)

198. *Japanese Vajra.*—Bronze. The *vajra* (Tibetan, *dorje*), literally, diamond, or that which is indestructible, symbolic of the true doctrine which can not be destroyed, is the ritual scepter or wand of Mahayana or northern Buddhism. It is originally the thunderbolt of Indra, the Hindu god of the atmosphere, only that the points of the darts are closed. "The Nepalese scriptures say that a contest once occurred between Buddha and Indra, in which the latter was defeated, and had wrested from him his chief and peculiar instrument of power, the vajra or thunderbolt, which was appropriated as a trophy by the victor, and has ever since been adopted by his followers as the favorite emblem of their religion"[12] The Tibetans believe the *dorje* to have fallen from heaven and to have alighted in a monastery at Lhasa, where the original is still retained. It is called in Tibetan *serapun-dze.* An annual festival has been established in its honor and is one of the principal religious fetes.[13] The three-pronged vajra is called by the Japanese *san-ko;* the five-pronged, *go-ko;* the single-pointed vajra which is in use in Japan is called *do-ko.* Length, 5¾ inches. Japan. (Cat. No. 130390, U.S.N.M.)

199. *Japanese Vajra.*—Bronze. Length, 5¼ inches. Japan. (Cat. No. 167172, U.S.N.M.)

200. *Tibetan Dorje.*—Bronze. Length, 4¾ inches. Tibet. (Cat. No. 167268, U.S.N.M.)

---

[12] William Woodville Rockhill, Notes on the Ethnology of Tibet. Report of the U. S. National Museum, 1893, p. 740.

[13] Edward Paske, Journal of the Archaeological Institute of Great Britain and Ireland, vol. 8, p. 202.

201. *Temple bell* (*Tibetan, drilbu*).—Bronze. On the outer surface near the handle are in relief eight mystic syllables. The handle is cylindrical and has a head, representing the *Dharma* (doctrine), surmounted by a *dorje*. The bell is used in the performance of daily services, and the great lamas are often represented with a bell in the hand. This bell was made in Derge, which country is famous for the clear-toned bells cast there. Tibet. (Cat. No. 131011, U.S.N.M.)

202. *Temple bell.*—Bronze. Similar to the preceding No. 201, less the head of Dharma on the handle. Monastery of Dolon nor, eastern Mongolia. (Cat. No. 130389, U.S.N.M.)

203. *Vajra.*—Bronze. Similar to No. 198. Length, 4½ inches. Japan. (Cat. No. 77137, U.S.N.M.)

204. *Vajra.*—Copper. Six-pronged, with one prong in the middle. Crude casting. Length, 6 inches. Shanghai, China. (Cat. No. 158311, U.S.N.M.)

205. *Vajra.*—Brass. Eight-pronged, with one prong in the middle. Length, 4¾ inches. Probably China. (Cat. No. 311802, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

206. *Vajra-dagger* (*Tibetan, phurbu*).—Bronze. The three-angular dagger is set into an animal's (elephant's (?)) head. The central portion is in form of a vajra, and the hilt end is terminated by a triple demon's head and surmounted by a horse's head, representing Tamdrin or Hayagriva (for which see above No. 158). It is used in incantation to stab the demons. Length, 7¾ inches. Tibet. (Plate 72, fig. 1, Cat. No. 311803, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

207. *Tip of a mendicant's alarm staff* (*hikila, Tibetan, khargsil*).—Consisting of a socketed brass bar with a circular loop on which are strung six jingling rings. It is carried by mendicant monks to drown out by its jingling worldly sounds, and to warn off small animals, lest they be trod upon and killed. Height, 4¾ inches. Probably Tibet. (Plate 72, fig. 2, Cat. No. 311791, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

Prayer wheels.—The prayer wheel (Tibetan, *mani chos kor*) is a cylinder of metal, or, in the larger wheels, of wood or even leather, through which runs an axis prolonged below to form a handle. Around this axis are rolled, one on top of the other, sheets of paper or leaves of a book inscribed with some formula or spell. The sheets are wound on the axis from right to left, and the wheel when set in motion must revolve in the opposite way, so that the writing passes in front of the person turning the wheel in the way in which it is to be read; that is, from left to right. A piece of metal attached by a small chain to one side of the barrel facilitates the turning of it. Each complete revolution of the wheel counts as one repetition of all the prayers contained in the cylinder. The prayer wheel is used especially by the Buddhists of Tibet, and the most usual invocation inscribed on the rolls in prayer wheels consists of the words: "Om! mani padme! Hum," which is rendered: "Hail, jewel in the lotus." The repetition of this formula is the most common mode of praying met with among the Mongols and Tibetans. It is addressed to Avalokitvsvara (Padmapani), who appeared from out of a lotus for the deliverance of mankind. By the Tibetans he is held in special veneration as the protector and patron of Tibet, and is being incarnated in the Dalai Lama, the head of Tibetan Buddhism. Prayer wheels are placed in the entrance to temples and houses, to be turned by each person passing by it, on gables of houses, or over the hearth, where they are twirled by the wind or smoke. Sometimes a wheel is fixed to the bed of a stream and kept in motion by the current, thus praying night and day for the owner. Besides the small hand-prayer wheels, usually measuring from 3 to 5 inches in height and from 2 to 3 inches in diameter, there are large machines set up in temples and monasteries, which are sometimes 30 or 40 feet high and 15 or 20 feet in diameter. In these are placed a collection of the canonical books of lamaism (ka-gyur, see p. 322), and by means of bars fixed in the lower extremity of the axis of the barrel it is put in motion. It is a materialistic putting into practice of the symbolical phrase "Turning the wheel of the law."

208. *Small Stationary Prayer Wheel.*—Bronze. The axis projects above the top, so that it may be put in motion without removing it from the stand on which it rests. It is adorned with a raised ornamentation of the *dorje* and an invocation in Nepalese Sanskrit characters, while the top of the cylinder is ornamented with a wheel, and the bottom with four *dorjes*. Tibet. (Cat. No. 130393, U.S.N.M.).

209. *Hand Prayer Wheel.*—Bronze. The top is decorated with a silver wheel, studded with coral and turquoise beads. The bottom has four *dorjes*, and on the sides is the six-syllable spell in Landza characters in silver. Bands above and below are decorated with *dorjes* and lotus flowers, respectively. The axis terminates in a pineapple-shaped knob of silver. Tibet. (Cat. No. 130392, U.S.N.M.)

210. *Prayer Wheel.*—Bronze. The top is dome-shaped. The barrel is divided into two compartments by a ridge, which is decorated with coral and turquoise beads. Darjeeling (on the border of Tibet), India. (Cat. No. 74494, U.S.N.M.)

211. *Strip of Chinese Paper.*—On which the formula "Om, mani padme hum" is nearly 400 times repeated in print. As about 100 of such sheets can be wrapped in the cylinder, a revolution of the wheel would be equivalent to repeating the formula 40,000 times. Tibet (Cat. No. 131014, U.S.N.M.)

212. *Prayer wheel.*—Bronze. Similar to the preceding, No. 210. The bottom is decorated with scroll patterns. Darjeeling, India (Cat. No. 74493, U.S.N.M.)

213. *Prayer wheel.*—The barrel of bronze is divided by a band of brass into two compartments, which have the invocation. Top and bottom, as also the pineapple-shaped knob on top and the bead on the side, are likewise of brass. The top is in shape of a fluted dome; the bottom is decorated with four *dorjes*, all in repousse. Probably Tibet. (Cat. No. 311794, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

214. *Prayer wheel.*—Bronze. Resembling the preceding. Leh, Ladak. (Cat. No. 175152, U.S.N.M.) Gift of W. L. Abbott.

215. *Prayer wheel.*—Bronze. Flat top; otherwise similar to the preceding. Leh, Ladak. (Cat. No. 175153, U.S.N.M.) Gift of W. L. Abbott.

216. *Prayer wheel.*—The barrel is of felt covered with coarse woolen cloth. An iron pivot runs through the barrel and fits in a roughly carved wooden handle. The cylinder is covered with a piece of red cotton cloth, to the corners of which are attached glass beads. Tibet. (Cat. No. 167169, U.S.N.M.)

ROSARIES.

The rosary, like the prayer wheel, is especially peculiar to the northern, or Mahayana, school of Buddhism, with its belief in the merit and efficacy of meditation and in the potency of repeating mystic spells and formulas. The Buddhist full rosary is composed of 108 beads, and this number is given a symbolic signification. The number 108 is said to correspond to a like number of mental conditions, or sinful inclinations, which are to be overcome by the recitation of the beads. The number 108 generally plays a great part in the tradition and philosophy of Buddhism: 108 Brahmans were summoned at Gautama's birth to foretell his destiny. The Burmese footprints of Buddha have sometimes 108 divisions. The Ka-gyur, the Tibetan canon of scriptures is composed of 108 vloumes, and the white pagoda at Peking is surrounded by 108 columns. In Japan, on the festival of the dead (*bommatsuri* or *bonku*), which is celebrated from the 13th to the 15th of July, 108 welcome fires (*mukaebi*) are lighted along the shores of the sea or lake or river by which a city or village is situated.

The full rosary of 108 beads is usually divided by three beads of a different size or material into four groups of 27 beads each. The two ends of the string before being knotted are passed through three extra beads, called "retaining beads," or "union holders," as they keep the proper rosary beads in position and indicate the completion of a cycle. They symbolize the Buddhist triad—the Buddha, the doctrine (*dharma*), and the community (*sangha*). Attached to the main string are two small pendant strings, having each 10 smaller beads. These pendants are used as counters to keep count of the number of times the rosary is said. A bead of one pendant string is slid down on completion of a single recital of the rosary, while the beads of the second note each 10 repetitions. They thus serve to register the utterance of 108 multiplied by 10 multiplied by 10, equaling 10,800 prayers or formulas. Sometimes there are two additional pendants.

Alongside of the full rosary of 108 beads, employed by the monks, there are in vogue rosaries of 18 and 16 beads, representing, respectively, the 18 *lohans* or chief disciples of Buddha counted by the Chinese, and the 16 *rohans* of the Japanese. The common people, moreover, use indifferently rosaries with various numbers of beads.

The material of the Buddhist rosaries varies according to the taste, wealth, and rank of the owner. The commonest are made of seeds, wood, pebbles, shells, glass, or bone; the more costly of jade, turquoise, coral, amber, silver, and gold, and even of pearls and other gems. The countries in which the Buddhist rosary is most widely used are China, Tibet, and Japan.[14]

217. *Chinese rosary* (*su-chu*).—The 108 beads of the main string are palm-wood balls. The dividing and retaining beads are of silver, richly enameled, measuring 1½ inches in diameter. The three counter strings have each 10 beads, likewise of enameled silver but of smaller size, being only one-half inch in diameter. From the retaining beads is suspended a silk ribbon embroidered with small glass beads of diverse colors to represent the swastika and other symbols, with a silver enameled medallion, measuring 2¼ by 1¾ inches in the center, and terminating in an oblong or oval bead 2 inches long. Such an oval bead is also at the end of each of the three counter strings, each 1¼ inches long. They are called the "four dewdrops," which they resemble, or the "disciple beads," or the "regents of the four heavens." They typify the emperor, father, mother, and the teacher, to whom a Chinese subject owes reverence and obedience. This rosary is the official necklace which used to be worn by dignitaries on state occasions. China. (Cat. No. 202869, U.S.N.M.) Gift of Yang Yu, Chinese minister to the United States, 1897.

218–20. *Three Chinese rosaries.*—Consisting of 108 globular beads made of black wood. Hoihau, China. (Cat. No. 154242, U.S.N.M.)

221. *Chinese rosary.*—Consisting of 18 olive-shaped beads, probably made of some wax or resin composition, each being carved into an image of one of the 18 lohans or saints. China. (Cat. No. 130388, U.S.N.M.)

[14] Compare also "The collection of rosaries in the U. S. National Museum," by I. M. Casanowicz. Proc. of the U. S. National Museum, vol. 36, pp. 333-360, with pls. 21-30.

222. *Chinese rosary.*—Consisting of 18 beads made of the fruit of the *Trapa bicornis* of China, which resembles a Buffalo's head with two blunt horns. China. (Cat. No. 5503, U.S.N.M.)

223. *Tibetan rosary* (*trengwa, "string of beads"*).—Consisting of 108 disk-shaped shell beads, divided into four groups of 27 beads each by three red coral beads. The three retaining beads (*do dzin*) are a large spherical amber bead, a smaller disk-shaped one, and a conical one of coral. The four counter strings (*drang dzin*), with 10 silver beads on each terminate in various ornaments. This form of rosary is in common use among the lamas. The rosary in Tibet is not only an essential part of the outfit of the lamas, but is everywhere in appearance. Nearly every man and woman carries a rosary, holding it in the hand, or attached to the girdle, or wearing it around the neck as a necklace, or twisted around the wrist as a bracelet. Laymen also use it to assist in ordinary calculations, like the sliding balls of the Chinese, in their business transactions. Kumbum, Tibet. (Cat. No. 167271, U.S.N.M.)

224. *Tibetan rosary.*—Consisting of 108 disks cut from human skull, divided into four sections of 27 each by three larger disks of conch shell, with two retaining beads of amber and wood, respectively, but without counters. Such rosaries are especially used in the worship of Dorje jig-ch'e (Sanskrit, Yama), the king of the dead. Tibet. (Cat. No. 130387, U.S.N.M.)

225–6. *Tibetan rosaries.*—Made of small disks of rosewood, with red coral beads as dividers. It has no counters, and the dividing beads, as also the three retaining ones, have to be counted to complete the number of 108. Beads of reddish color, usually of red sandalwood, are used in the worship of the fierce Tamdrin (Hayagriva, see above No. 158), the demon patron of lamaism. Ta-chien-lu, China. (Cat. No. 167267, U.S.N.M.)

227. *Tibetan rosary.*—Consisting of 108 disks of yellow wood, with the dividing beads of the same material only slightly larger and thicker. It has only two retaining beads and no counters. Batang, China. (Cat. No. 131058, U.S.N.M.)

228–229. *Tibetan rosaries.*—Consisting of 108 spherical beads of yellow wood, without counters and with only one retaining bead. Said to have been brought from Lhasa, the holy capital city of Tibet. Ladak. (Cat. Nos. 178119–178120, U.S.N.M.) Gift of W. L. Abbott.

230. *Japanese rosary* (*jiu-dzu*).—Consisting of 112 globular beads made of cherry wood. In the Japanese *jiu-dzu* the Buddhist rosary attained its highest development. The rosary of 112 beads (*sho-zoki jiu-dzu*), which is used by all sects in common, is divided by 2 large beads, called parent beads (*oya-dama*) into two equal parts. They are distinguished into the upper parent bead (*ten-no oya-dama*),

also called father, sun, Buddha, and lower parent bead (*chi-no oya-dama*), mother, moon, *Bo*, divine spirit, which inspired and perfected the enlightenment of Buddha. The ends of the string before being knotted are drawn through the 2 parent beads which have for this purpose a third opening. From the upper parent bead extend 2 pendant strings on which are strung 21 beads, smaller than those on the main string, in the following manner: Immediately above the large parent bead, on the left-side pendant string, is a solitary bead. Beyond this the strings are knotted. Then come 5 beads on each string, when they are again knotted. Still again there are another 5 beads on each pendant, which then terminates in an elongated bead, called dewdrop (*tsuyu-dama*). The use of the solitary bead is that in holding the rosary, with the upper parent bead uppermost, it should be in the left hand; this will insure a right signification to each bead during prayer. The collective name of these pendant beads is *kami-deshi*, superior disciples. Extending from the lower parent bead are 3 strings, on 2 of which are 5 small beads, called *shima-deshi*, or inferior disciples, each terminating in a dewdrop bead, while the third has 10 small beads without a dewdrop. They are used as counters and are called *kadzu-tori*. The 4 dewdrop beads are also termed *shi-ten-no*, the four regents who are supposed to preside over the four quarters of the universe. The rosary thus represents symbolically the Buddhist pantheon. On the main string, at an interval of 7 beads on either side from the upper parent bead, are 2 beads, smaller than the others, and again, at an interval of 14 beads from these, on either side, are other 2 of the same kind. They indicate where a special invocation is to be uttered while the rosary is lifted to the forehead with a reverence.

A smaller rosary of 16 beads, corresponding to the Japanese *rohans*, or chief disciples of Buddha (analogous to the 18 *lohans* of the Chinese), is chiefly used by lay peoples on ceremonial and social occasions. Japan. (Plate 73, Cat. No. 130683, U.S.N.M.)

231–2. *Two Japanese rosaries.*—Consisting each of 112 globular beads made of plum-tree wood. The same as the preceding No. 230. Japan. (Cat. No. 130683, U.S.N.M.)

233. *Prayer beads* (*mak-nap*).—Made of small black seeds, strung on a cord. The invocations repeated by the Laos by means of the beads are: Sabbe sangkara anicca, 300 times; sabbe sangkara dukkha, repeated 400 times; sabbe sangkara anatta, repeated 500 times. Laos, Further India. (Cat. No. 217666, U.S.N.M.)

234. *Buddhist monks' begging bowl.*—Spherical, of thin iron, with wooden base. Inclosed in an open work bag formed of bands of cotton, the ends of which serve as handles. To this cloth is secured a lacquered base. From the bottom hang models of the perquisites of a monk, namely, (1) the water strainer, used to exclude the small

animals which might be found in the water from being killed; (2) a drum; (3) sandals; (4) steel and flint for striking fire; (5) vessel for pouring out water when performing acts of merit; (6) a shaving knife. Height, 10¾ inches; diameter, 9½ inches. Laos, Further India. (Cat. No. 217664, U.S.N.M.)

235. *Buddhist monk's begging bowl.*—Old bronze, decorated with groups of rosette-shaped dots. Height, 4 inches; diameter, 8 inches. Japan. (Plate 74, Cat. No. 158321, U.S.N.M.)

236. *Buddhist monk's begging bowl.*—Earthenware, black lacquered. Height, 7 inches; diameter, 9 inches. Burma. (Cat. No. 129555, U.S.N.M.)

237. *Buddhist monk's rice spoon.*—Made of shell. Rice and fruit constitute the diet of Buddhist priests. They obtain these viands by begging from house to house, and an alms bowl, rice spoon, and fruit bag belong to the equipment of a Buddhist priest. They are bound to abstain from meat and intoxicating liquors, and from partaking of any food after midday. Length, 6 inches. Siam. (Plate 75, fig. 1, Cat. No. 127163, U.S.N.M.)

238. *Buddhist monk's rice spoon.*—Made of alabaster. Length, 4 inches. Tokio, Japan. (Plate 75, fig. 2, Cat. No. 127552, U.S.N.M.)

239. *Fly flap.*—Lacquered and gilt. The feathers are arranged in shape of a heart. "It is properly a screen, and is never used as a fan but to cover the face when presenting the alms bowl for alms so that the monk may receive the gift without knowing the giver. The Buddhist believes it is more blessed to give than to receive, and the merit belongs to the giver." Length, 26 inches; width, 14 inches. Laos, Further India. (Cat. No. 217665, U.S.N.M.)

2. RELIGIOUS EDIFICES AND THEIR PARAPHERNALIA.

240. *The Wat Chang pagoda.*—Model of wood, painted. Pagodas (the Burmese name for these structures; Singhalese, *dagaba* or *dagoba;* Sanskrit, *stupa;* Pali, *thupo,* whence Anglo-Indian *tope;* Nepalese, *chaitya;* Tibetan, *chorten;* Chinese, *tah;* Japanese, *to*) are religious structures the original purpose of which was to receive the relics of Buddha, or the remains of such of his disciples as distinguished themselves by piety or learning. But already in the early periods of Buddhism stupas were constructed *ex voto,* either for marking some important event in the life of Buddha and the history of Buddhism, or for decorating the monasteries and temples. In keeping with the original purpose of the pagoda, its earliest architectural style was derived from the tomb or tumulus. The earliest stupas are simple cupolas or hemispheres raised on a low basement, about half the diameter in height. With the exception of a small cell for the ashes or relics, these shrines were solid masses of bricks or stone. Gradually the plinth was increased until it rose from one to two diameters

in height. The apex of the dome was usually surmounted by a disk placed horizontally, on which rose, as a terminal, an umbrella (*tee*), the emblem of royalty and state among eastern nations. Later the number of umbrellas was increased to 3, 7, 9, 11, and even 13 (always an odd number), placed one above the other.[15]

The pagoda of Wat Chang ("great monastery") is considered the most magnificent edifice of Bangkok, the capital of Siam. It is built of brick, and its outside plastering is wrought into a mosaic by means of porcelain of different colors set in it so as to form figures of elephants, griffins, demons, flowers, etc. From its broad octagonal base the bell-shaped structure rises in elegant tapering terraces, ending in a dome-shaped top, from which rises a sharp spire. In large niches upon the sides toward the summit are images of Buddha riding on elephants, and the whole building is lavishly adorned in both color and carving. It is assumed that the pagoda measures from the base to the tip of the spire about 250 feet in height. It is surrounded by smaller pagodas, shrines, monks' dwellings, flower and fruit gardens, ponds, grottos, and various stone statues. Dimensions, 3 by 3 by 3 feet. Bangkok, Siam. (Cat. No. 158420, U.S.N.M.) Gift of the Marquis Visuddha, minister of Siam to England.

241. *Chinese pagoda.*—Model of wood. Consisting of nine stories, surmounted by a spire, called in Japanese *kiu-do* (nine rings), resembling a corkscrew such as may be used to uncork a columbiade. The form of the Chinese pagoda is probably derived from the spire ringed with umbrellas, described in the preceding No. 240, of the Hindu *stupa*. The umbrella-shaped roof is the main element in the Chinese pagoda, the walls being mere screens, set between pillars. Each platform as it towers upward in decreasing size is supposed to denote a world. To the roofs of the various stories are attached small bells and tinkling copper leaves, which are swung and rung by the wind, to denote the eternal music of the spheres, and the carved balustrades and projecting eaves are emblems of the habitations of the happy beings dwelling in the supernal regions. Of the several stories only the first is used as a shrine for relics and images, while the others are hollow, with staircases leading up to the top.

The roofs are black lacquered, the railings and halls are red lacquered, the spire is gilt lacquered. Height, 5 feet by 23 inches square. China. (Cat. No. 313624, U.S.N.M.)

242. *Pagoda.*—Model of wood, lacquered and gilt. Consisting of three stories, surmounted by the nine-ringed spire (*kiu-do*), terminating in the jewel or sacred pearl, one of the three treasures or

[15] Compare "The Wat Chang Pagoda of Bangkok, Siam," by I. M. Casanowicz. Smiths. Misc. Coll. vol. 47, pp. 273, 274.

emblems of royalty in Japan. Height, 30 inches by 15 inches square. Japan. (Plate 76, Cat. No. 154965, U.S.N.M.)

243–245. *The Temple Hongwanji and hair rope.*—The great Hongwanji temple of the "True Sect" (*Shin shu*), at Kioto, Japan, was completed in 1895. Its dimensions are those of a western cathedral. Ninety-six massive pillars support the roof at a height of 126 feet. The timbers were all dragged from the mountain and lifted into their places by 29 immense ropes made of human hair, the voluntary offerings of innumerable women, which are still preserved within the precincts. Tokio, Japan. (Plate 77, fig. 1, plan of the temple Hongwanji; fig. 3, section of a hair rope, measuring 32 inches in length and 4½ inches in diameter, used in the erection of the temple; fig. 2, photograph of the ropes made of human hair. Cat. Nos. 150829–150831, U.S.N.M.) Gift of V. Marshall Law.

246, 247. *Pair of Nios.*—Models of wood, painted and decorated. The *Nios* or *Niokongas* ("the two bold golden kings") are usually placed on both sides of the lofty portal to a Buddhist temple in Japan as gatekeepers or guardians. They are the Hindu gods Brahma and Indra. They are represented naked, close-set, athletic figures, 10 or 12 feet high, with eyes and features distorted, painted vermilion red, wrestling against the powers of evil. Height, 16½ inches. Japan. (Plate 78, Cat. No. 166079, U.S.N.M.)

248, 249. *Pair of Nios.*—Models of wood, black lacquered. Height, 14 inches. Japan. (Cat. No. 130457, U.S.N.M.)

250. *Buddhist temple.*—Model of wood (in parts), red painted. Miniature copy of a Laos Buddhist temple, carved and set up by a priest, with the carvings, placement of the timbers, and the several parts of it, as the throne for the image of Buddha, the pulpit from which the scriptures are read, the Nagas on each side of the entrance, representing in every detail a copy of a Buddhist temple in Laos. Laos, Further India. (Cat. No. 217670, U.S.N.M.)

251, 252. *Temple lanterns.*—The lids of these two lanterns are of lacquered wood. The upper lid of each is provided with a bronze handle representing a dragon; the lower lid with bronze cocks. The lids have openings to admit a candle, for which an iron spike is provided on the bottom of the lower lid, upon which the candle is stuck. By raising the upper lid, the painted paper cylinder, which emits the light, is unfolded. The lanterns can either be hung up by the handles or suspended on poles which are passed through holes in both lids provided for that purpose. Height, 12½ inches; diameter, 13¾ inches. Japan. (Plate 79 shows the lanterns opened; plate 80, fig. 1, exhibits the top; fig. 2 the bottom. Cat. No. 154967, U.S.N.M.

253. *Temple lantern.*—Copper. Hexagonal, with dome-shaped top in open work. Richly enameled in various colors and decorated with a profusion of floral designs. Height, 21 inches; diameter, 10 inches. Korea. (Cat. No. 154983, U.S.N.M.)

254. *Altar covering* (Chinese, *huan mun-tiao-kua*).—Made of brown cloth, consisting of a center piece scalloped at the lower edge, with two side pieces which descended over the edge of the altar. Embroidered in gold with dragons and *kilins* (*kirins*), a mythical animal, pictured as resembling a stag in its body and a horse in its hoof, but possessing the tail of an ox and a parti-colored or scaly skin, and a single horn, having a fleshy tip, proceeds out of the forehead. The *kilin* is believed to exhibit great benevolence of disposition toward other living animals, and to appear only when wise and just kings or sages are born. Dimensions, 24 by 30¼ inches. Shanghai, China. (Cat. No. 158307, U.S.N.M.)

255–258. *Four altar coverings* (Chinese, *huan mun-tiao-kua*).—Made of oblong pieces of brown cloth, with centerpieces of red cloth. The edges are embroidered in silk with floral designs, while on the body is an inscription in Chinese characters pasted on. Dimensions, 37 by 8¼ inches. Shanghai, China. (Cat. No. 158307, U.S.N.M.)

259, 260. *Pair of candlesticks*.—Made of pewter in the shape of the Chinese character for longevity (*sheu*). The candles are stuck on the points at the top of the candlesticks, and lighted whenever a ceremony takes place. This is done in the temple service as well as in home worship. Height, 19 inches. Shanghai, China. (Plate 81, figs. 1 and 3, Cat. No. 158294, U.S.N.M.)

261. *Incense burner* (*kong-po-to*).—Made of pewter. On the front are in relief the Chinese characters for longevity (*sheu*) and bliss (*fu*). Height, 7½ inches; length, 5½ inches; width, 4 inches. Shanghai, China. (Plate 81, fig. 2, Cat. No. 158295, U.S.N.M.)

262. *Imitation candlesticks*.—Wooden sticks with inserted points for candles to be stuck on them. Height, 8 inches. Japan. (Cat. No. 130678, U.S.N.M.)

263. *Censer*.—Bronze. Supported on three legs formed of double volutes or spirals. The handles are in shape of dragons. The cover, in open work, is surmounted by a mythical bird perched on some mythical animal. The circumference is embossed with dragons and other monsters. Height, 10 inches; diameters, 6 and 4¾ inches. Japan. (Plate 82, fig. 1, Cat. No. 220057, U.S.N.M.) Lent by Miss Eliza R. Scidmore.

264. *Candlestick*.—Bronze. Consisting of the figure of an emaciated ascetic holding a long dragon, the head of which rests on the base, while the tail terminates in a bowl for inserting a candle. Height, 6½ inches. Kobe, Japan. (Plate 82, fig. 2, Cat. No. 154825, U.S.N.M.)

265. *Censer*.—Brass. Height, 6½ inches. Kobe, Japan. (Cat. No. 254828, U.S.N.M.)

266. *Censer*.—Brass. The cover, in open work, is surmounted by a knob. Height, 4 inches. Japan. (Cat. No. 158314, U.S.N.M.)

267. *Censer.*—Bronze. The cover, in open work is surmounted by a crouching mythical animal. Around the circumference are embossed trees with various birds perching in them. Height, 5½ inches; diameter, 3½ inches. Japan. (Cat. No. 311806, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

268. *Censer.*—Bronze. Resting on three legs which are of animal-headed human figures. The lid is surmounted by a mythical animal. Height, 5¼ inches; diameter, 4¼ inches. Seoul, Korea. (Cat. No. 151618, U.S.N.M.)

269. *Incense.*—Burma. (Cat. No. 129531, U.S.N.M.)

270. *Incense.*—Japan. (Cat. No. 130685, U.S.N.M.)

271. *Flower vase.*—Brass. Placed before Buddhist shrines. Height, 5 inches; diameters, 4 and 2¼ inches. Probably China. (Cat. No. 158313, U.S.N.M.)

272. *Lotus cup.*—Bronze. Eight-fluted cup set in a quadruple eight-petaled lotus, with short stem and base of an inverted eight-petaled lotus. The lid has twenty perforations for inserting flowers. Height, 4¾ inches; diameter, 2½ inches. India (?). Cat. No. 311796, U.S.N.M.) Bequest of Miss Eizabeth S. Stevens.

273. *Holy water vase* (Tibetan, *bumba* or *tsebum*).—Made of brass heavily gilded in Persian shape, with a large spherical body and slender bent spout. The neck is short and narrow and terminates in a flaring mouth in shape like an overturned bowl. In the top of this is a small circular opening, in which a chased metal tube fits, reaching far down into the vase, and in its upper end a bunch of the sacred *kusa* grass and some peacock feathers. This instrument is the aspergil. The vase has a covering of silk fastened around the neck so as to completely hide the vase. Such coverings are put on most objects used in the temple worship, on the sacred images, books, etc., probably as a mode of honoring these sacred objects. The water used in these vases has a little saffron in it, and sometimes a little sugar. The vase is used especially in the ceremonies connected with the worship of Tsepamed (Amitayus), the Buddha of long life (see No. 137), and is called the vase of life. Height, 6½ inches. Kumbum, Tibet. (Cat. No. 130402, U.S.N.M.)

274. *Libation bowl.*—Made of a human skull with a lining of iron and an ornamented copper gilt rim fitting on it. The cover of copper gilt is finely and intricately chased and has on each side the mystic syllable *om* with an arabesque design surrounding it. The top of the cover is surmounted with four half vajras (dorjes) at right angles, a fifth and larger one forming the handle. The stand on which the skull rests is of gilt copper and triangular in shape. At the three angles are human heads, painted red, white, and green. The skull bowl is likewise used in the worship of Tsepamed, when it is filled with nectar brewed from *chang*. After

the ceremony it is drunk by those present—a kind of a lamaist eucharist. The custom of using skulls as holy vessels, or even as eating bowls, is a very old one in Asia. Height, 9½ inches; diameters, 8 and 6¼ inches. The specimen in the Museum came from Kumbum, Tibet. (Cat. No. 130384, U.S.N.M.)

275. *Prayer banners* (Chinese, *yen-kou-fo, or tong hoan*).—Consisting of five brass figurines holding small suspended banners of cloth. They are set up on the altar during recital of prayers for the souls of the dead, especially for the souls of those who failed to receive burial. Their number probably corresponds to the five earthly (*manushi*) Buddhas of the present age (*kalpa*), see p. 296, note 1). Height, 15¾ inches. Shanghai, China. (Plate 83, Cat. No. 158303, U.S.N.M.)

276. *Pair of prayer wands* (Chinese, *yen-kou tsi-tao*).—Made of copper. Used in reciting prayers for the souls of the dead. They are placed crosswise one over the other. Length, 7⅛ inches. Shanghai, China. (Cat. No. 158310, U.S.N.M.)

277. *Scent sprinkler.*—Made of white metal in form of a long-necked narrow vase. Used at Buddhist funerals. Height, 14½ inches. Ceylon. (Cat. No. 154975, U.S.N.M.)

278. *Temple sword.*—On one side of the blade is incised a winding dragon, on the other a vajra (dorje). The scabbard is red and gilt lacquered, crossed by bands in red and black. The hilt is covered with shark skin and set on either side with bronze dragons. The lower end of the scabbard and the head of the hilt are framed in a marine animal (lobster?) of bronze. A sword is placed on the altar in front of the celebrant in the worship of Fudo (see above No. 157). Length, 45 inches. Japan. (Cat. No. 154969, U.S.N.M.)

279. *Temple sword.*—On one side of the blade is incised a dragon winding round a vajra (dorje), on the other, a vajra. The scabbard is decorated in cloisonne enamel on a blue ground with rosettes alternating in pale green and crimson red, with other floral designs between them. The hilt, which is in shape of a vajra, is decorated in champleve enamel. Used in the worship of Fudo (No. 157). Length, 23 inches. Japan. (Cat. No. 154968, U.S.N.M.)

280. *Japanese prayer book.*—Folded. This prayer book comes from the famous temple Mis-kru-saw in Japan. The temple is a resort for invalids, particularly for those having affections of the eye, and the prayers contained in this book are for special use in the temple. Japan. (Cat. No. 130676, U.S.N.M.)

281. *Temple drum.*—Hung in a lacquered wooden frame set on a four-legged support. On the flattened faces of the drum are painted in gold lacquer a bird and leaves. Drums or bells are put up in front of Buddhist temples, on which the priests strike to announce the

hours of prayer. The worshippers also strike them to invite the presence of the deity. Drums are likewise used in Buddhist worship to accompany the chanting of the priests. Diameter of the bell, 16 inches; height, 7½ inches; height of the frame, 36 inches. Japan. (Cat. No. 168815, U.S.N.M.)

282, 283. *Pair of temple drums.*—Set on four-legged lacquered wooden stands and surmounted by cocks. The circumferences of the drums are covered with red cloth. On the flattened surfaces are painted three comma-shaped segments, the Japanese modification of the Chinese (and Korean) tah-gook, formed of two segments, the common representation of the *yang* and *yin*, the two first causes and great principles of the universe, or contrary influences, such as darkness and light, male and female, good and evil, etc. The figure also represents the Japanese *magatama*, or "crooked jewel," one of the emblems of sovereignty in Japan, As regards the cocks perched on top of the drums, Dr. John Ellerton Lodge, curator of Chinese and Japanese art in the Museum of Fine Arts of Boston, kindly communicated the following interesting story:

> The familiar Japanese or Chinese design of a cock on a drum is intended to suggest a well-known story of the famous Emperor Yao, who is said to have ascended the throne of China in the year 2357 B. C. This enlightened monarch caused a drum to be placed in front of his palace gate, with the announcement that whoever had any complaint to make to the sovereign should come to the gate and beat upon the drum, thereby attracting the Emperor's attention. So wisely, however, did this ruler govern his people, that none ever came to enter a complaint, and in the course of time the fowls went to roost on the silent drum.

Height, 26 inches. Japan. (Plate 84, Cat. No. 159966, U.S.N.M.)

284. *Wooden fish* (Japanese, *mokugio;* Chinese, *mo-yii*).—Carved and red lacquered. Used as drum in Buddhist ceremonies. The shape is accounted for by the supposition that the fish is sleepless, keeping its eyes always open on account of the lack of eyelids and eyelashes. It is therefore an emblem of wakefulness and watchfulness in the striving after perfection. Height, 12 inches; length 18 inches. Japan. (Plate 85, front; plate 86, back. Cat. No. 150893, U.S.N.M.)

285. *Wooden fish* (Chinese, *mo-yii;* Japanese, *mokugio*).—Carved, and painted red, with wooden mallet for striking it. Similar to the preceding No. 284. Height, 10½ inches; length, 14 inches. Shanghai, China. (Cat. No. 158296, U.S.N.M.)

286. *Wooden drum* (Chinese, *siao-ku*).—Shaped like two flat plates put together. It is carried by the priest in processions and struck on the side. Diameter, 7½ inches. Shanghai, China. (Cat. No. 155300, U.S.N.M.)

287. *The nine-toned bell* (Chinese, *chin yin-lo*).—Made of copper. Consisting of 10 small gongs suspended in a screen or gate-like cabinet which is struck with a small stick as an accompaniment to prayer.

Height, 24 inches; width, 22 inches. Shanghai, China. (Plate 87, Cat. No. 158305, U.S.N.M.)

288. *Small gong* (Chinese, *yin-to*).—Made of copper in shape of a pan or flat plate, with a wooden carved handle. It is struck with a carved slender stick as introductory to prayers in Buddhist temples. Diameter, 6¾ inches. Shanghai, China. (Cat. No. 158302, U.S.N.M.)

289. *Small bell* (Chinese, *siao-chung*).—Made of copper, suspended from a carved wooden frame. It has no clapper, but is struck with a stick on the outer circumference. Used in the temple service. Height, 14½ inches. Shanghai, China. (Cat. No. 158306, U.S.N.M.)

290. *Inverted bell* (Chinese, *ch'm'g to*).—Made of copper in form of a pot or kettle, sounded on the outer surface with a stick in Buddhist worship. Height, 4¼ inches; diameter, 9 inches. Shanghai, China. (Cat. No. 158297, U.S.N.M.)

291. *Small bell.*—Made of copper. Suspended from a slender wooden carved stick which is held in the hand, while the bell is struck on the outer surface during the recital of prayers. Height, 1½ inches; diameter, 2⅝ inches. Shanghai, China. (Cat. No. 158308, U.S.N.M.)

292. *Pair of large cymbals* (Chinese, *da-pa*).—Made of brass. These cymbals are employed in the temple service, and also in private ceremonies, such as weddings, funerals, etc. They are supposed to have been introduced into China from India. Diameter, 9½ inches. Shanghai, China. (Cat. No. 158298, U.S.N.M.)

293. *Pair of small cymbals* (Chinese, *siao-pa*).—Made of brass. Used only in the temple service of the Buddhists. Diameter, 8 inches. Shanghai, China. (Cat. No. 158299, U.S.N.M.)

294. *Pair of cymbals.*—Made of brass. Used in Buddhist processions. Diameter, 7 inches. Laos, Further India. (Cat. No. 217504, U.S.N.M.)

295. *Drum of skulls* (Tibetan, *damaru*).—Made of two skulls attached together by a wooden disk cemented to them. A band of embroidered satin, decorated with elaborately knotted silk tassels of Chinese make, covers the disk between the two heads, by which the person using the drum may hold it in his hand, his thumb and forefinger being placed around the disk of wood between the drumheads. From the band are depending small knobs covered with cloth by short strings of such length that when the drum is sharply twirled around they strike the heads. Used by the lamas in the temple service in Tibet. Height, 3 inches; diameter, 4½ inches. Kumbum, Tibet. (Cat. No. 130385, U.S.N.M.)

296. *Drum of skulls* (*damaru*).—Painted in red and blue with heads of demons and skulls. The band around the wooden disk is of cotton. Height, 5¼ inches; diameter, 6½ inches. India. (Cat. No. 153363, U.S.N.M.)

297. *Triratna, or the three jewels, namely, Buddha, the law (dharma), and the congregation (sangha).*—Wood, red and black lacquered and gilt. Represented by three columns set on a base. The center cone, which represents Buddha, issues from a lotus flower and in its circumference are set five Buddha figurines of ivory, of which three are seated in the witness position and two in that of meditation. They are probably intended to represent the five mundane (*manushi*) Buddhas of the present age. Between the petals of the lotus are carved five open lotuses and beneath them five leaves inlaid with pieces of shell and looking glass. The two side columns, which represent the law and the congregation, respectively, are carved in the shape of a closed lotus, flattened on one side, into which is inserted an ivory panel, representing Buddha standing in the gift-bestowing attitude. Height, 17 inches; width, 12½ inches. Laos, Further India. (Plate 88, Cat. No. 217501, U.S.N.M.)

298. *Triratna.*—Wood, lacquered and gilt. Representing Buddha standing in the center, while the two figures on the right and left are sitting. On the base is an inscription in Pali. Height, 14 inches; width, 7 inches. Laos, Further India. (Plate 89, Cat. No. 217585, U.S.N.M.)

299. *Triratna.*—Terra-cotta relief, finely molded. Buddha seated in the witness position in a niche, formed of a pointed arch resting on columns, an elaborate halo of rays rising above his head. The two smaller figures on his sides sitting in meditation. Height, 3¼ inches; width, 2¼ inches. Laos, Further India. (Cat. No. 217631, U.S.N.M.)

IV. MISCELLANEOUS: MAGIC, DIVINATION, ETC.

300. *Lotus.*—Model of wood. The lotus (*Nelumbium speciosum*) is, as has been said previously (No. 2), the favorite flower of India and invested with much symbolism. Among others, it is the symbol of purity. The lotus upon the lake seems to spring from the body of the waters without contact with the earth, and no matter how muddy the water may be, the lotus preserves its own purity undefiled. Thus Buddha is made to say: "Just as a lotus born in water, bred in water, overcomes water and is not defiled by water, so I, born in the world and bred in the world, have now overcome the world." The worshipers of Amitabha, or Amida, in China and Japan believe that each man while living on earth is represented in paradise by a lotus, which flourishes or languishes according to his spiritual condition. The saved dead (by faith in the invocation of Amitabha) are carried to the lake of lotuses where they are reborn with a spiritual body within the calyx of one of the lotuses. According to their merits, the lotus opens sooner or later. Some are imprisoned for thousands of ages within the closed calyx of their lotuses—a kind of painless purgatory. Height, 3½ inches. Kobe, Japan. (Cat. No. 154830, U.S.N.M.)

301–2. *Pair of mythical lions.*—Bronze. Lions of metal or stone, sometimes of colossal size, are often placed at the entrance of Buddhist temples as protectors from evil spirits. They are also emblematic of Buddha who bears the epithet *Sakyasimha*, "the lion of the Sakya race." Length, 2 inches. Kobe, Japan. (Cat. Nos. 154831–154832, U.S.N.M.)

303. *Mythical lion* (*singto*).—Wood, red lacquered. Height, 6 inches. Laos, Further India. (Cat. No. 217578, U.S.N.M.)

304–5. *Pair of kirins* (Chinese, *kilin*).—Wood, black lacquered and gilt. Standing on lacquered bases. For a description of the mythical kirin see above under No. 254. Height, 7¾ inches. Japan. (Cat. No. 154296, U.S.N.M.)

306. *Mythical animal, dog Fo* (?).—Wood, painted brown with gray spots, lacquered and gilt. Height, 27 inches; length, 32 inches. China or Japan. (Cat. No. 313625, U.S.N.M.)

The following small collection of bronze animal figurines from Laos may be votives or weights:

307. *Bronze dog.*—Height, ¾ of an inch. Laos, Further India. (Cat. No. 217551, U.S.N.M.)

308. *Bronze monkey.*—Height, ¾ of an inch. Laos, Further India. (Cat. No. 217552, U.S.N.M.)

309. *Bronze zebu, standing on base.*—Height, 1⅜ inches. Laos, Further India. (Cat. No. 217547, U.S.N.M.)

310. *Bronze zebu, couchant.*—Height, three-fourths of an inch. Laos, Further India. (Cat. No. 217548, U.S.N.M.)

311. *Bronze cow* (?).—Height, three-fourths of an inch. Laos, Further India. (Cat. No. 217549, U.S.N.M.)

312. *Bronze horse.*—Height, seven-eighths of an inch. Laos, Further India. (Cat. No. 217550, U.S.N.M.)

313. *Bronze bear, on base.*—Height, 1 inch. Laos, Further India. (Cat. No. 217546, U.S.N.M.)

314–322. *Nine griffins, or dragons, on bases.*—Bronze. Called by the Laos "noble animals," which peacefully roam through the splendid gardens of the gods. Height, ¾ to 3¼ inches. Laos, Further India. (Cat. Nos. 217537–217545, U.S.N.M.)

323. *Demon-queller* (Chinese, *Chung Kw'ei;* Japanese, *Shoki.*—Made of wood; carved and painted. On his head in the upstanding hair is perched a dragon; at his feet is a crouching demon, and over the belt is carved the mask of a monster. The demon queller is in Chinese mythology supposed to be a ghostly protector of the Emperor Ming Hwang (713–762 A. D.). He is usually represented as a truculent giant, clad in official garb and armed with a two-edged sword. He is sometimes shown as riding upon a lion, but more commonly is engaged in punishing the pigmy demons. The subject forms one of the most frequent inspirations of the Japanese artist, and appears

in numberless specimens of porcelain, ivory, wood carving, and other works.

This statuette is a specimen of old Japanese carving. Height, 39 inches. Japan. (Plate 90, Cat. No. 130461, U.S.N.M.)

324. *Devil dancer's dress.*—Consisting of a blue cotton jacket with thin strips of palm leaves stuck into it, giving it the form of fur. Ceylon. (Cat. No. 154980, U.S.N.M.)

325. *Devil dancer's dress.*—The same as No. 324, only that the jacket is of white cotton. Ceylon. (Cat. No. 154981, U.S.N.M.)

326. *Devil dancer's lash.*—Ceylon. (Cat. No. 154982, U.S.N.M.)

Sir James Emerson Tennent gives the following explanation and description of the devil dance in Ceylon: "The Singhalese have demon or Sanne for each form of disease, who is supposed to be the direct agent and inflicter, and who is accordingly invoked for its removal. Hence on every domestic occurrence, as well as in every domestic calamity, the services of the *katadias* or devil priests are to be sought and their ceremonies performed * * *. Especially in cases of sickness and danger the assistance of the devil-dancers is implicitly relied on: An altar, decorated with garlands, is erected within sight of the patient, and on this an animal, frequently a cock, is to be sacrificed for his recovery. The dying man is instructed to touch and dedicate to the evil spirit the wild flowers, the rice, and the flesh which have been prepared as the *pidaneys*, or offerings to be made at sunset, at midnight, and the morning; and in the intervals the dancers perform their incantations, habited in masks and disguises to represent the demon which they personate, as the immediate author of the patient's suffering. In the frenzy of these orgies the *katadia*, having feigned the access of inspiration from the spirit he invokes, is consulted by the friends of the afflicted, and declares the nature of the disease, and the probability of its favorable or fatal termination. At sunrise, the ceremony closes with an exorcism chanted to disperse the demons who have been attracted by the rite; the devil dancers withdraw with the offerings and sing, as they retire, the concluding song of the ceremony, 'that the sacrifice may be acceptable and the life of the sufferer extended.' "[16] And describing the performance of such a dance the same author says: "We witnessed the extravagances of two professional devil dancers, who were performing a ceremony in front of a little altar, for the recovery of a patient who was dying close by. It is difficult to imagine anything more demoniac than the aspect, movements, and noises of these wild creatures; their features distorted with exertion and excitement and their hair tangled in ropes, tossed in all directions, as they swing round in mad contortions."[17]

[16] Sir J. E. Tennent, Ceylon. An account of the island, physical, historical, and topographical. London, 1860, vol. 1, p. 540.

[17] Idem, vol. 2, p. 581.

327. *Geomantic compass* (Chinese, *lo-king*, or *lo-pan*).—Consisting of a disk of lacquered wood, beveled down at the bottom to the shape of a saucer. The upper surface carries in its center a small compass, around which run 17 inscribed concentric circles, containing the sundry geomantic factors, as the 8 permutations of the trigram, the 12 signs of the zodiac, the 24 celestial constellations, and so forth. It represents the ancient Chinese system of cosmogony and natural philosophy, and forms the basis of a system of divination.

Geomancy, or, as the Chinese call it, "wind and water," rules (*fung-shui*), is much used by the Chinese for divining future events, or ascertaining the luckiness or unluckiness of any event, or selecting sites for houses, cities, and especially burial places, which are supposed to have important results on the prosperity of the living. The principles of geomancy depend on two supposed currents running through the earth, known as the dragon and the tiger; a propitious site has these on its left and right. A skillful observer (*fung-shui siensang*, or "wind and water doctor") can detect and describe such currents with the help of the compass, also the direction of the watercourses, shapes of the male and female ground and their proportions, position of rivers, trees, and mountains, color of the soil, and the changes of the elements. (Compare S. Wells Williams, The Middle Kingdom: New York, 1853, vol. 2, pp. 245–247). Diameter, 7½ inches. China. (Plate 91, Cat. No. 126954, U.S.N.M.)[18]

328. *Divination slips* (Chinese, *chi en-toong*).—Consisting of two bamboo tubes containing slips of bamboo which are inscribed with different characters. The person wishing to know the will of the gods or his fortune shakes the tube and, with averted face, draws out a slip and reads the answer on it. Shanghai, China. (Cat. No. 158304, U.S.N.M.)

329. *Divination blocks* (Chinese, *chiao*).—Consisting of two pieces of split bamboo, kidney-shaped, with one side convex and the other flat. The supplicant tosses them into the air in front of the altars of the gods he is supplicating. If both convex sides turn up, the answer is *yang-yang*, which signifies the male principle of nature, and means "indifferently good"; if both flat sides turn up it is *yin-yin*, which signifies the female principle of nature, the answer is understood to be negative and unfavorable; if one convex and the other flat, the answer is considered as absolutely affirmative and the prayer as granted. Shanghai, China. (Cat. No. 158301, U.S.N.M.)

330. *Divination cards*.—Five disks of rough cardboard, painted in red, green, blue, and yellow with concentric circles, with Tibetan letters in the center and surrounded by flames on the margin. Dia-

[18] For a detailed explanation of the geomantic compass see J. J. M. de Groot, The Religions of China, Leide, 1897, vol. 3, p. 959, and Paul Carus, Chinese Thought, Chicago, 1907, p. 58.

meter, $4\frac{1}{4}$ inches. Tibet. (Cat. No. 311864, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

331. *Divination cards.*—Nine cardboards, painted in the same colors as the preceding No. 330, with various grotesque monstrous animals. Length, $4\frac{1}{4}$ inches; width, $3\frac{1}{2}$ inches. Tibet. (Cat. No. 311865, U.S.N.M) Bequest of Miss Elizabeth S. Stevens.

332. *Book of divination.*—Manuscript in Pali on palm leaves, inclosed in a wooden case. The leaves and the case are perforated through the center for the passing of a cord which holds the book together. Length, $2\frac{1}{2}$ inches; width, $1\frac{1}{2}$ inches. Laos, Further India. (Cat. No. 217647, U.S.N.M.)

333. *Amulet case* (Tibetan, *gavo*).—Made of copper in shape of shrine, with two handles or ears on either side for suspension. The front of the case is richly adorned in repoussé work with figures of birds, lotus, and other floral designs, and set with eight medallions of gilt brass, representing the eight glorious emblems figured on Buddha's footprint, namely, (1) the conch-shell trumpet of victory; (2) the umbrella; (3) the vase; (4) the victorious banner; (5) the golden fish; (6) the lucky diagram; (7) the lotus; and (8) the wheel. Amulet boxes of wood, silver, copper, or leather, in which are carried charms against various accidents, are worn by the Tibetans around the neck, or suspended from the girdle, while the larger ones are affixed over the head in the house or tent. They contain some meaningless Sanscrit inscription, a few fragments of the cast-off robe of a saintly lama, peacock feathers, supposed to keep off moths, sacred kusa grass, etc. In front of the case is an opening for the image of a deity (missing in this specimen). Height, 8 inches; width, $5\frac{1}{4}$ inches; depth, $3\frac{1}{4}$ inches. Probably Tibet. (Plate 92, Cat. No. 311793, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

334. *Amulet case* (*gavo*).—Made of silver. Decorated with the eight glorious emblems, arabesques, and Chinese dragons, and provided with tubes on the sides for the passing of a cord by which it was suspended around the neck or fastened to the girdle. Height, $4\frac{1}{2}$ inches; width, 3 inches; depth, $1\frac{1}{2}$ inches. Lhasa, Tibet. (Cat. No. 130391, U.S.N.M.)

335. *Amulet case* (*gavo*).—Made of brass, decorated with plant designs in filigree work, and provided with handles on the sides for suspension. On top are three porcelain beads, representing the *triratna* (see No. 297), painted blue in imitation of turquoise, the color of Tara (see No. 155), who is usually depicted with a bluish-green complexion. In the opening, under glass, is a terra-cotta miniature figurine of the goddess Marichi (Tibetan, *odzez canma*), represented seated on a lotus in the witness position, with three faces, of which the left is that of a sow, and eight arms, holding various weapons, as the thunderbolt

(*vajra*), a bow and arrow, a club or ax. Originally the goddess of dawn, she was coupled with the myth of the primeval productive sow. She is also considered as the consort of the demon-general Tamdrin (Hayagriva, see No. 158), and is believed to be incarnated in the abbess of the convent of Palti Lake in Tibet. Height, 3 inches; width, 2½ inches. Tibet. (Cat. No. 311795, U.S.N.M.) Bequest of Miss Elizabeth S. Stevens.

336. *Charm* (*copy*).—Consisting of a diamond-shaped lattice frame, attached to a bamboo pole and having various structures and carvings of fishes fastened to it. It is set up in a corner of the rice field before the planting of the rice. The carvings of the fishes represent Buddha in one of his incarnations as a fish (compare also, for the signification of the fish, No. 197). After this charm has been set up nine stalks of rice are planted. As each rice stalk is planted the formula: *Namo tasso bhazarato arahato sammasam-buddhassa* is repeated, and an offering of flowers, rice, curry, and chicken meat is placed on a stand beneath the fishes. The whole area is then fenced in and remains sacred until the rice is harvested. Height, 32 inches. Laos, Further India. (Cat. No. 217667, U.S.N.M.)

337. *Charm.*—Consisting of a bamboo cylinder, lacquered and gilt, strung on a cotton cord. Laos, Further India. (Cat. No. 217644, U.S.N.M.)

338. *Charm.*—Consisting of stone, copper, and zinc beads, and a crystal of pyrites strung on a cotton cord. Laos, Further India. (Cat. No. 217645, U.S.N.M.)

339. *Amulet* (*peck-che, seng-die*).—Consisting of a black stone, polished, with concave sides. "The possessor of this stone is protected against wounds by bullets, knives, swords, and remains well and happy." One-half of an inch square. Laos, Further India. (Cat. No. 217646, U.S.N.M.)

340. *Amulet, "lucky crystal."*—Protecting against evil influences. Laos, Further India. (Cat. No. 217648, U.S.N.M.)

341. *Amulet.*—Consisting of a knot of palm leaf, inscribed with auspicious sentences. It is tied around the neck of children to protect them against evil influences. Laos, Further India. (Cat. No 217649, U.S.N.M.)

342. *"Naga cloth."*—Piece of cotton cloth, painted with circles, squares, and pyramidal figures between the winding coils of serpents (Nagas) or dragons, and inscribed with incantations. It is to "protect against all manner of evil and bodily harm, and, kept in the house, it protects against fire." Length, 48 inches; width, 36 inches. Laos, Further India. (Cat. No. 217650, U.S.N.M.)

343. *"Naga cloth."*—Piece of cotton, with a large magic square inclosing a serpent or dragon in the center, and four smaller squares

on one margin, drawn in India ink, and a Pali inscription. Length, 18 inches; width, 27 inches. Laos, Further India. (Cat. No. 217651, U.S.N.M.)

344. "*Naga cloth.*"—Piece of bleached muslin. The edges are inscribed in squares or checkers. The center is filled with four seated figures in witness position and four standing ones, inclosed within a garland. The designs are painted in yellow and vermilion. 18 inches square. Laos, Further India. (Cat. No. 217652, U.S.N.M.)

345. "*Naga cloth.*"—Piece of cotton with inscribed squares and adorned with figures of men, birds, and fishes and floral designs. Length, 17 inches; width, 36 inches. Laos, Further India. (Cat. No. 217653, U.S.N.M.)

346–349. *Native medicine.*—Four bags containing from 4 to 24 different substances, as various woods, bones, pieces of Buddha's alms bowl, etc. These are rubbed on a stone, and the resulting powder washed off in water which is given to the patient to drink. Each bag is labeled and selected according to the sickness. Laos, Further India. (Cat. No. 217654, U.S.N.M.)

350. *Piece of oval sandstone.*—Cut out on the upper surface. Supposed to have been used for grinding or rubbing medicine, but more probably for sharpening some instrument. Length, 3 inches; width. 1½ inches. Laos, Further India. (Cat. No. 217655, U.S.N.M.)

351. *Kakemono.*—Representing Buddha in the center surrounded by saints or Bodhisattvas. Painted in gold and various colors, The style much resembles that of the illuminated missals of the Middle Ages. A Kakemono is a scroll of paper or cloth, with a picture or inscription painted or printed upon one side. The designs are usually religious. They are rolled upon a cylindrical stick, and are intended to be hung upon the wall. Japan. (Cat. No. 305813, U.S.N.M.) Gift of Mrs H. B. Buckingham and Isabel C. Freeman.

352. *Kakemono.*—Representing Buddha with 12 saints or arhats. The faces are painted white, the caps red, the robes yellow, the halos light green. China (?). (Cat. No. 154273, U.S.N.M.)

353. *Kakemono.*—Monochrome. Representing Daruma by Toteku the Unkoku School (1538–1610 A. D.). Daruma was the twenty-eighth Buddhist patriarch. He arrived in China in 520 A. D. and converted the then emperor. It is said he came to Japan in 613 A. D. and died there. During nine years he sat in profound meditation, neither moving or speaking, and when he returned to consciousness of his surroundings his legs had become paralyzed owing to their long disuse. He is often depicted in a humorous manner, with a comical head and round body, without arms and legs, which are supposed to have withered away from disuse. Japan. (Cat. No. 154273, U.S.N.M.)

354. *Kakemono.*—Buddhist ecclesiastic, seated in a chair holding in his right hand a vajra (?); in the left, a rosary. Head and neck are painted white; the robe is in vermilion. Above are trees. China (?). (Cat. No. 154273, U.S.N.M.)

355. *Kakemono.*—Monochrome. Daikoku, one of the Japanese seven gods of fortune (see No. 167), with mallet, seated on rice bags. Japan. (Cat. No. 154273, U.S.N.M.)

356. *Kakemono.*—Monochrome. Ebisu, with fishing rod and fish (see No. 167). Japan. (Cat. No. 154273, U.S.N.M.)

BRONZE BUDDHA.

FOR EXPLANATION OF PLATE SEE PAGE 301.

TEAKWOOD BUDDHA FROM BURMA.

FOR EXPLANATION OF PLATE SEE PAGE 302.

WOODEN BUDDHA FROM CEYLON.

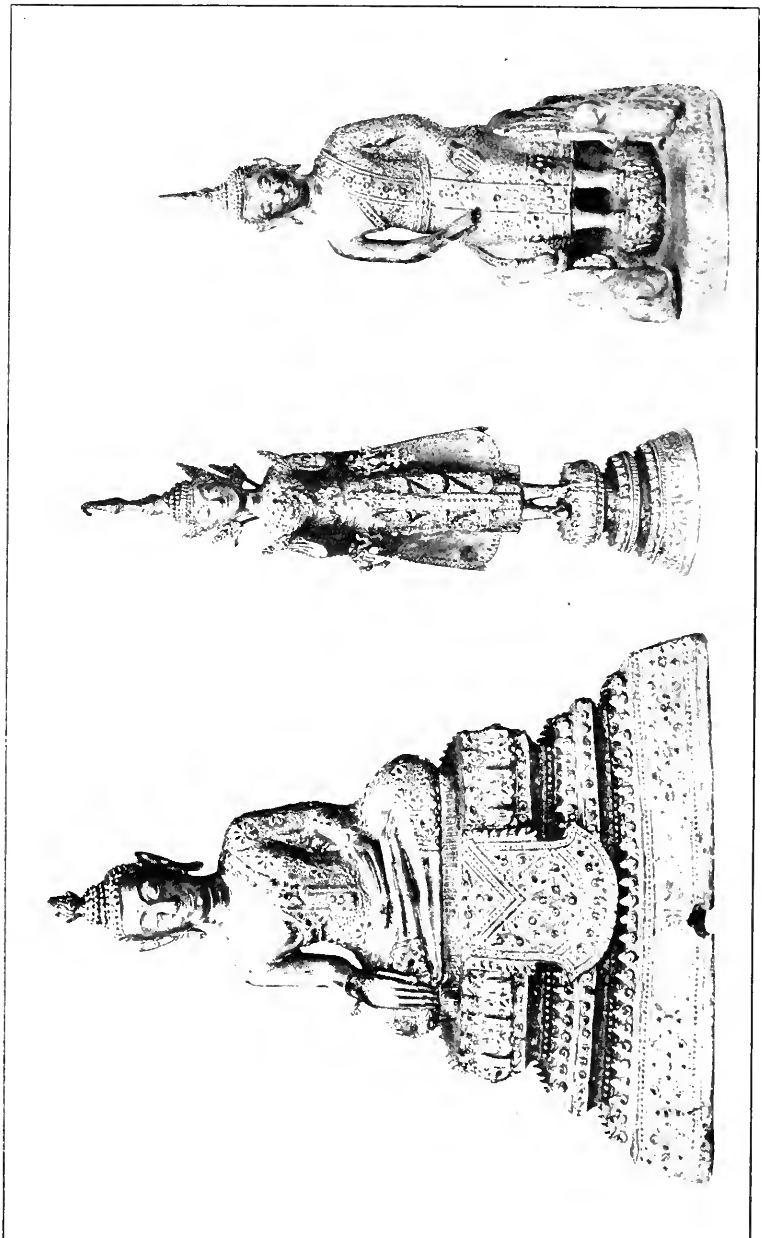
FOR EXPLANATION OF PLATE SEE PAGE 303.

ALABASTER BUDDHA FROM LAOS, FURTHER INDIA.

FOR EXPLANATION OF PLATE SEE PAGE 303.

BRONZE BUDDHA, FROM JAPAN.

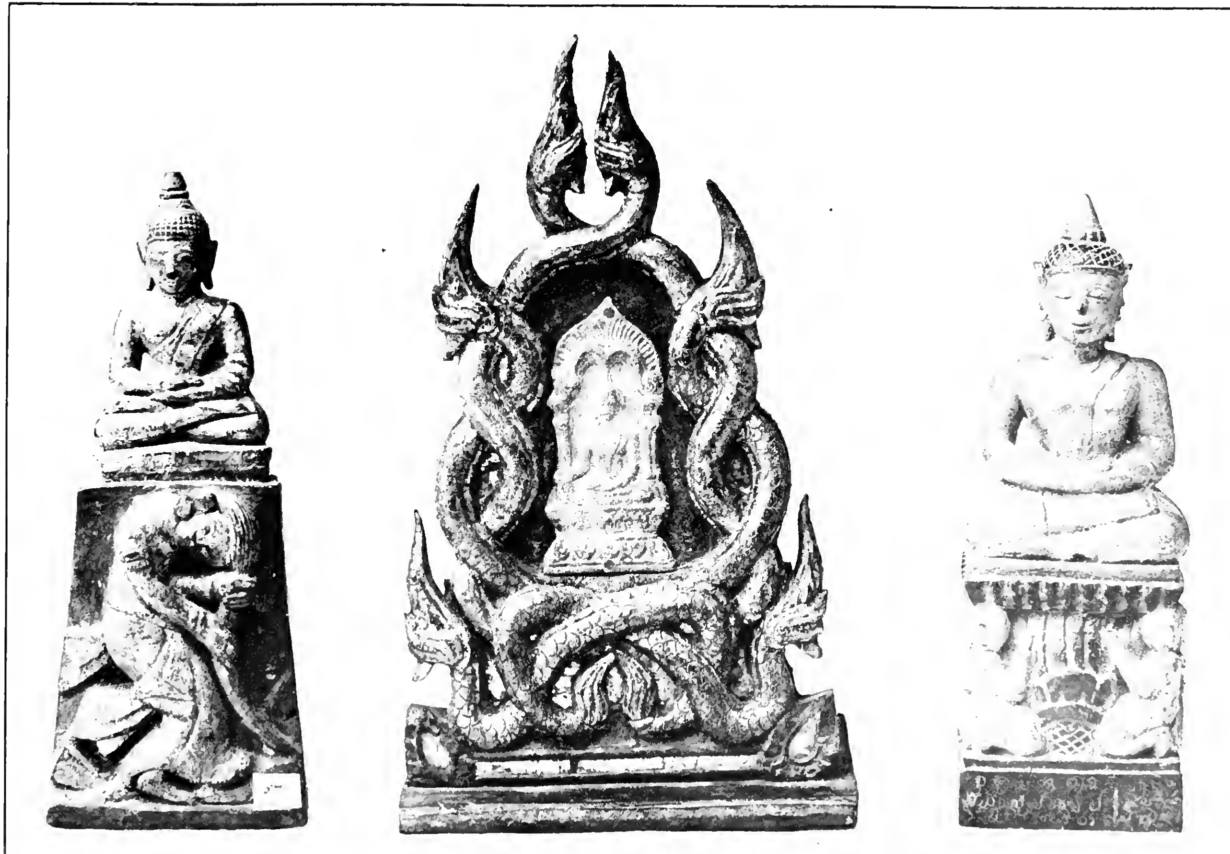
FOR EXPLANATION OF PLATE SEE PAGE 304.



1 2 3

1. BRONZE BUDDHA, FROM LAOS; 2, BRONZE BUDDHA OR BODHISATTVA, FROM SIAM; 3, BRONZE BUDDHA, FROM LAOS.

FOR EXPLANATION OF PLATE SEE PAGES 305 AND 306.



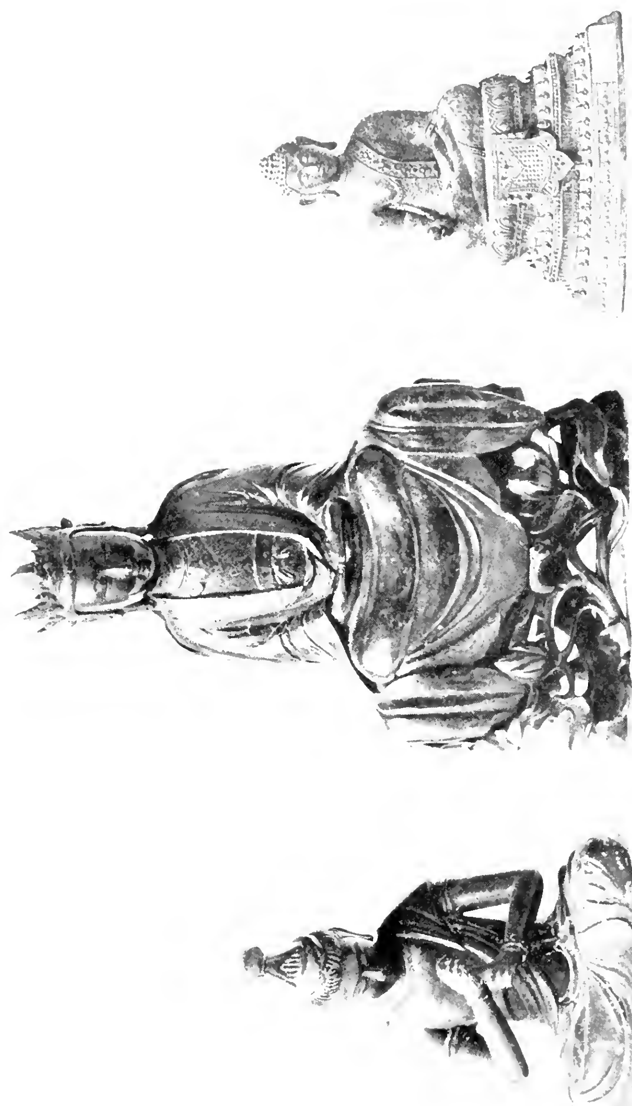
1 2 3

1. Wooden Buddha and Earth Goddess, from Laos; 2, Bronze and Wooden Buddha and Nagas, from Laos; 3, Wooden Buddha and Disciples, from Laos.

For explanation of plate see pages 306 and 307.

WOODEN BUDDHA AND GARUDA, FROM LAOS.

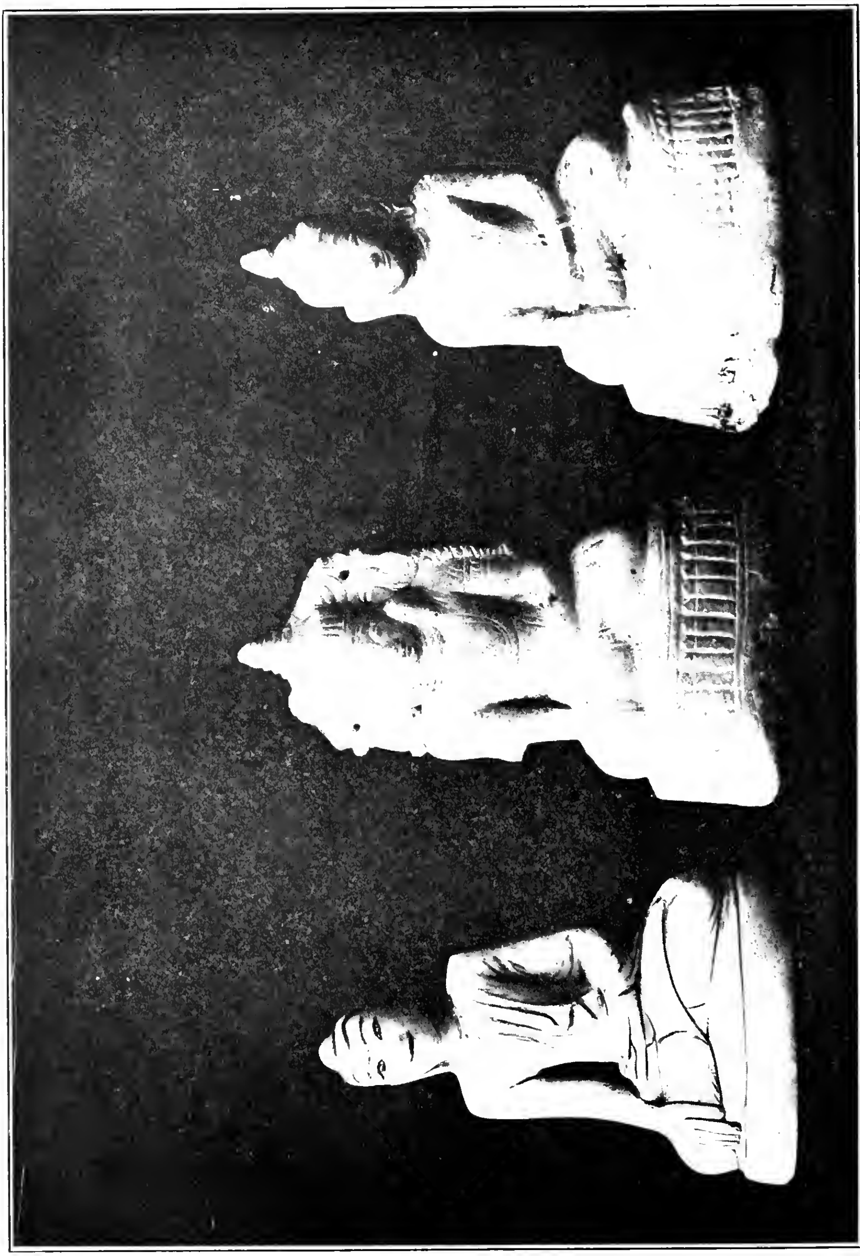
FOR EXPLANATION OF PLATE SEE PAGE 307.



1 2 3

1. Bronze Buddha or Bodhisattva, from Japan; 2, Bronze Buddha on Chair; 3, Bronze Buddha, from Laos.

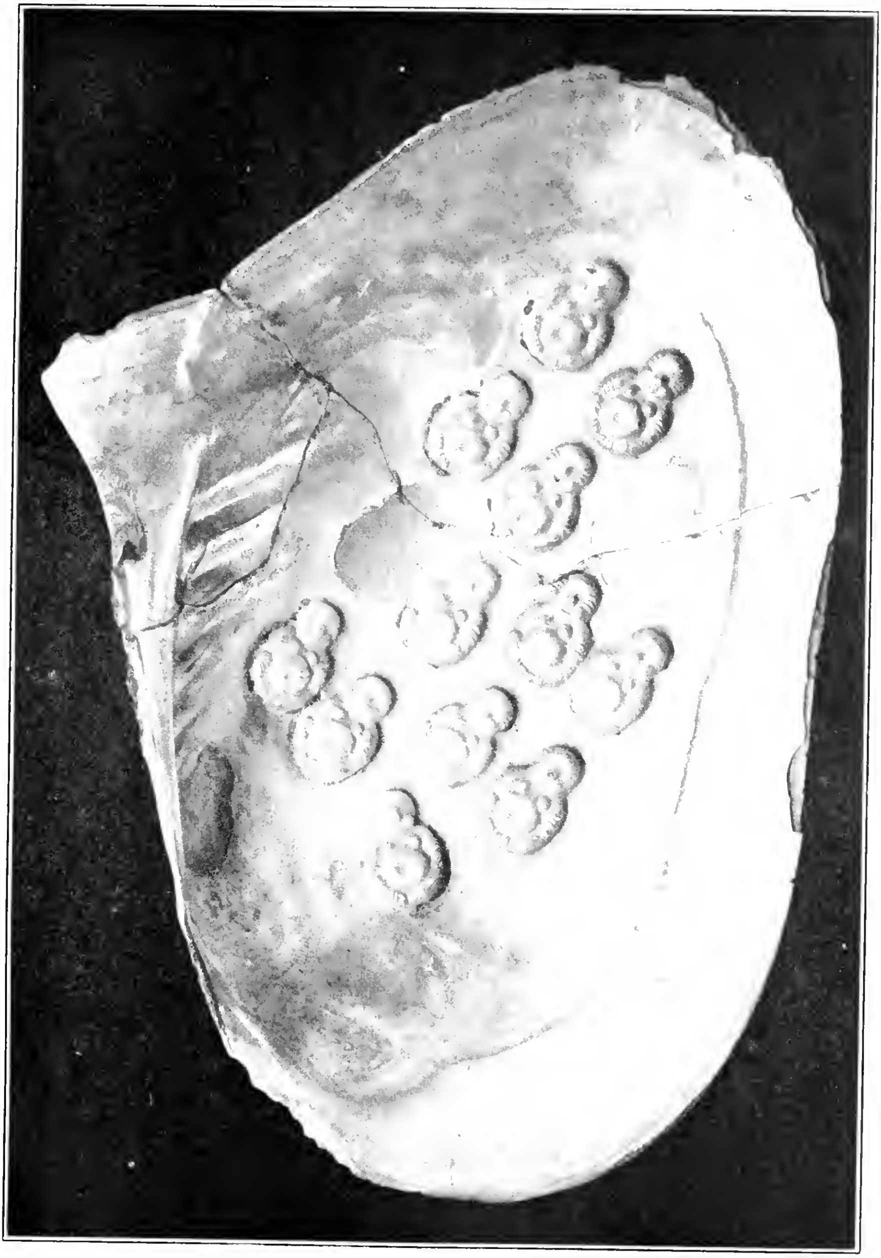
For explanation of plate see page 308.



1 2 3

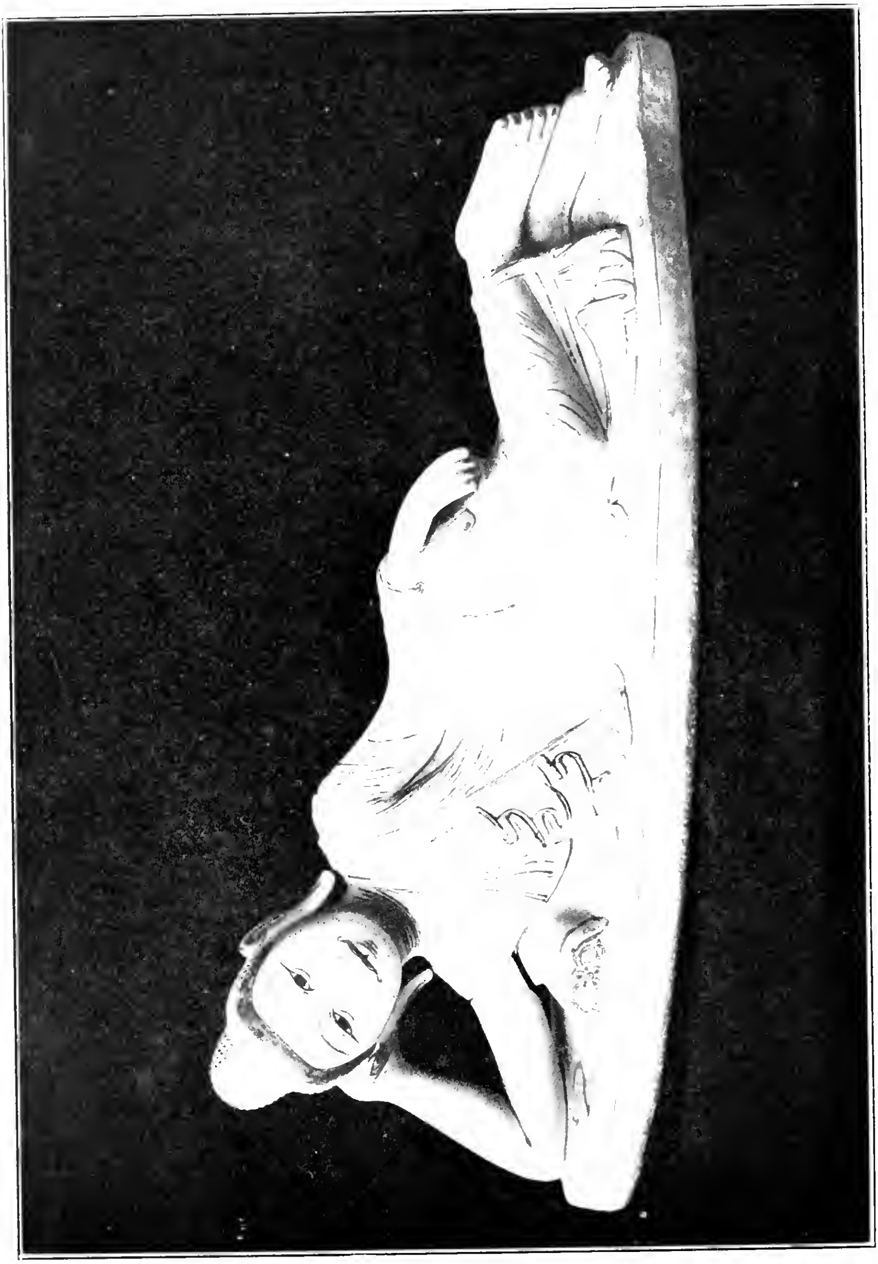
1. Marble Buddha, from Burma; 2, Alabaster Buddha, from Burma; 3, Alabaster Buddha, from Burma.

For explanation of plate see page 309.



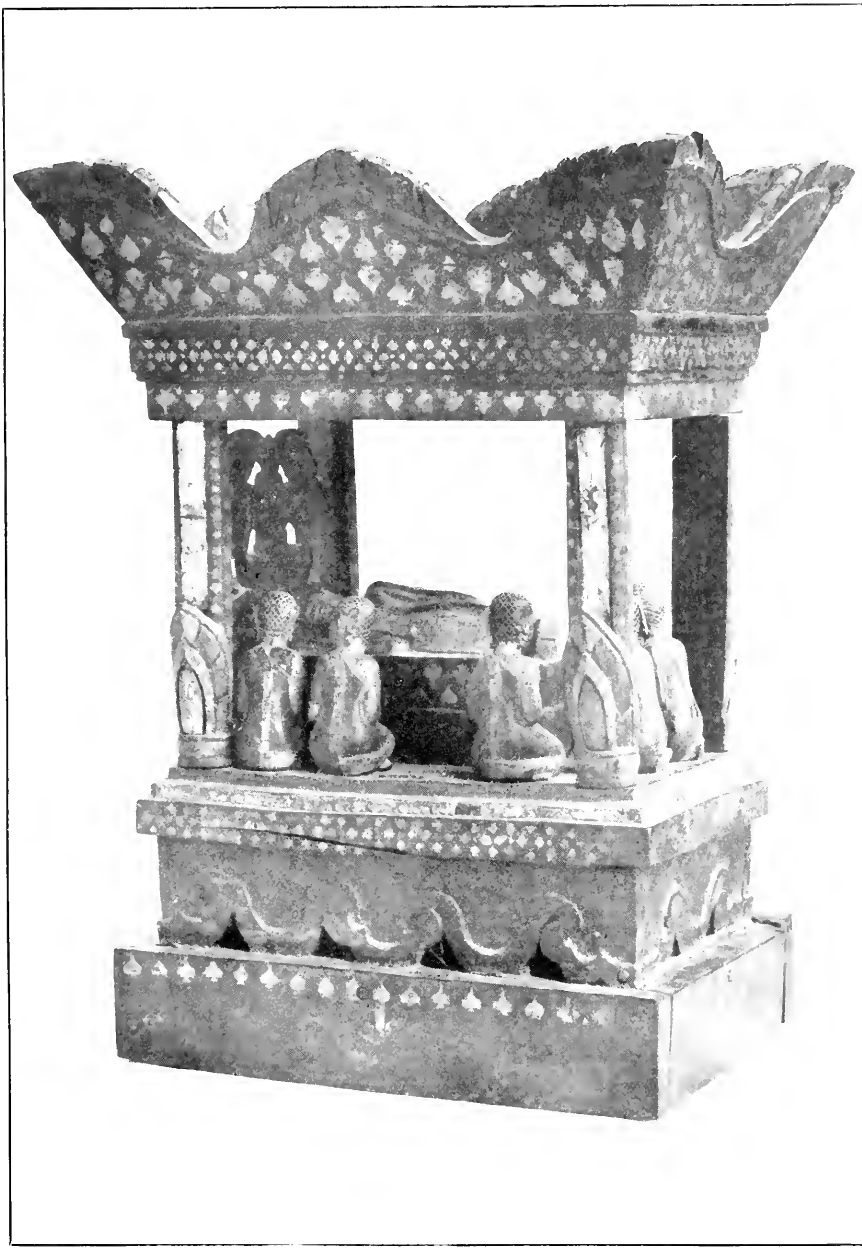
Buddha Figurines on Clam Shell from China.

For explanation of plate see page 313.



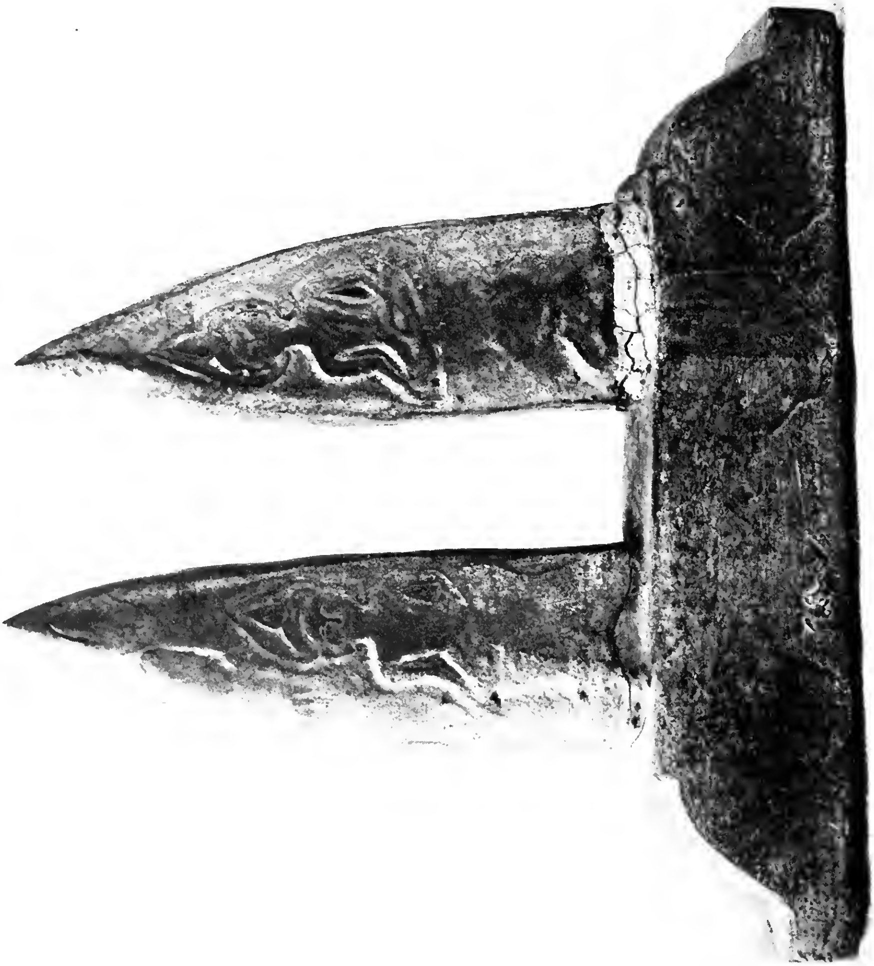
ALABASTER BUDDHA ENTERING NIRVANA (LYING) FROM INDIA.

FOR EXPLANATION OF PLATE SEE PAGE 313.



WOODEN BUDDHA ENTERING NIRVANA, FROM LAOS.

FOR EXPLANATION OF PLATE SEE PAGE 313.

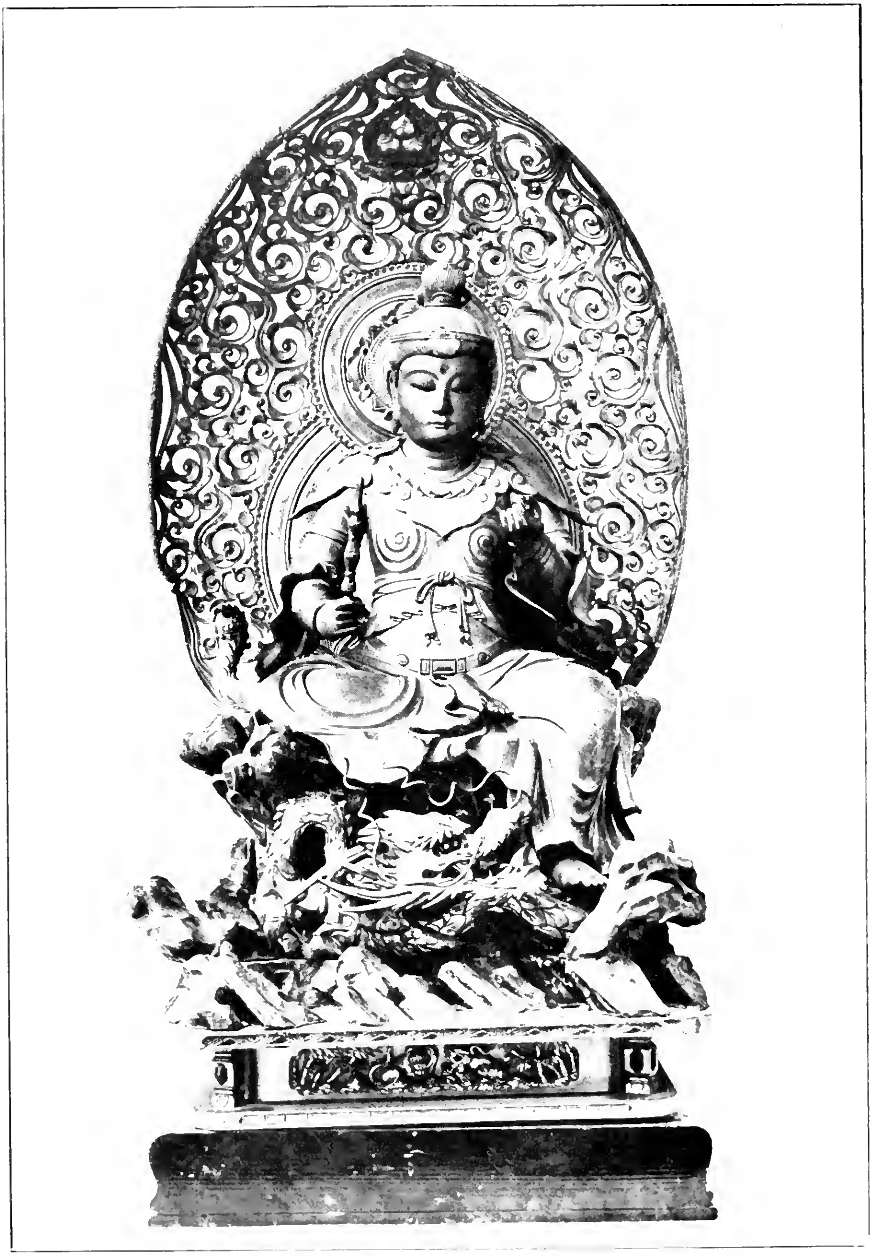


Bronze Horns of Buddha from Laos, Further India.

For explanation of plate see page 314.

CAST OF BUDDHA'S FOOTPRINT, FROM INDIA.

FOR EXPLANATION OF PLATE SEE PAGE 314.



WOODEN AMITABHA, FROM JAPAN.

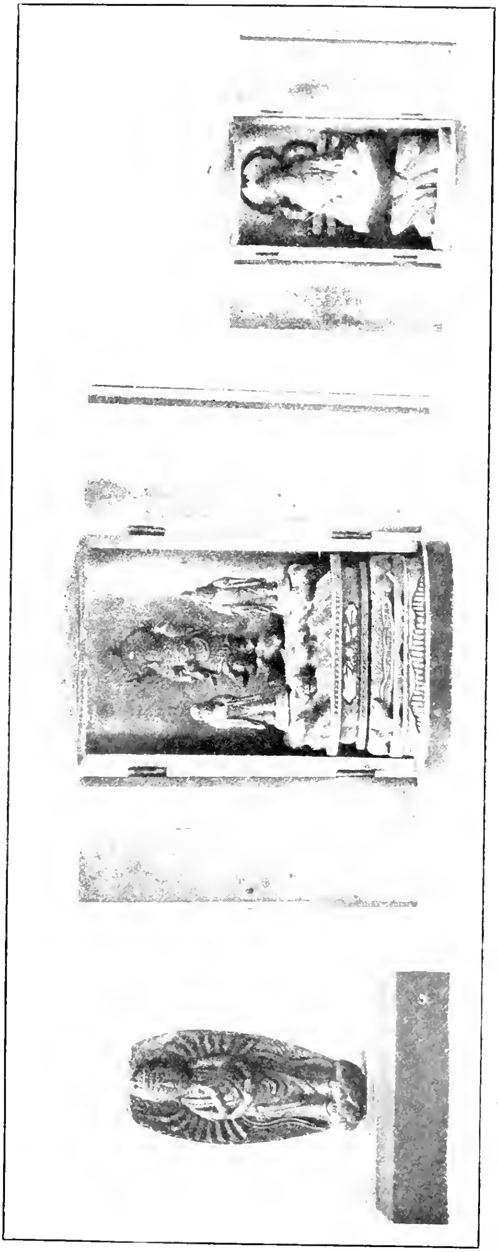
FOR EXPLANATION OF PLATE SEE PAGE 314.

PORCELAIN KUAN-YIN, FROM FOOCHOW, CHINA.

FOR EXPLANATION OF PLATE SEE PAGE 315.

WOODEN KUANNON, FROM KOBE, JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 316.



1, CLAY THOUSAND-HANDED KUANNON, FROM JAPAN; 2, SANDALWOOD KUANTI, FROM CHINA; 3, KUANNON IN SHRINE, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 316.

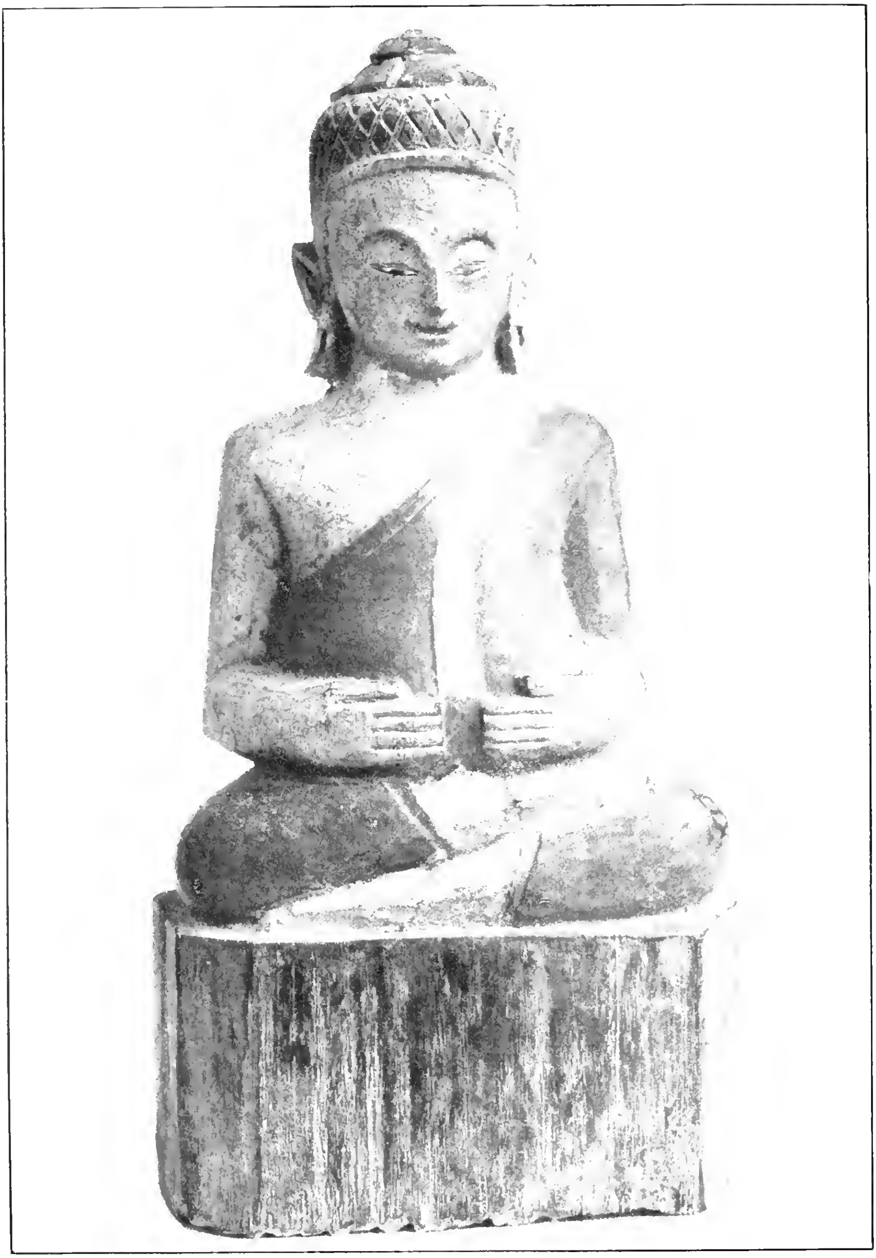
1 2

1, WOODEN BODHISATTVA FROM BURMA OR SIAM; 2, BRONZE BODHISATTVA, FROM CHINA OR MONGOLIA.

FOR EXPLANATION OF PLATE SEE PAGES 317 AND 318.

FUDO IN SHRINE, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 318.



WOODEN FIGURE OF MAHA UPAKUT, FROM LAOS.

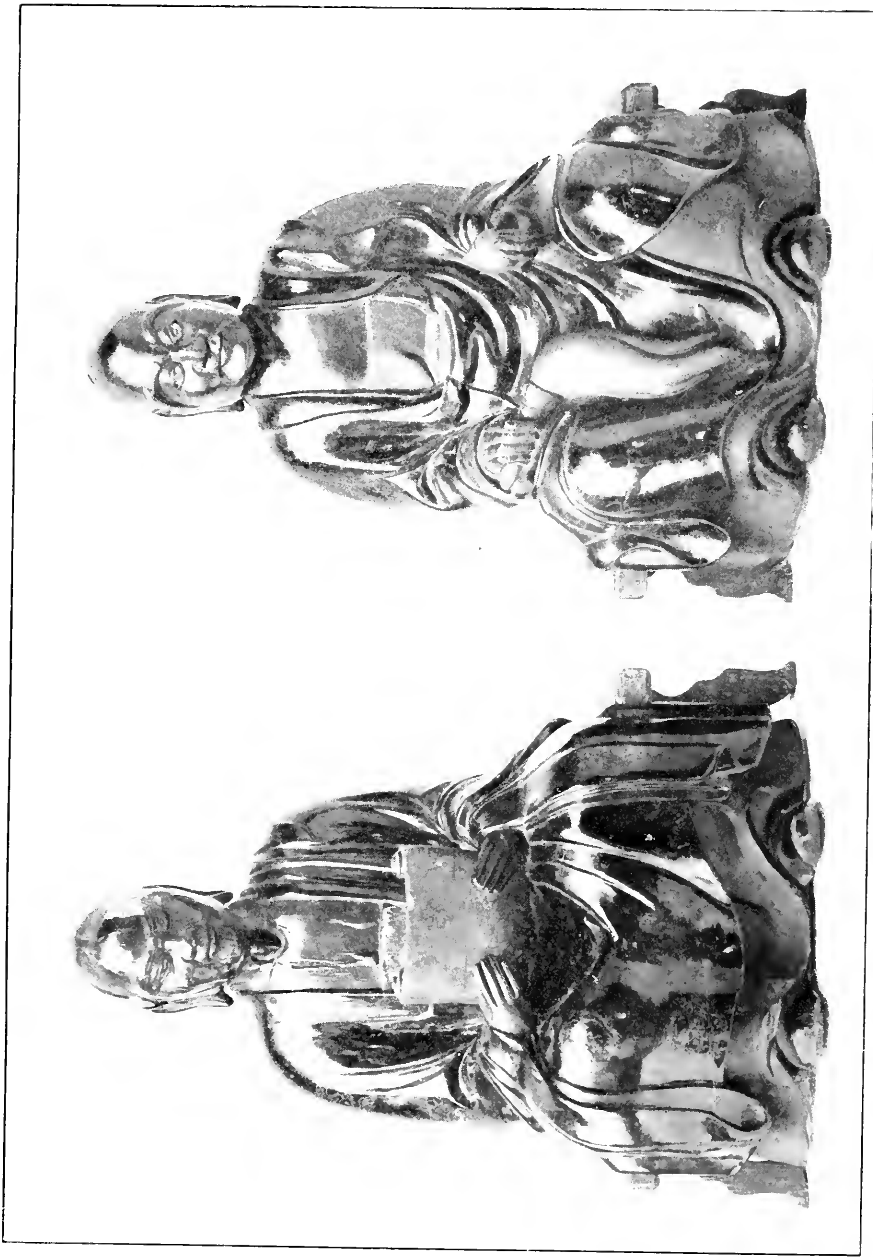
FOR EXPLANATION OF PLATE SEE PAGE 319.

WOODEN DAIKOKU, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 321.

BRONZE FUKUROKOJU, FROM CHINA OR JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 321.

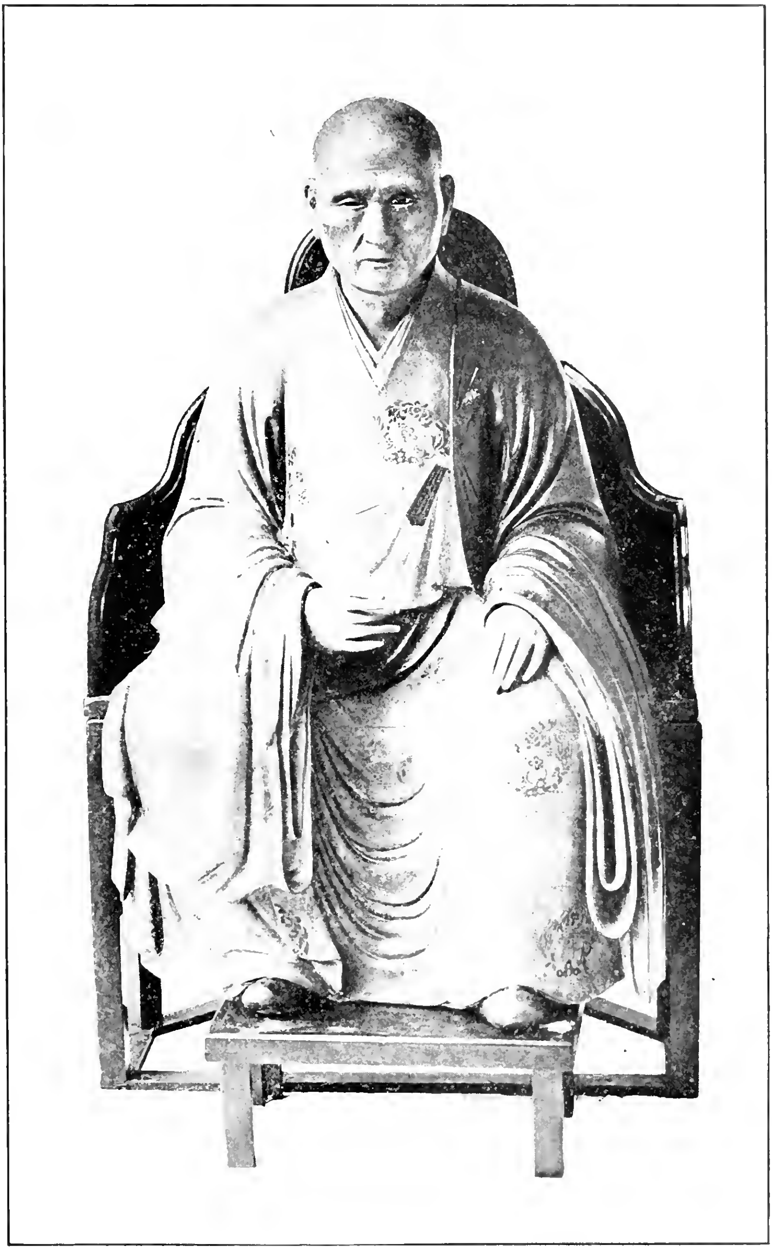


WOODEN ARHATS, FROM TOKIO, JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 323.

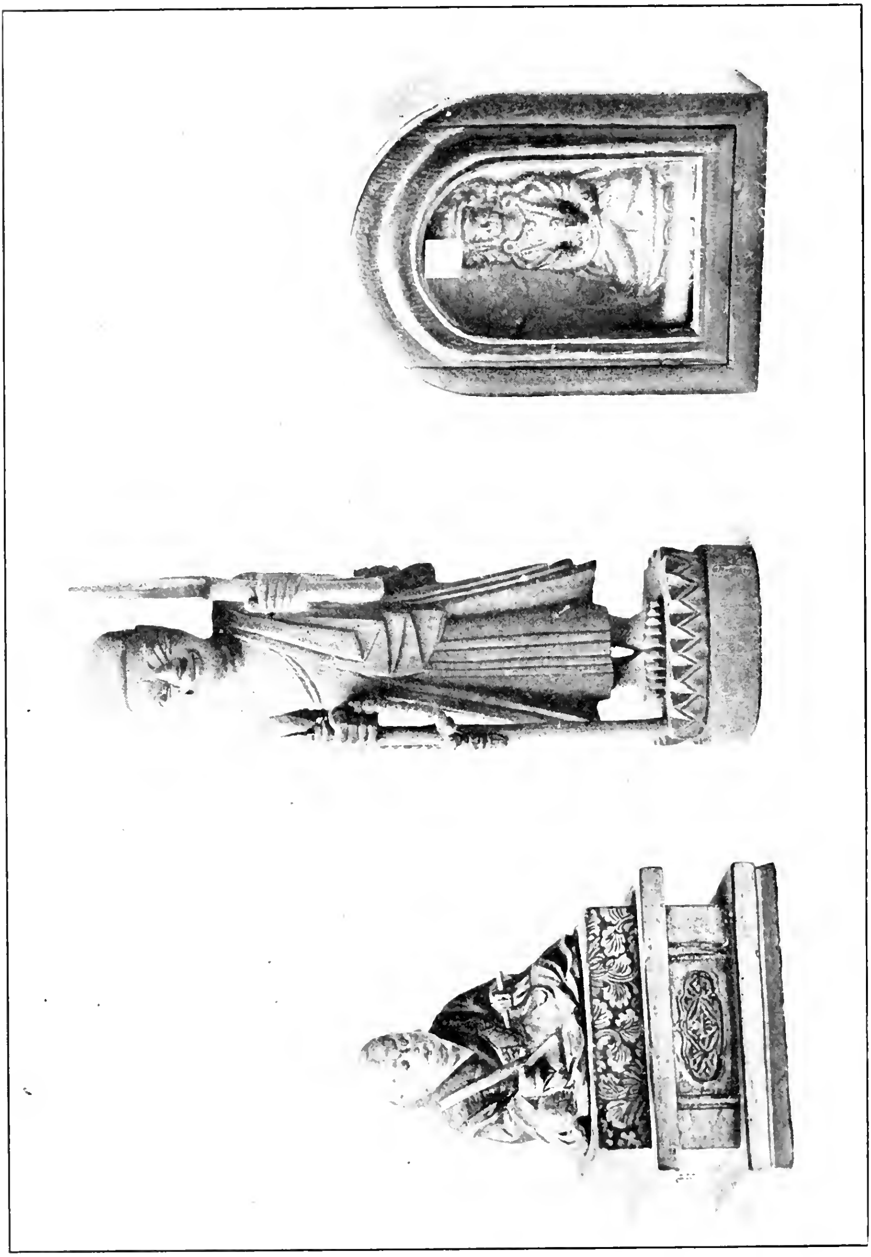
WOODEN CHINESE BUDDHIST ECCLESIASTIC, FROM CHINA.

FOR EXPLANATION OF PLATE SEE PAGE 324.



WOODEN BUDDHIST ECCLESIASTIC IN CEREMONIAL ROBES, FROM CHINA.

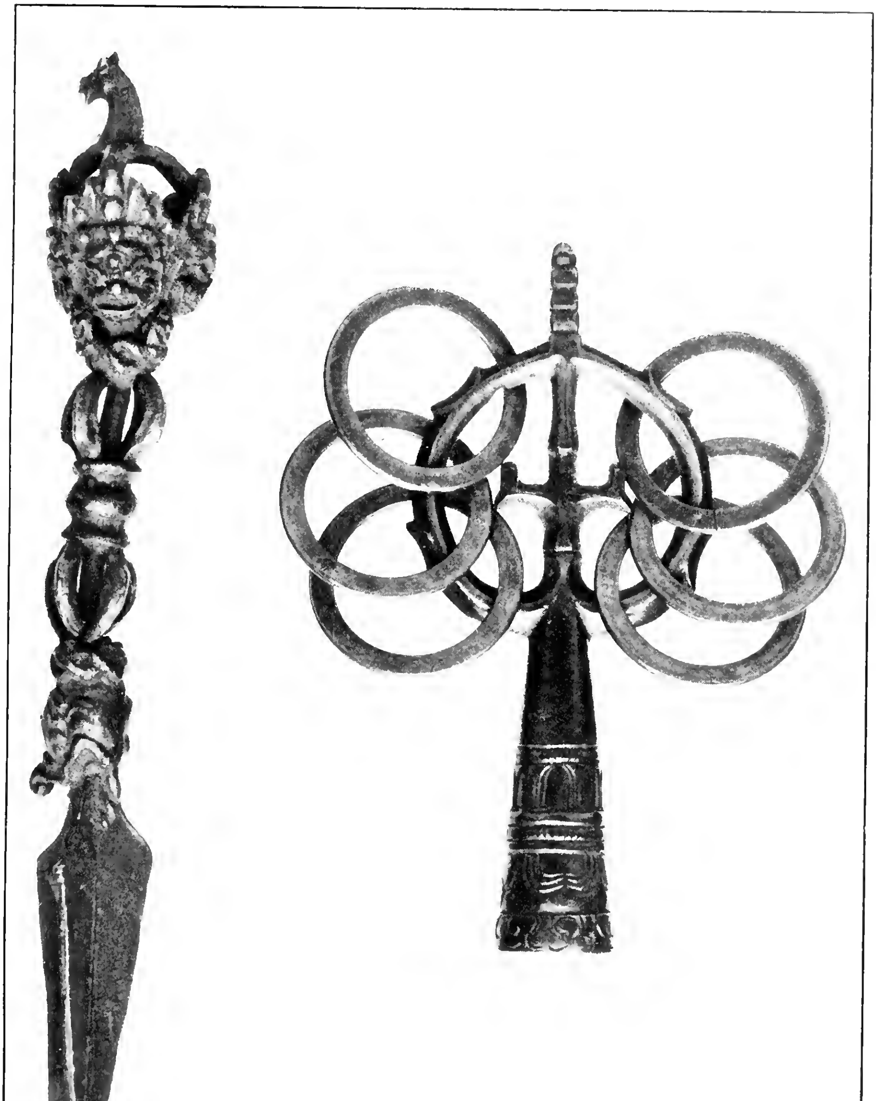
FOR EXPLANATION OF PLATE SEE PAGE 324



1 2 3

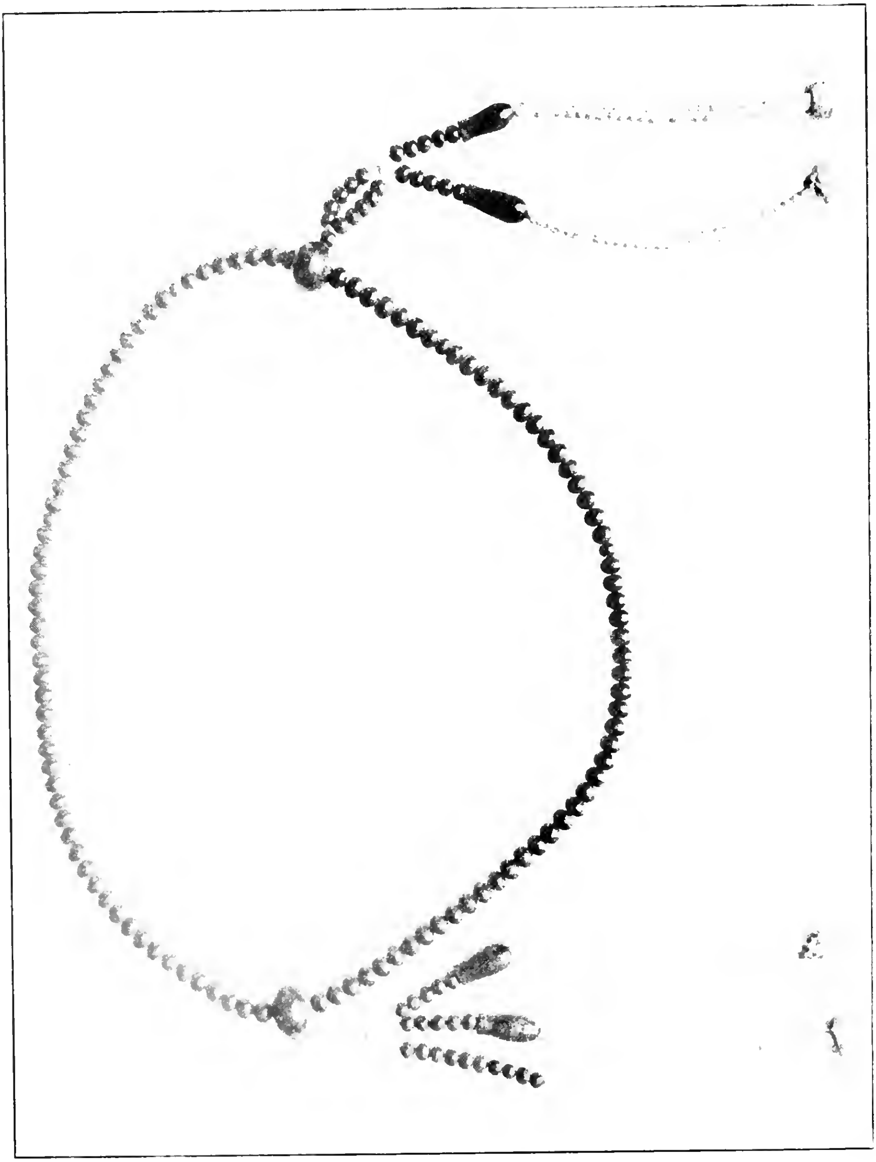
1, BUDDHIST PRIEST IN CEREMONIAL DRESS; 2, BUDDHIST PRIEST WITH OUTFIT; 3, BUDDHA, FROM TIBET.

FOR EXPLANATION OF PLATE SEE PAGES 324 AND 325



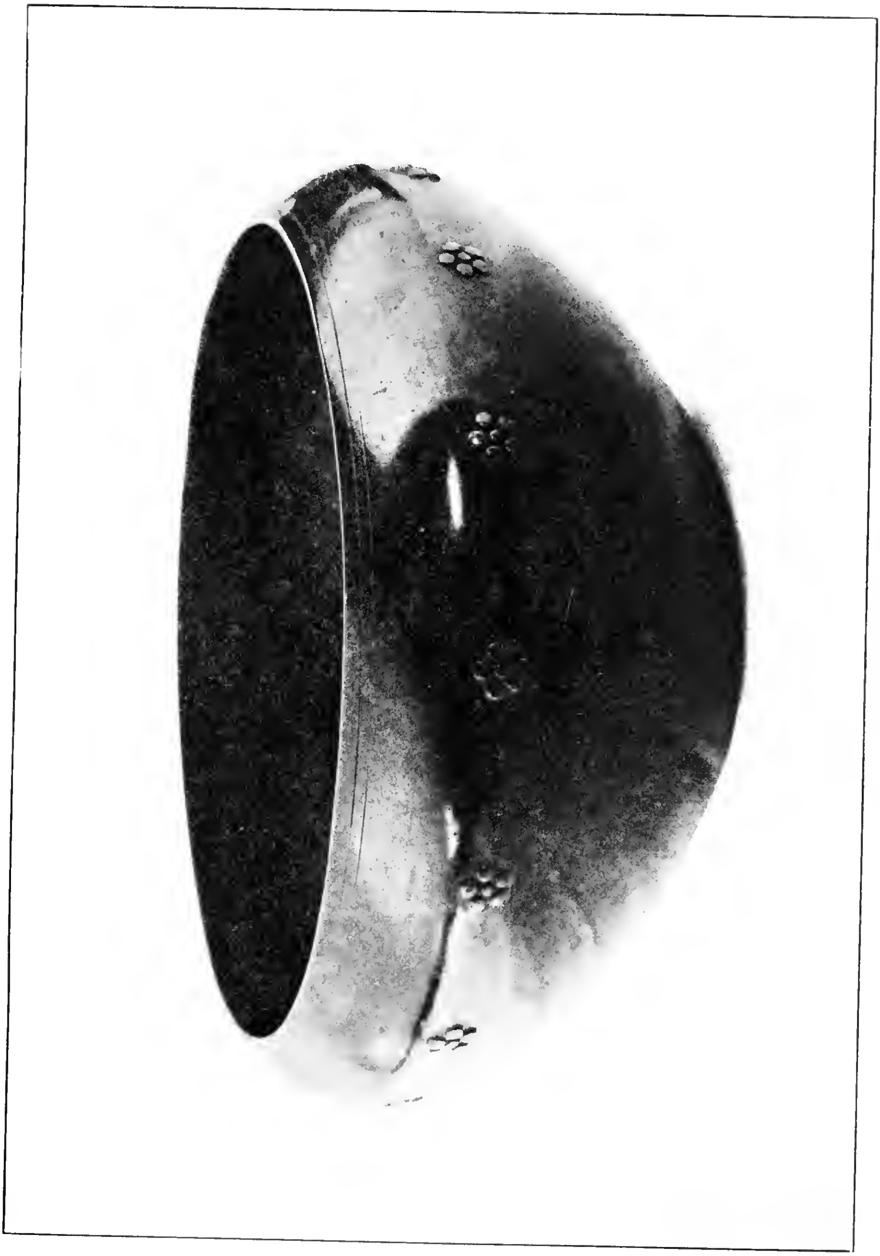
1, Bronze Vajra-Dagger, from Tibet; 2. Brass Tip of Mendicants Staff, from Tibet.

For explanation of plate see page 326.



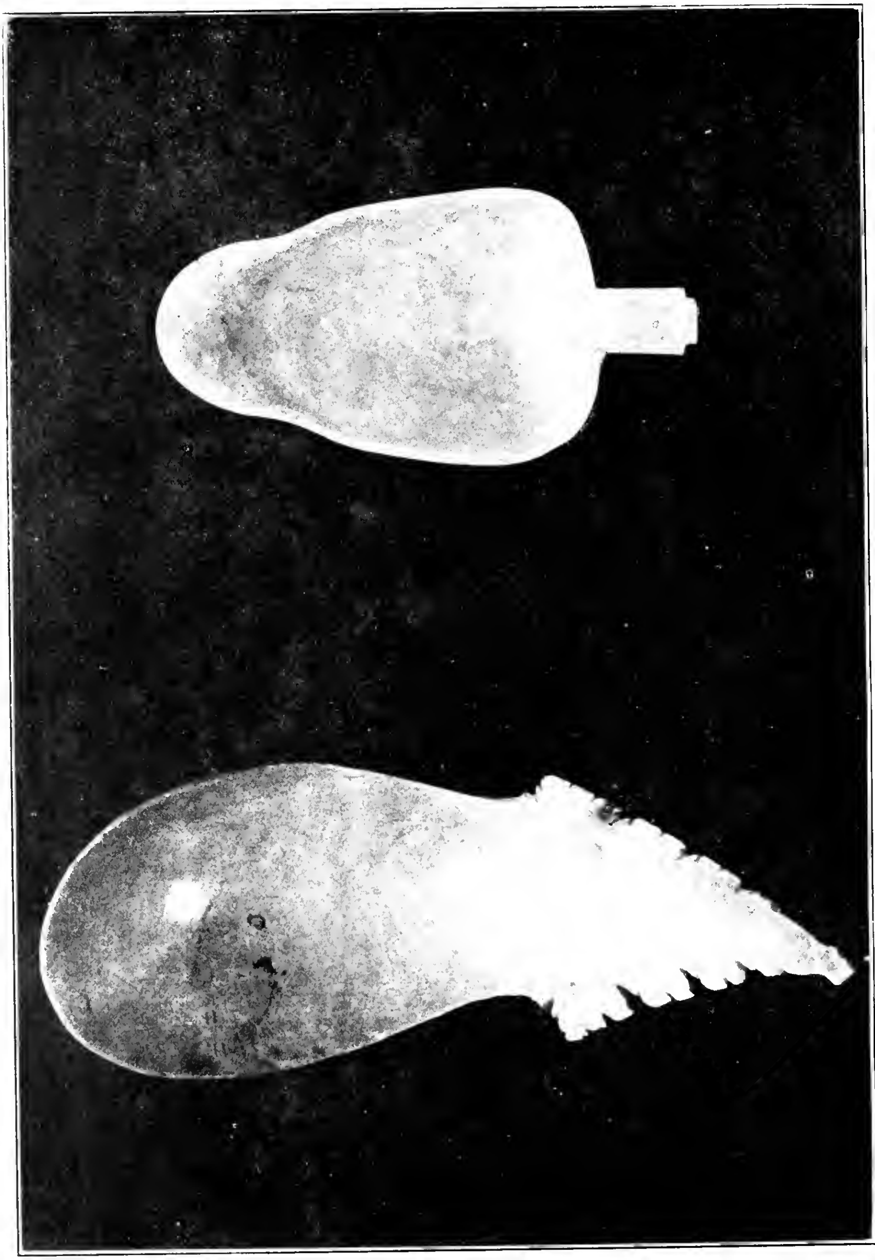
CHERRYWOOD JAPANESE ROSARY, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 331.



BRONZE BEGGING BOWL, FROM JAPAN.

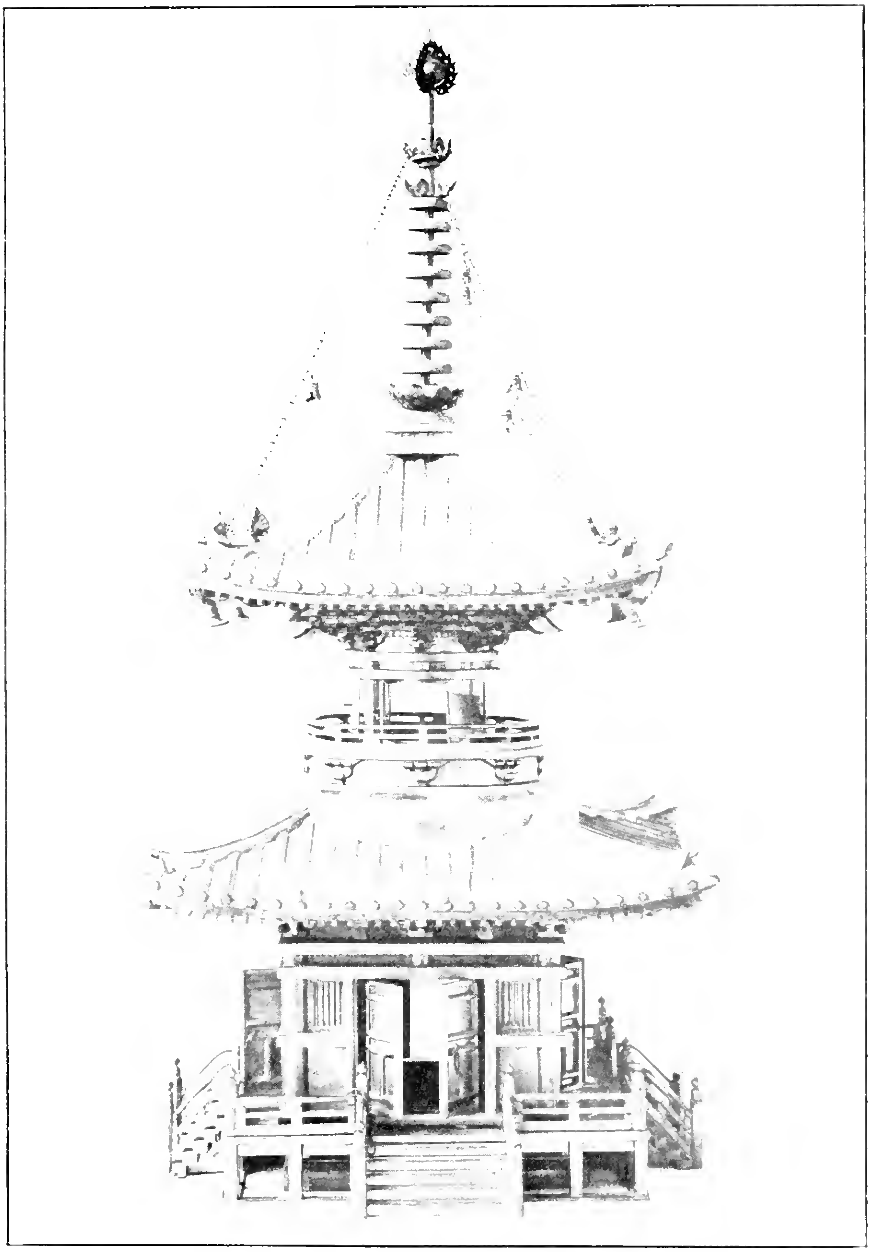
FOR EXPLANATION OF PLATE SEE PAGE 332.



1 2

(1) Shell and (2) Alabaster Rice Spoons of Buddhist Monks.

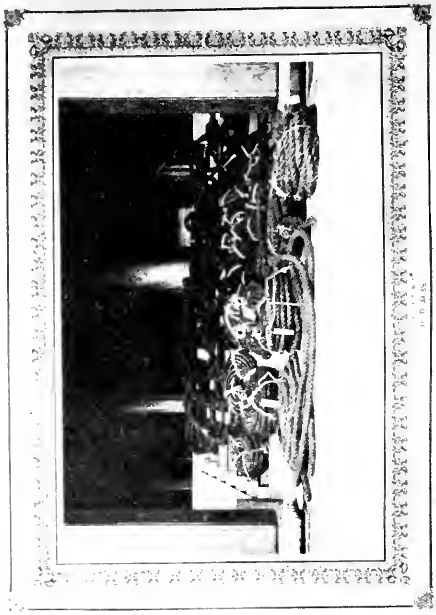
For explanation of plate see page 332.



MODEL OF A WOODEN PAGODA, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 334.

1

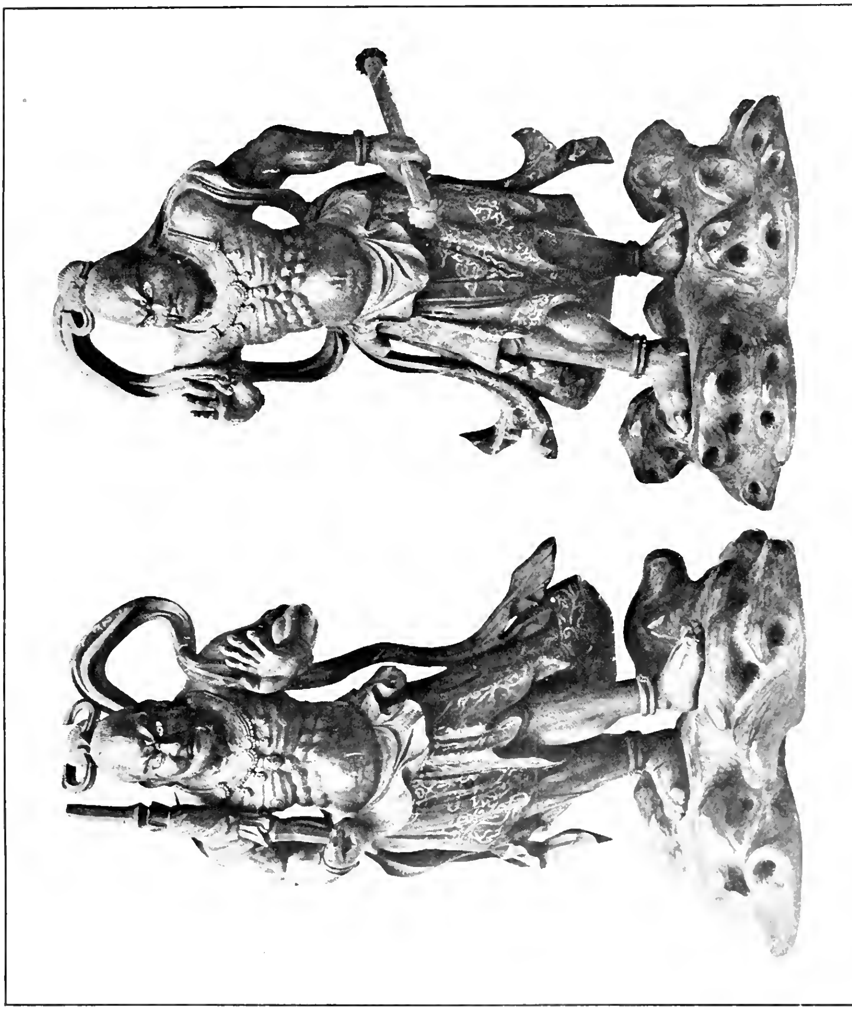


2

3

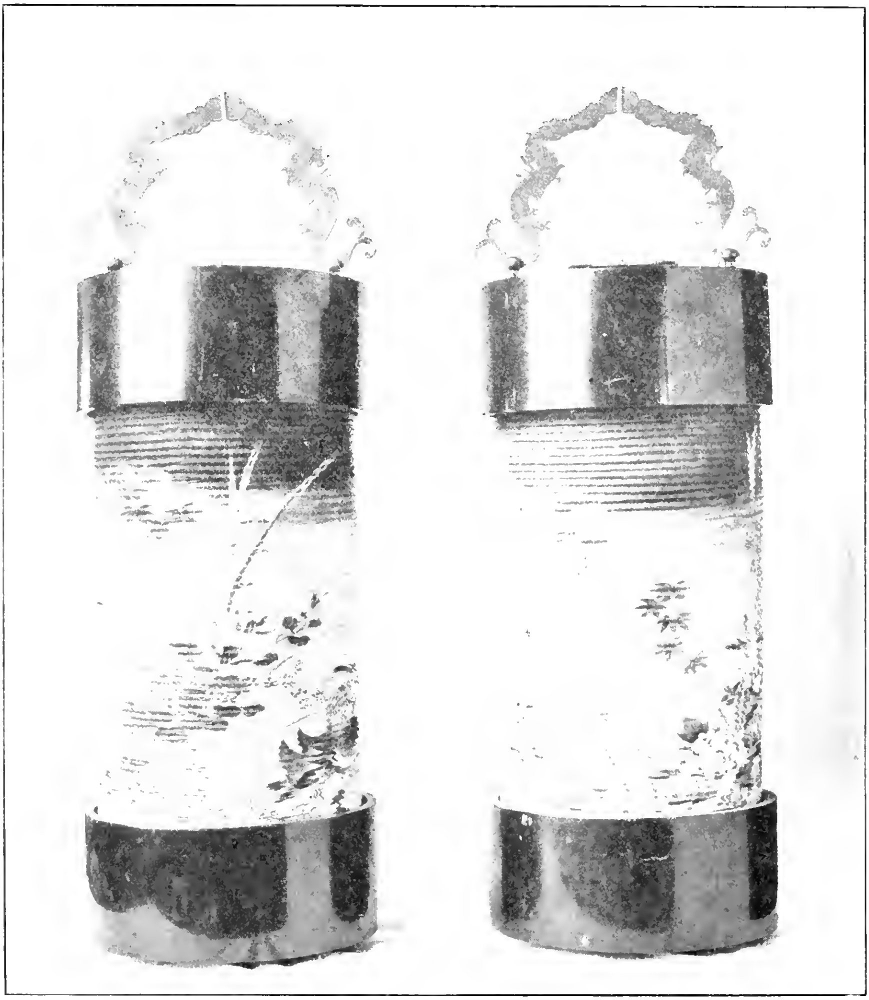
1, Print Showing Plan of the Temple Hongwanji, from Tokio, Japan; 2. Photograph of Ropes Made of Human Hair, from Tokio, Japan; 3, Section of Human Hair Rope, from Tokio, Japan.

For explanation of plate see page 334.



WOODEN NIOS MODELS, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 334.

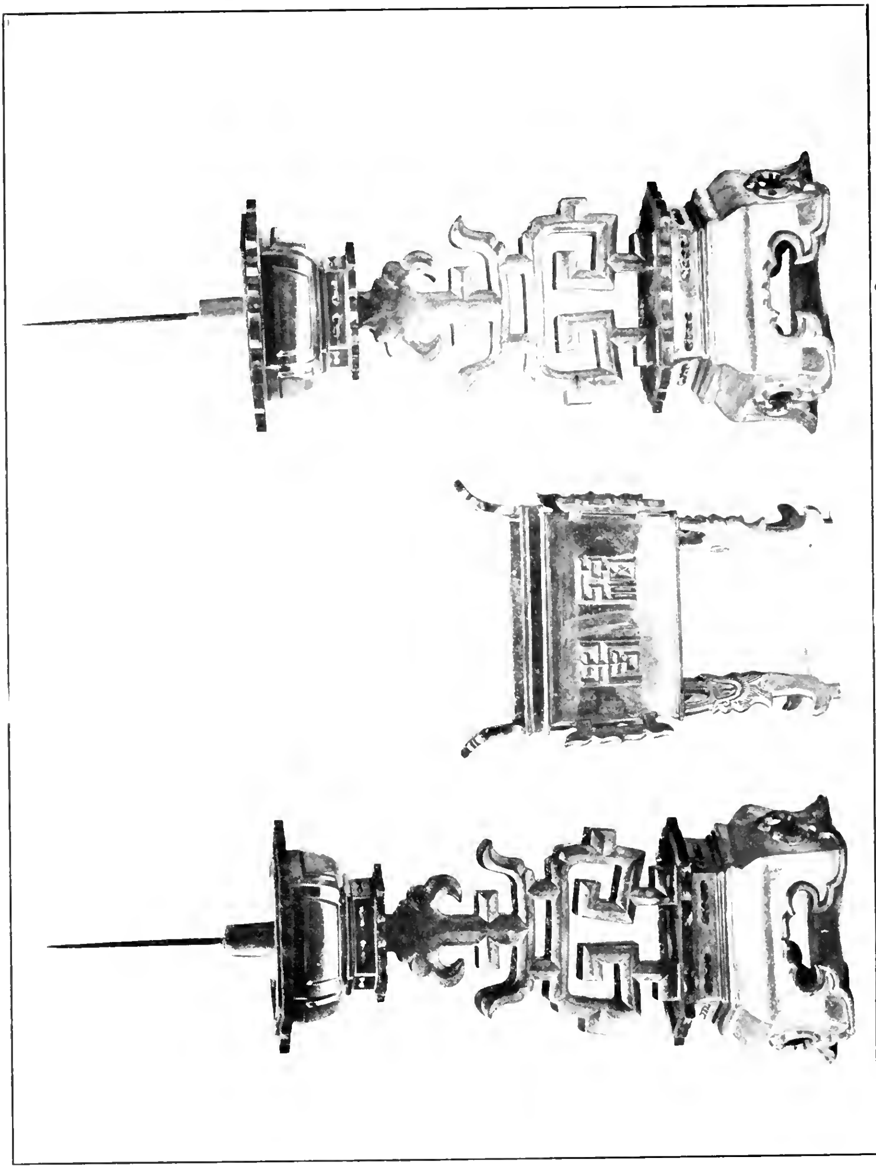


OPEN TEMPLE LANTERNS, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 334.

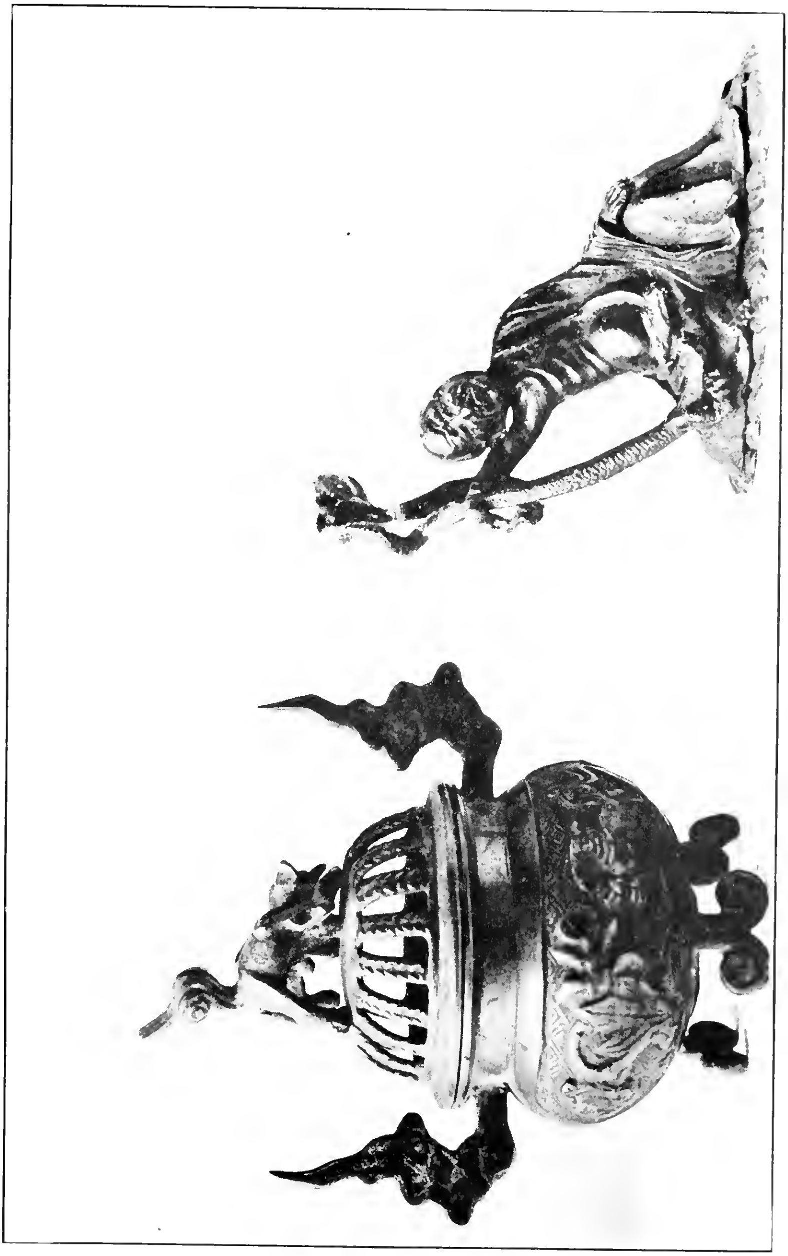
Closed Temple Lanterns, from Japan.

For explanation of plate see page 334



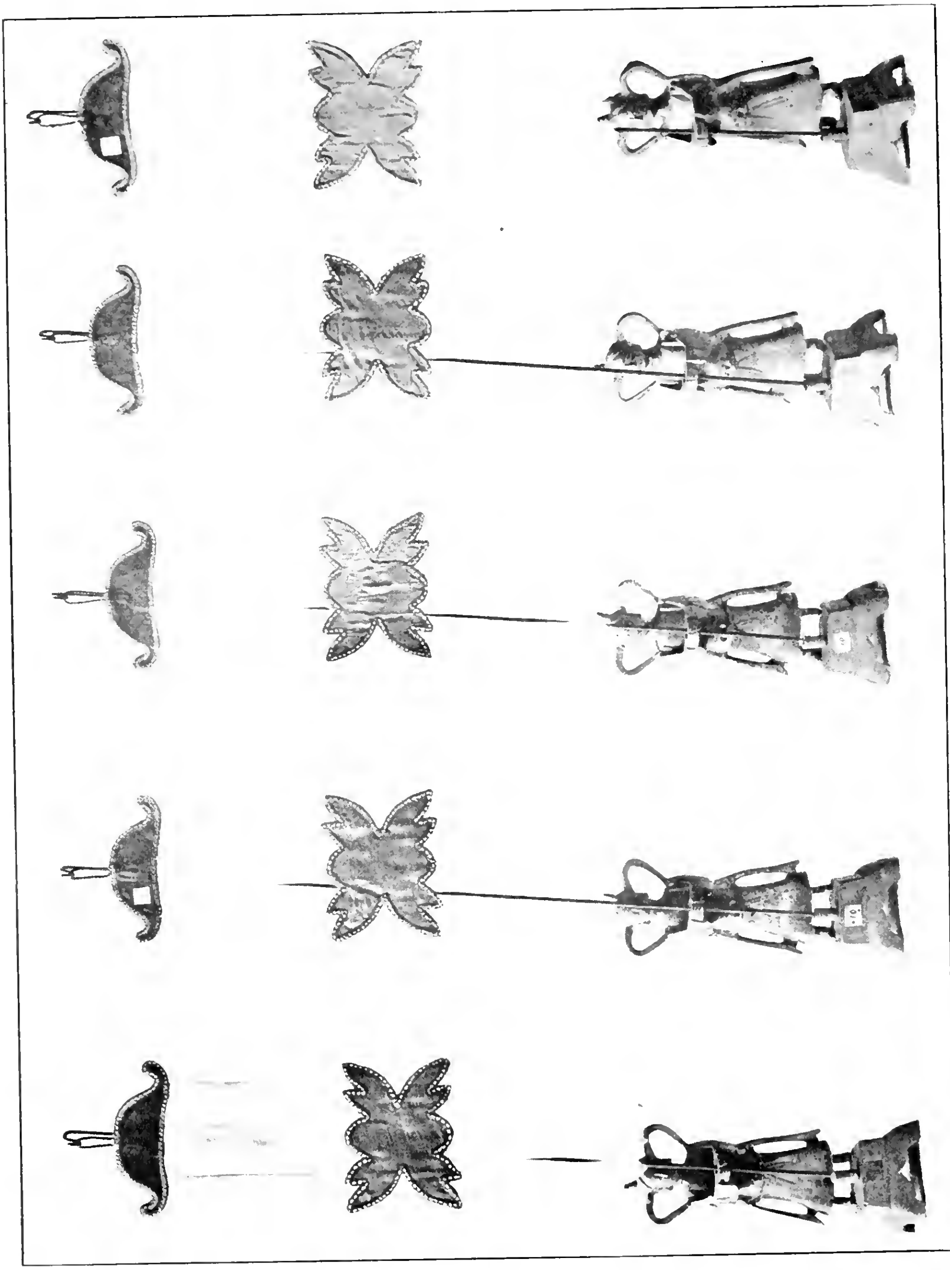
1 AND 3, PEWTER CANDLESTICKS, FROM SHANGHAI, CHINA; 2, PEWTER INCENSE BURNER, FROM SHANGHAI, CHINA.

FOR EXPLANATION OF PLATE SEE PAGE 335.



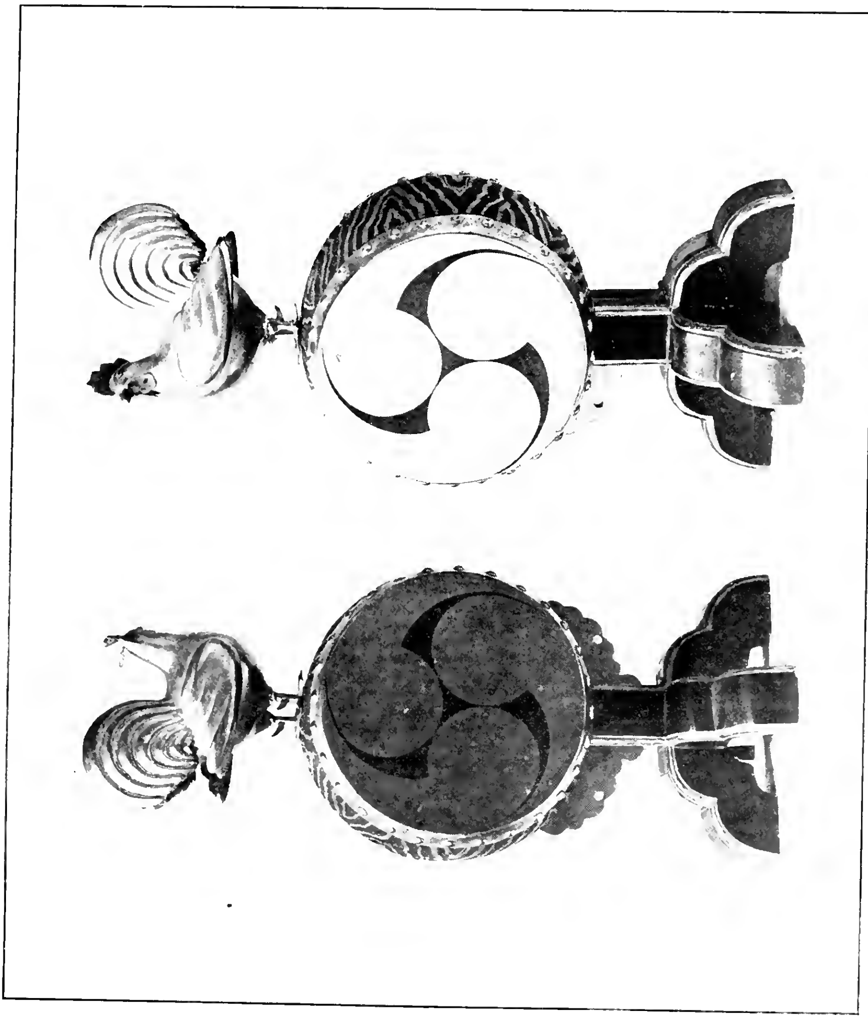
1, Bronze Censor, from Japan; 2, Bronze Candlestick, from Japan.

For explanation of plate see page 335.



PRAYER BANNERS, FROM SHANGHAI, CHINA.

FOR EXPLANATION OF PLATE SEE PAGE 337.

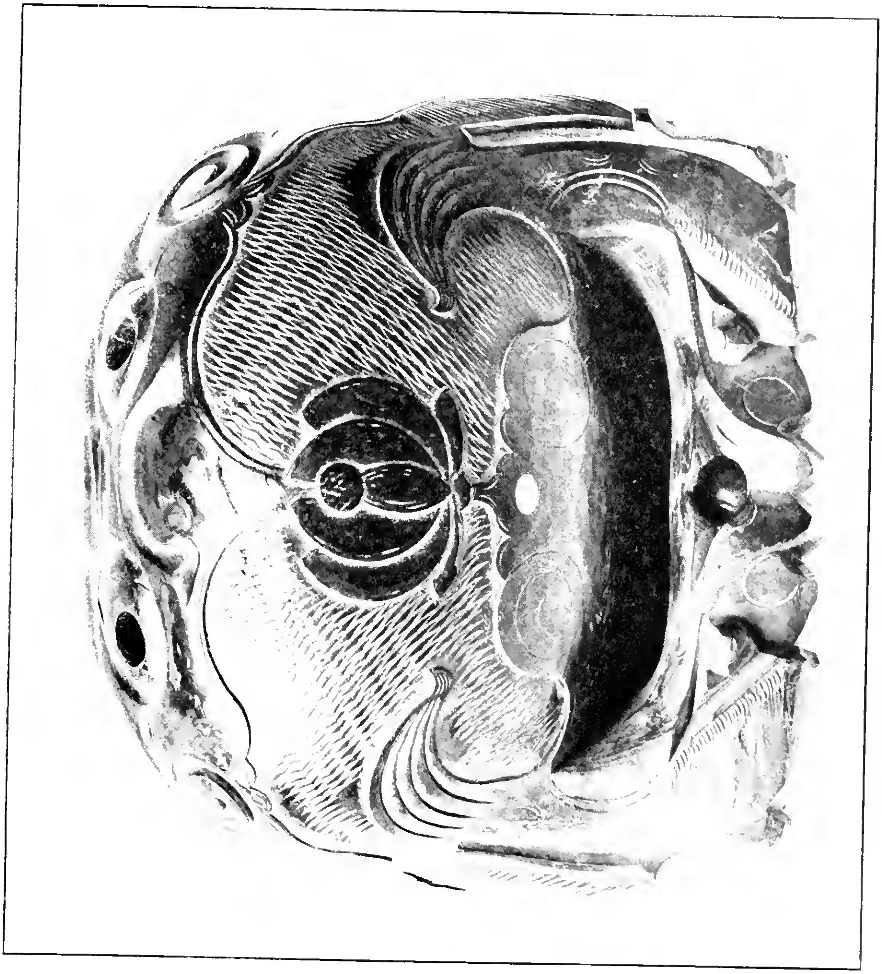


TEMPLE DRUMS, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 338.

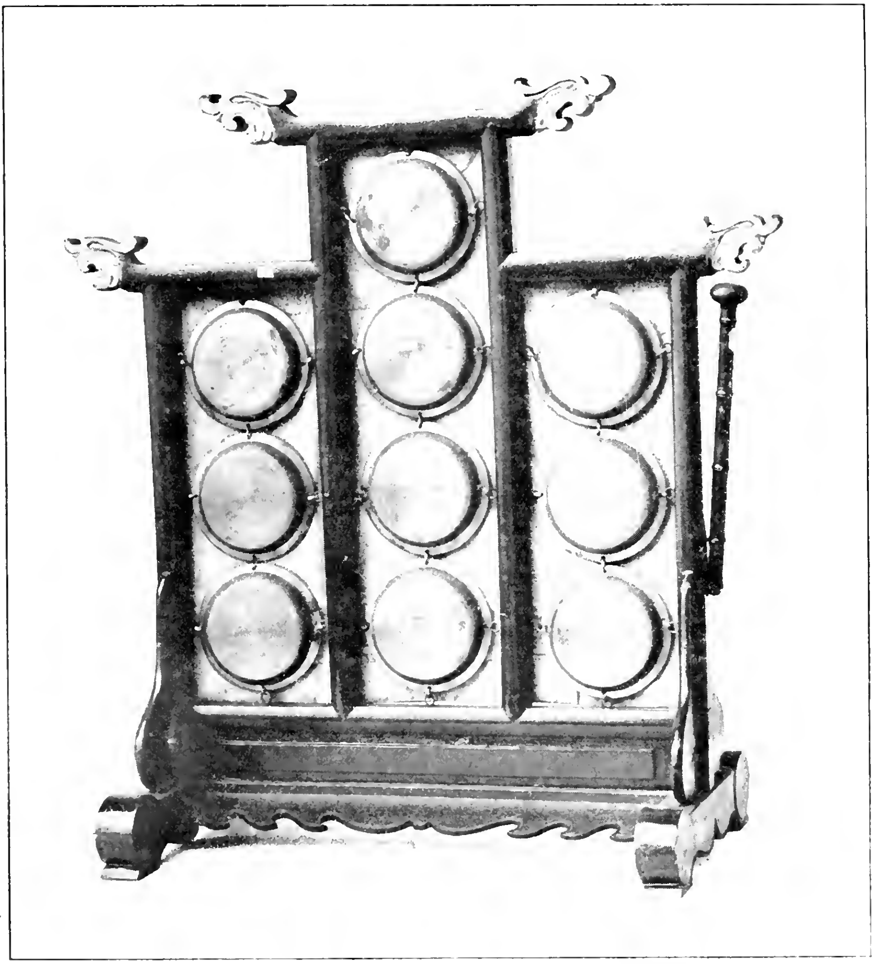
FRONT VIEW OF WOODEN FISH, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 338.



BACK VIEW OF WOODEN FISH, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 338.



COPPER NINE-TONED BELL, FROM SHANGHAI, CHINA.

FOR EXPLANATION OF PLATE SEE PAGE 339.

WOODEN TRIRATNA, FROM LAOS.

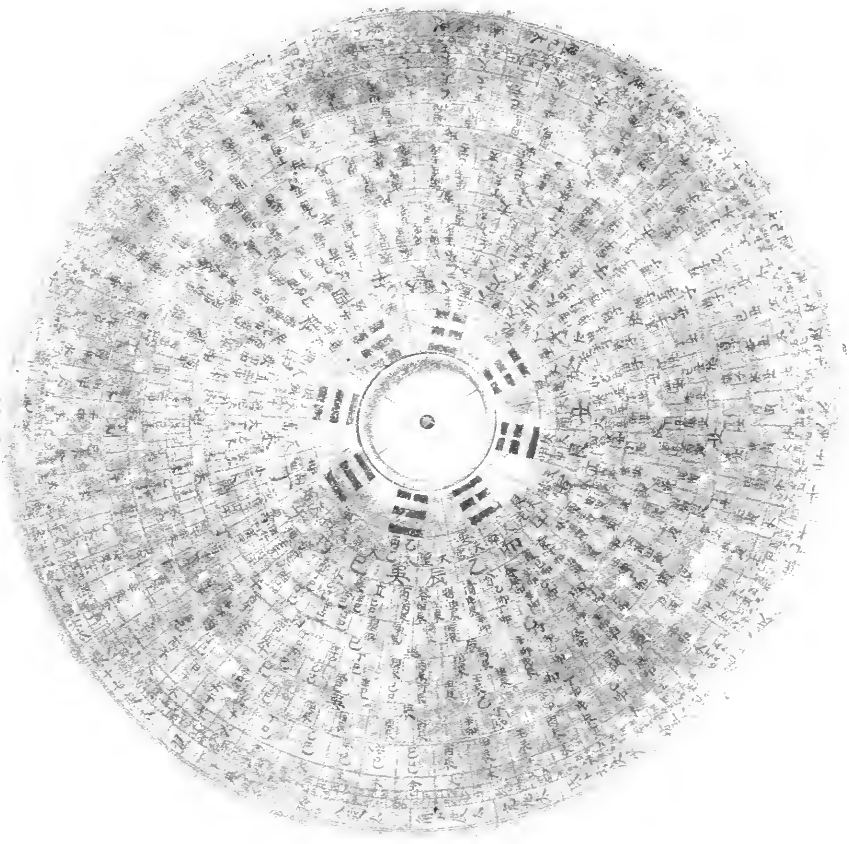
FOR EXPLANATION OF PLATE SEE PAGE 340.

WOODEN TRIRATNA, FROM LAOS.

FOR EXPLANATION OF PLATE SEE PAGE 340.

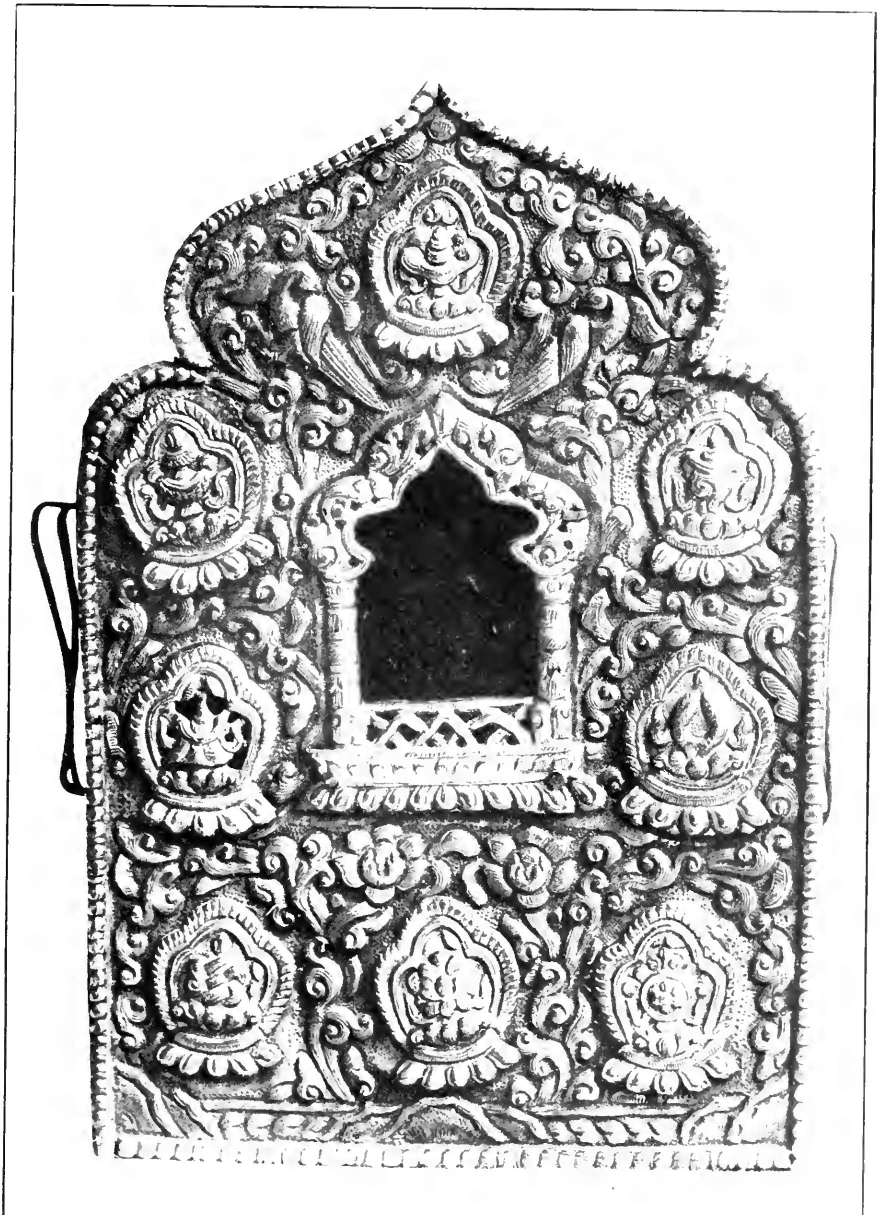
WOODEN DEMON-QUELLER, FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 342.



GEOMANTIC COMPASS, FROM CHINA.

FOR EXPLANATION OF PLATE SEE PAGE 343



COPPER AMULET CASE, FROM TIBET.

FOR EXPLANATION OF PLATE SEE PAGE 344

NEW SPECIES OF LEPIDOPTERA IN THE UNITED STATES NATIONAL MUSEUM.

By William Schaus,

Assistant Curator of Insects, United States National Museum.

The species described from Cuba, Costa Rica, Guatemala, Panama, British and French Guiana were collected by Mr. John T. Barnes and myself during our visits to those countries; those described from Argentina were received from Don Pedro Jorgensen and some very interesting new species have recently been received from Mr. Julius Arp, of Rio de Janeiro. My description is made from a single specimen marked "type". Where specimens from different localities are mentioned the first locality is that of the type.

Family ARCTIIDAE.

Subfamily Lithosiinae.

AGYLLA ARTHONA, new species.

Male.—Antennae brown. Palpi, throat, and legs orange, the mid-tarsi black in front. Frons black. Vertex white, between antennae orange. Tegulae whitish gray. Thorax white. Abdomen pale ocherous gray, terminally and laterally yellow. Fore wings silvery white, the costa orange. Hind wings thinly scaled, whitish gray. Fore wings below silky gray, the costa orange. Hind wings below white. Venation normal.

Expanse.—35 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 23350, U.S.N.M.

Close to *Agylla nivea* Walker.

CISTHENE LOCCEA, new species.

Male.—Antennae black. Head and body deep yellow. Legs black. Fore wings fuscous gray; medial and subterminal broad yellow lines, the medial line almost vertical expanding slightly on costal and inner margins, the subterminal widest on costa, outcurved, close to margin from vein 5 to inner margin; the apical dark space rather narrow. Hind wings deep yellow, the outer margin black, about 2.5 mm. wide. Underneath the medial line on fore wing is slightly broader; a black spot at base of costa on hind wing.

Expanse.—27 mm.

Habitat.—Mazatenango, Guatemala.

Type.—Cat. No. 23351, U.S.N.M.

Near *Cisthene menea* Drury.

ILLICE LINCEA, new species.

Male.—Antennae black. Palpi and lower portion of frons yellow, head otherwise and thorax orange. Abdomen reddish. Legs whitish yellow, the tarsi tipped and banded with black. Fore wings orange; basal third of costa finely black; a black basal spot on costa, and an antemedial and postmedial black costal spot, beyond the latter the costa is more broadly black continuing around apex and along outer margin as a broad black line on cilia tipped with white and preceded by a white shade not reaching tornus; a black subterminal line before apical portion, and a black spot at middle of inner margin. Hind wings roseate orange; a black spot at apex. Wings underneath reddish, the markings as above, but there is no basal spot on costa of fore wing, the antemedial spot is very faint, and the postmedial spot suffuses with the black costal line.

Expanse.—18 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23352, U.S.N.M.

AFRIDA PURULHA, new species.

Male.—Head, collar, and thorax white irrorated with black. Abdomen brownish gray. Fore wings white; the basal third with a few black scales; medial space thickly irrorated with brown and fuscous limited by vertical black lines; terminal third with fewer irrorations except in space inclosed by a fine black postmedial line which is wavy and deeply outcurved from below costa to the vertical line at vein 2; cilia thickly mottled with black. Hind wings grayish white; faint traces of a pale brown medial line, and similar shading on termen. Fore wings below gray. Hind wings below white with some brownish rrorations forming vague medial and postmedial lines.

Expanse.—16 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 23353, U.S.N.M.

CLEMENSIA CHALA, new species.

Male.—Palpi dark gray. Head, collar, and thorax grayish white. Abdomen gray; anal tufts ocher white. Fore wings gray white; costa grayer with four small fuscous spots from base to before middle of wing, the last above a fuscous line interrupted on subcostal, and from median to submedian, this line is preceded in cell by a large fuscous gray spot, and followed by a smaller black spot; an interrupted and irregular dark line crosses wing close to end of cell; a black spot on discocellular; postmedial fine, dentate from costa to vein 6, then macular, and irregular; some subterminal brownish gray shading chiefly opposite cell; terminal fuscous spots on interspaces; below cell a pale brown shade from beyond base to postmedial line where it merges with a large gray brown semicircular spot on inner margin; cilia white with dark spots at apex, and between veins 3 and 5. Hind wings white on costa and in cell, otherwise whitish gray, a dark spot on discocellular and faint darker terminal spots. Fore wings below fuscous, the apex and termen narrowly, the inner margin broadly whitish; a down turned crest of hairs in cell. Hind wings below white, a dark spot on discocellular and faint postmedial line on costal margin.

Expanse.—18 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23354, U.S.N.M.

CLEMENSIA REMIDA, new species.

Female.—Head, collar, and thorax white irrorated with light brown. Abdomen fuscous gray, the anus white. Fore wings white irrorated with pale brown; base light brown limited by a fine dark brown line; the antemedial line, fine, dark brown, outcurved on costa and across cell, incurved below submedian, preceded by a rather broad dark brown curved shade and followed by a dark point in cell; a broad, irregular, pale brown postmedial shade, partly edged by dark brown lines and irrorated with dark brown, thickly so below end of cell, forming a fuscous brown spot; a dark line on discocellular; subterminally the irrorations form clusters at veins 4–6, and on costa; clusters of brown irrorations on cilia. Hind wings smoky gray.

Expanse.—20 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23355, U.S.N.M.

Near *Clemensia brunneomedia* Schaus.

Family NOLIDAE.

CELAMA COGIA, new species.

Male.—Palpi brown laterally. Head, collar, thorax, and base of abdomen white; some dark irrorations on tegulae. Abdomen light gray. Fore wings: Base to beyond middle on inner margin and to before middle at costa pure white except costa which is brown and there are a few brown scales in cell; outer portion dark gray with faint brownish postmedial, subterminal, and marginal lines, the two latter with some fuscous irrorations and short black streaks on some of the veins, the postmedial with more pronounced black streaks and spots; a dark brown and black streak on discocellular. Hind wings whitish gray. Fore wings below brownish gray, the veins darker; the inner margin whitish. Hind wings below whitish gray; veins and termen dark; a faint discocellular line; some brown irrorations on costal margin.

Expanse.—14 mm.

Habitat.—St. Jean, Maroni River, French Guiana.

Type.—Cat. No. 23356, U.S.N.M.

CELAMA RALPHIA, new species.

Male.—Palpi brown. Head white, the vertex tinged with gray. Collar gray crossed by a brown line in front. Thorax brownish gray. Abdomen paler than thorax. Fore wings brownish gray, darkest terminally; a dark brown streak at base of costa; antemedial line very fine, interrupted, fuscous, outcurved, followed in cell by a round black spot; post-medial fine, punctiform, very slightly curved below costa, then inbent, coalescing on inner margin with a dark brown spot; subterminal dark points outbent from costa to vein 6, then parallel with termen; cilia with indistinct darker spots. Hind wings white, the termen narrowly and cilia tinged with gray brown.

Expanse.—13 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23357, U.S.N.M.

NOLA PARANA, new species.

Female.—Palpi, head, collar, and thorax white, the latter with dorsal grayish shading and irrorations. Abdomen gray brown. Fore wings dull white with a few dark irrorations especially in and below cell; costa brown at base and medially mottled with fuscous; a very faint outcurved antemedial line; a dark gray-brown inbent shade from discocellular, expanding somewhat on inner margin, closely followed by the fine post-medial line which is outangled on costa, sinuous, and below vein 3 somewhat incurved; an irregular subterminal line and terminal shade, both dark and grayish brown; cilia with dark spots. Hind wings mostly pale brownish gray, the inner margin whitish. Fore wings below fuscous. Hindwings below white with dark irrorations on costa and apex; a thick dark streak on discocellular.

Expanse.—18 mm.

Habitat.—Castro, Parana.

Type.—Cat. No. 23358, U.S.N.M.

NOLA JOANNA, new species.

Male.—Palpi laterally dark brown. Head white. Collar and thorax white mottled with dark brown. Abdomen brownish gray. Fore wings white; base of costa streaked with fuscous brown; a black point in cell followed by the antemedial line which is remote, almost medial, fine, evenly outcurved, almost obsolete below submedian, defined by the fuscous brown shading following it which expands anteriorly forming a large triangular spot with its base on costa; postmedial very fine, and faintly marked, brown, outcurved around cell, vertical from vein 2 to inner margin where it is preceded by a short curved line; termen and cilia fuscous brown. Hind wings dark gray. Hind wings below gray; costal margin broadly white with brown irrorations; a dark point on discocellular.

Expanse.—11 mm.

Habitat.—St. Jean, Maroni River, French Guiana.

Type.—Cat. No. 23359, U.S.N.M.

NOLA BARACOA, new species.

Female.—Palpi laterally reddish brown. Head, collar, and thorax grayish white; frons with brown irrorations. Abdomen light gray, the base dorsally white. Fore wings grayish white; a large light brown spot on costa close to base; a small antemedial spot from which the line is fine, black, deeply outcurved, inbent to submedian, down bent below it, and in cell is followed by a brown spot; a medial spot on costa from which the postmedial fine, black, line is deeply outcurved, then deeply incurved below vein 3, and outbent toward tornus; a subterminal light brown, faint macular shade, somewhat irregular; similar terminal spots. Hind wings white terminally shaded with pale brown.

Expanse.—15 mm.

Habitat.—Baracoa, Cuba.

Type.—Cat. No. 23360, U.S.N.M.

NOLA FOLGONA, new species.

Female.—Palpi gray. Head white. Body gray; some white scaling at base of abdomen. Fore wings gray, sparsely irrorated with brown; a brown point on costa at base; antemedial inbent from costa near middle consisting of fuscous gray scales almost punctiform and with a distinct small dark spot in cell; postmedial punctiform, slightly outcurved around cell, faintly incurved from vein 3 to inner margin; subterminal dark streaks on interspaces; terminal dark points. Hind wings whitish at base becoming pale brownish gray outwardly. Hind wings below with the white more extended.

Expanse.—13 mm.

Habitat.—Santiago, Cuba.

Type.—Cat. No. 23361, U.S.N.M.

NOLA SANTAMARIA, new species.

Female.—Palpi and head white with a few black irrorations. Collar fuscous brown, the hind edge white. Thorax fuscous, the patagia white with fuscous brown irrorations. Abdomen brownish with fine segmental white lines. Fore wings white irrorated with black; a black subbasal spot on costa with black points on either side; antemedial and medial spots on costa close together, a wavy black line from the former, slightly inbent, the latter with spots below it in cell; postmedial macular, black brown, with short black streaks on veins, curved around cell, broadly shaded on its inner side at cell and below it to inner margin with black brown; termen broadly shaded by black brown, the veins with black streaks cut by a fine white wavy subterminal line; cilia gray mottled with fuscous brown. Hind wings whitish gray, showing the markings of under side; the veins terminally somewhat darker. Fore wings below brownish gray. Hind wings below white; the costa irrorated with brown; a dark brown spot on discocellular; a brown postmedial line; a fine terminal brown line.

Expanse.—20 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23363, U.S.N.M.

The dark shading on inner side of postmedial line makes this species conspicuous even in worn specimens.

NOLA RUBESCENS, new species.

Female.—Palpi, head, collar, and thorax white irrorated with reddish brown. Abdomen gray with white segmental lines. Fore wings white irrorated with reddish brown; four large reddish brown costal spots from which blackish lines originate; base reddish brown; antemedial line fine, angular to just below cell, then obsolete; postmedial macular, evenly outcurved, down bent below vein 2, its inner edge broadly shaded with reddish brown; subterminal outbent on costa, then parallel with termen macular; termen reddish brown leaving a fine terminal white line; cilia gray cut by white scaling at veins. Hind wings fuscous gray; the basal half of costa white. Fore wings below fuscous gray the inner margin white. Hind wings below white, irrorated with brown chiefly on costa and termen.

Expanse.—16 mm.; expanse of male 12 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23364, U.S.N.M.

NOLA RECEDENS, new species.

Female.—Palpi light brown. Head, collar, and thorax grayish white with a few light brown irrorations. Abdomen gray. Fore wings grayish white; costal margin from base to postmedial line shaded with brownish gray; antemedial line black, wavily dentate, interrupted, starting from subcostal, somewhat inbent below cell, preceded by a black point in cell, and three between cell and submedian, followed in cell by a brownish gray spot which suffuses with costal shade; postmedial line black, punctiform, only slightly outcurved, and inbent at veins, vertical below vein 2, preceded throughout by a brownish gray shade; subterminal shade fuscous, oblique from costa, and twice inset; terminal black spots; cilia white with fuscous spots. Hind wings fuscous gray. Hind wings below white, costa with dark irrorations; a dark spot on discocellular; termen tinged with gray..

Expanse.—19 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23365, U.S.N.M.

NOLA CUBENSIS, new species.

Female.—Head, collar, and thorax white shaded with light reddish brown. Abdomen brownish. Fore wings white; costal margin to beyond middle and cell reddish brown; a geminate, black antemedial line, evenly outcurved and inbent to base of inner margin; a fine black medial line, well defined below cell where it is lunular; postmedial black, geminate, sinuously outbent from costa, curved across veins 4 and 3, and deeply inbent to vein 2, angled near the median line, and from there to inner margin it forms a slight outward curve; from the angle at vein 2 another black line is outcurved to near tornus, inbent on submedian with a slight outcurve below it; the subterminal is oblique from costa to near termen, inangled on vein 5, where a projecting line connects it with the outer postmedial line; it is then outcurved and is obsolescent below vein 3; some black scaling forms a vague terminal line. Hind wings whitish, the veins streaked with gray. Hind wings below white; some dark irrorations on costa; a vague postmedial, punctiform line; a faint discocellular mark.

Expanse.—18 mm.

Habitat.—Alto del Cedro; Baracoa, Cuba.

Type.—Cat. No. 23366, U.S.N.M.

Bears a strong resemblance to *Roeselia bifiliferata* Walker.

NOLA ELSA, new species.

Female.—Head, collar, and thorax white with a few brownish irrorations. Abdomen gray. Fore wings white with a few scattered dark irrorations; traces of antemedial and postmedial brownish lines; the raised tufts light brown, the outer spot surmounted by a triangular light brown costal spot; a faint subterminal line suffusing with two marginal series of short paired streaks. Hind wings whitish gray; a fine dark terminal line.

Expanse.—12 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23367, U.S.N.M.

The triangular costal spot is the most conspicuous character in determining this species.

NOLA TURBANA, new species.

Male.—Palpi white, some brown shading laterally. Head, collar and thorax white, shoulders brown. Abdomen light brown. Fore, wings: A little more than the basal third white limited by a straight dark brown shade beyond which the wing is lighter brown; base of costal margin shaded with brown, except a white basal spot; fine white transverse lines on costal margin beyond middle; a black spot on discocellular; a fine black punctiform, postmedial line, deeply outcurved beyond cell. Hind wings whitish gray, becoming darker terminally; a dark line on discocellular. Fore wings below cell and vein 2 white, otherwise smoky gray. Hind wings below whitish gray; a round pale brown spot at end of cell.

Expanse.—12 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23368, U.S.N.M.

Near *Nola habrophyes* Dyar.

NOLA MARIA, new species.

Male.—Antennae with long pectinations. Head, collar, and thorax light gray. Abdomen brownish white. Fore wings light gray, with darker gray irrorations increasing terminally; lines ill defined, formed of irrorations; the antemedial outcurved, followed in cell by a black spot; a whitish tuft at end of cell; postmedial punctiform, inbent from costa to vein 3, then inset to inner margin; some terminal dark spots, and terminal points on interspaces. Hind wings white, the cilia faintly tinged with brown. The underside without markings.

Expanse.—18 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23369, U.S.N.M.

NOLA LIMONA, new species.

Male.—Head, collar, thorax and base of abdomen white, palpi laterally dark brown; a transverse dark streak across middle of tegulae. Abdomen whitish gray. Forewings white with a few pale brown irrorations; traces of an antemedial, interrupted black line, followed by a small round pale brown spot in cell; postmedial curved around cell, almost vertical below vein 2, fine, black, barely defined on costal margin; a fine subterminal line outcurved below costa, inset at vein 5 and forming sagittate spots to inner margin; termen shaded with dark gray leaving a narrow terminal white line with black points on veins; basal half of cilia with gray spots. Hind wings white, the termen grayish. Forewings below gray, the inner margin white. Hind wings below white, the costal margin and apex gray, the inner margin white. Hind wings below white, the costal margin and apex gray irrorated with dark brown; the termen narrowly grayish.

Expanse.—16 mm.

Habitat.—Banana River, Costa Rica, Cayuga, Guatemala.

Type.—Cat. No. 23370, U.S.N.M.

NOLA YEGUA, new species.

Female.—Palpi white laterally shaded with brown. Head, collar, and thorax white, the collar with some dark brown irrorations. Abdomen whitish with gray segmental shading. Forewings dull white with a few scattered dark scales; costal edge with dark brown spots; traces of a very fine antemedial line, inbent below cell; the raised tufts shaded with dark brown; a larger dark spot on costal margin medially. The postmedial line finely outcurved beyond cell, straight from vein 2 to inner margin, black-brown, partly punctiform; an irregular subterminal pale brown shade; termen shaded with very pale brown; indistinct terminal brownish points. Hind wings whitish at base, becoming pale grayish brown terminally. Wings below without markings except dark costal points on forewing.

Expanse.—17 mm.; male 14 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23371, U.S.N.M.

ROESELIA INGA, new species.

Male.—Head, collar, and thorax silvery white; palpi brown. Abdomen gray. Forewings silvery white; basal fourth of costa black; a large medial dark brown spot on costa, suffusing with a smaller spot in cell, all edged with black brown; from end of cell at vein 3 a fuscous vertical line to inner margin; a wavy subterminal brownish shade, preceded and followed on costa by a dark point; termen faintly tinged with gray. Hind wings whitish, the apex grayish, narrowing to anal angle. Forewings below fuscous gray. Hind wings below white with brown irrorations on costa; the apex grayish.

Expanse.—18 mm.

Habitat.—Carabaya, Peru.

Type.—Cat. No. 23373, U.S.N.M.

ROESELIA TRIAS, new species.

Male.—Palpi brown tipped with white. Head, collar, and thorax white with a few dark irrorations. Abdomen silvery gray. Forewings silky whitish gray; a black brown antemedial line, slightly outcurved from subcostal to submedian; a V-shaped medial spot on costa continuing as an outbent line across cell, angled at vein 3, and inbent to inner margin, followed by a white line on discocellular; postmedial fine, black, deeply outbent along costa from medial spot, angled, thicker and obliquely down bent to vein 4, where it is fine, deeply incurved, and close to medial line from vein 3 to inner margin; a wavy and interrupted dark subterminal line; a fine dark terminal line. Hind wings white; a faint brownish postmedial line, and a finer terminal line. Fore wings below silky gray brown. Hind wings below white; a dark spot on discocellular; a dark postmedial line and fine terminal line; some dark irrorations on costa.

Expanse.—23 mm.

Habitat.—Carabaya, Peru.

Type.—Cat. No. 23374, U. S. N. M.

Family NOCTUIDAE.

PROTAGROTIS VENIPICTA, new species.

Female.—Palpi black. Head and collar fuscous brown, the former mottled with ocherous hairs on vertex, the latter deeply fringed behind with ocherous. Thorax steel black with dark brown shading in front. Abdomen black brown above, underneath black mottled with white. Fore wings dark brown, the lines fuscous brown, the veins steel gray irrorated with blueish white; a subbasal line shaded on either side with ocherous on costa; antemedial line very fine, outbent on costa, incurved in cell, vertical below it, preceded by an ocherous shade on costa; a faint round ocherous orbicular spot; reniform very indistinct, paler brown with a few orange scales; postmedial outcurved below costa and inbent to inner margin, almost punctiform, geminate, preceded from vein 3 to inner margin by a straight dark line; some ocherous shading on postmedial below costa; subterminal close to postmedial consisting of black spots between the veins; a fine terminal black line. The wings are iridescent, so the dark shadings seem to suffuse. Hind wings fuscous brown. Fore wings below fuscous with a fringe of long fine downturned hairs on costa; cilia brown with fuscous shading. Hind wings below fuscous gray, the apical half above vein 4 whitish with dark postmedial and subterminal lines; a dark discal point; termen narrowly whitish.

Expanse.—35 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23375, U. S. N. M.

ERIOPYGA CARNEITINCTA, new species.

Male.—Head, collar, thorax, and legs grayish clay color, the palpi laterally fuscous. Abdomen above dull fuscous; anal tufts and long lateral tufts brownish ocher. Fore wings silky lilacine gray thinly irrorated with black; costal margin to postmedial, end of cell, and an incurved shade from termen below apex to vein 3 reddish brown; reniform indistinct, pale reddish brown with a small fuscous gray spot at origin of veins 3 and 4; antemedial black points on veins; postmedial outangled on costa then slightly inbent to inner margin consisting of black points on veins, inwardly white edged on veins 2, 3, 4; termen shaded with brown; black terminal points on interspaces. Hind wings fuscous gray, the veins darker. Wings below whitish; costal margins pale flesh color with darker irrorations; dark discal points and a punctiform postmedial line; terminal black points; the disk of fore wings shaded with fuscous gray.

Expanse.—35 mm.

Habitat.—Purulha, Guatemala.

Type.—Cat. No. 23376, U.S.N.M.

HYDROECIODES MARCONA, new species.

Female.—Head and thorax black. Collar fuscous brown fringed behind with light brown tipped hairs. Abdomen fuscous brown with transverse black shades and irrorated with some gray scales. Fore wings dark silky brown, the medial space and termen shaded with fuscous; lines fine, black, the basal and antemedial lines preceded by slightly paler brown shading; the postmedial outcurved, lunular, the lunules filled in with paler brown; the subterminal line dentate. Orbicular and reniform white, the orbicular containing a cinnamon brown spot, the reniform which is medially constricted containing a cinnamon brown line. Hind wings fuscous. Wings below fuscous, the hind wings with some whitish shading below cell and along inner margin; a black streak on discocellular; a black medial and fainter postmedial line.

Expanse.—35 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23377, U.S.N.M.

HYDROECIODES RITARIA, new species.

Female.—Palpi dark gray above, ocherous below. Head, collar, and thorax purplish brown. Abdomen fuscous brown. Fore wings dark red, the extreme costa and veins, also postmedial shades from veins 2–5, grayish black; base of wing bright yellow crossed by a lunular red subbasal line; antemedial line fuscous, lunular, preceded by some yellow scales on costa and below cell; a vague dark medial line; postmedial line dark, wavy, very slightly outcurved; a subterminal series of black points, followed by yellow scaling, chiefly from vein 4 to costa; orbicular a small round yellow spot; reniform yellow irrorated with red and edged below with white; cilia fuscous brown. Hind wings dark silky brown, the cilia pale.

Expanse.—28 mm.

Habitat.—Volcan de Santa Maria, Guatemala; Orizaba, Mexico.

Type.—Cat. No. 23378, U.S.N.M.

CIRPHIS VELVA, new species.

Male.—Head, collar, and thorax grayish purple; the patagia dorsally mottled with pale reddish. Abdomen grayish; anal tufts yellowish. Fore wings: Costal margin grayish purple with black irrorations; inner margin, a shade below end of cell and between veins 2 and 3, where it is joined by an oblique shade from termen below vein 7, also grayish purple with black irrorations; cell, below it basally, and postmedial space otherwise mottled yellow and red; termen reddish suffused with grayish purple; a small white streak on median at veins 3 and 4; postmedial black points on veins; terminal black points on interspaces; cilia iridescent reddish or gray; cilia on inner margin white. Hind wings thinly scaled, white. Fore wings below roseate white, the termen and costa lilacine gray with black irrorations; a black point on costa before apex; terminal black points.

Expanse.—33 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23379, U.S.N.M.

Near *C. pyrastis* Hampson.

CIRPHIS MACOYA, new species.

Male.—Palpi, head, collar, and thorax ocherous gray. Abdomen whitish gray with black irrorations; the last two segments grayer dorsally; anal tufts ocherous yellow. Fore wings ochreous gray with scattered irrorations; the cell, a streak below it, intervenal streaks and either side of submedian, also veins beyond cell finely edged with pale reddish brown; the termen with grayish suffusions at tornus and from above vein 4 to vein 7; a fine black streak in cell along median terminating in a black point at discocellular; a large black spot between veins 3 and 5 at cell; postmedial black points on veins, and terminal black points on interspaces. Hind wings white, terminal black points except at anal angle. Fore wings below ocherous white; a black point on costa before apex; black terminal points, more conspicuous on hind wing.

Expanse.—35 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23380, U.S.N.M.

Near *Cirphis jaliscana* Schaus.

CIRPHIS CHEJELA, new species.

Male.—Palpi purplish gray. Frons brown with a darker transverse shade. Vertex, collar, and thorax lilacine gray; a dark transverse line on collar; a few black irrorations on patagia. Abdomen ocherous white, the subdorsal hairs on basal half white. Fore wings: The veins, a streak on costal margin, and one between median and submedian, white finely edged with pale brown; fine brown streaks edged with white in cell, below median, above submedian and between veins from cell; a faint oblique whitish shade from termen below apex to vein 5; the brown intervenal lines beyond cell partly darker; a black point in end of cell close to discocellular at vein 5; postmedial black points on veins 2 and 5; terminal black points on interspaces; cilia light brown tipped with white. Hind wings thinly scaled, white. Fore wings below whitish, the costa tinged with ocherous and irrorated with black; a fuscous streak below costa from before end of cell to some indistinct postmedial points; terminal black points.

Expanse.—36 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23381, U.S.N.M.

Near *C. multilinea* Walker.

TRACHEA? MANCILLA, new species.

Female.—Palpi and head brown. Collar brown fringed with white. Thorax brown with large white patches on patagia. Abdomen above dark grayish brown shaded with white at base; whitish segmental lines; underneath whitish irrorated with brown. Fore wings chiefly dull fuscous brown broken into large spots finely edged with white; base narrowly white crossed by a black line; an antemedial greenish white fascia bifurcating on costa, and toward inner margin rather diffused below cell, followed in cell by a black orbicular spot; reniform large, linear, fuscous brown; postmedial almost vertical, expanding at vein 5, inclosing a small triangular spot and followed by two large spots, the upper one almost quadrate from vein 6 to costa, the lower spot from vein 5 to inner margin, outbent to near termen at vein 4, constricted at vein 2, then expanding to tornus; some fuscous brown subterminal spots; termen pale brown; terminal triangular dark brown spots; cilia long, dark gray, broadly tipped with white. Hind wings dark silky brown; outer half of cilia white. Hind wings below whitish thickly irrorated with brown; a dark discal spot and post medial line.

Expanse.—30 mm.

Habitat.—Guatemala City.

Type.—Cat. No. 23382, U.S.N.M.

HETEROCHROMA CELESTINA, new species.

Female.—Palpi ocherous streaked with brown laterally. Head, collar, and thorax ocherous brown; some black brown irrorations on tegulæ. Abdomen ocherous irrorated with brown. Fore wings: Basal third lavender gray with some cinnamon shading on its outer edge, the base crossed by a vivid green dentate line edged with black from costa to submedian, followed below cell by some cinnamon shading; the basal space is followed by a narrow green fascia divided by a fine wavy black brown line from subcostal vein to inner margin; medial space otherwise mostly light brown; a green lunule in cell and one below it edged with black on either side; the outer edging of cellular lunule forming an anular spot with brown center, which is again followed by a green line and a black streak which precedes the lunular whitish line on discocellular; a green spot on costa above discocellular; postmedial line fine, black, outcurved, and deeply lunular between the veins, inwardly shaded with lavender gray; the veins are broadly lavender gray to the postmedial line; terminal space brown before the subterminal line which is a vivid green, narrowing between veins 3 and 4 and expanding to tornus at inner margin; termen toward apex ocherous brown. Hind wings fuscous. The cilia whitish ocher. Wings below whitish, the disk of fore wings suffused with fuscous gray; hind wings with a large discal spot and a fine lunular brown line.

Expanse.—32 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23383, U.S.N.M.

HETEROCHOMA ROLLIA, new species.

Female.—Palpi fuscous brown fringed with reddish brown. Head, collar, and thorax purple mottled with fuscous brown; a transverse green line on collar; a green streak on patagia; green tips to posterior tufts on thorax. Abdomen bright reddish brown, shaded with pale greenish ocher at base. Body underneath dull red, the legs ocherous. Fore wings: Costa finely purple brown, and below it to subcostal pale green; base narrowly purple brown; subbasal paired black streaks outbent on costa, inbent below cell, and outset and inbent on inner margin, divided by green streaks, and outwardly scaled with green; antemedially the cell is brown, darker brown below cell to inner margin, followed in cell and on inner margin by small green dark edged spots, and below cell by a large green spot crossed by a dark line inwardly, and outwardly edged by a dark line, the costa above being crossed by two black lines; a black brown spot in end of cell crossed by two green lines, followed by a lilacine shade with a dark line on discocellular; a lilacine horizontal streak from cell above vein 2, expanding to close above vein 3 and not reaching termen; below vein 2 to terminal space the wing is fuscous brown, with oblique green lines on inner margin and a vertical postmedial green line from vein to submedian; postmedial space above vein 4, crossed by an outbent green line from vein 8 to vein 6, followed by another green shade suffusing with the green costal margin; a green lunule across vein 5; a subterminal fuscous brown shade outwardly edged by a white line, interrupted at vein 5, and from close above vein 4 to vein 3, by a pale cinnamon brown shade; termen pale green with a crenulate terminal black line with large white spots at tips of veins;

cilia yellow. Hind wings greenish white at base shading to brown on outer half; a wavy fuscous postmedial line; a terminal black line; cilia greenish white. Fore wings below silky brown, the inner margin greenish white; cilia pale green, tipped with black lunules on interspaces. Hind wings below greenish white, thickly irrorated with pale red except on base and inner margin; a large black discal spot; a minutely wavy fuscous postmedial line; a fine dark brown terminal line.

Expanse.—48 mm.

Habitat.—Huancabamba, Peru.

Type.—Cat. No. 23445, U.S.N.M.

PERIGEA BAALBA, new species.

Male.—Palpi laterally reddish brown fringed with gray in front. Head mottled brown and gray; a white shade between antennae. Collar reddish brown mottled with gray in front. Thorax gray white. Abdomen dark brown with a dorsal and segmental white lines. Fore wings grayish white; a little less than basal third on costa mottled dark and lighter brown, this color extending only a little below median vein and crossed by a gray basal line, limited by a fine black antemedial line, oblique and curved below cell and upbent to a narrow oblique medial brown shade from costa, which crosses the end of cell to vein 3; reniform small mottled with brown, its inner edge pure white; a small brown spot on costa above reniform, from which a very indistinct postmedial line is deeply outbent, curved, and vertical below vein 6; the line is fine, black, and well defined from veins 6–4 where it is followed to termen by a reddish brown shade, with a shorter similar streak above and below it on termen; a small brown postmedial spot below veins 2 and 3; brown points on costa before apex; terminal black points, largest on brown portion. Hind wings fuscous gray, the veins mostly darker. Fore wings below: The costa and termen reddish, the former with alternate white and dark spots on outer half; inner margin white, disk grayish; cilia gray with reddish spots. Hind wings below: Costa and termen reddish, the latter broadly so at apex; wing otherwise white to termen before anal angle.

Expanse.—38 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23384, U.S.N.M.

PERIGEA PARISTA, new species.

Female.—Palpi dark brown fringed with white. Head, collar, and thorax dark gray with some reddish brown shading. Abdomen above dull gray, underneath with large sublateral brown spots. Fore tarsi fuscous with white rings; midtarsi paler with fainter rings; hind tarsi and tibiae whitish with brown irrorations. Forewings: Veins slaty gray, irrorated with white on terminal third; a pale red streak above subcostal irrorated with darker red; basal third of wing in cell, below it, and on inner margin yellow mottled with red, limited by the antemedial dark red, lunular, line; a slaty gray shade across end of cell; medial space from cell to inner margin dark red shaded with slaty gray; reniform large, yellow, edged and crossed by red lines and with a small oblique white spot at vein 4; a yellow and red postmedial shade from vein 8 to vein 5 inwardly extended to reniform between veins 5 and 6; a similar incurved shade from vein 3 to inner margin; from vein 2 to vein 5 a slaty gray space inclosing a series of subterminal dark red streaks in interspaces; terminally the veins are edged with slaty gray, leaving reddish brown streaks on interspaces; cilia brownish iridescent with dark gray shading. Hind wings whitish shaded with smoky gray on outer margin. Forewings below with the disk slaty gray, the costal and inner margins pale; a whitish orbicular point and a larger reniform spot. Hind wings below white, the costal and outer margins irrorated with pale reddish brown; a faint postmedial line on costal margins of both wings.

Expanse.—29 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23385, U.S.N.M.

PHUPHENA PROSELYTA, new species.

Male.—Palpi and head dark brown with some white mottling. Collar and thorax cinnamon brown. Abdomen above fuscous, the dorsal tuft near base reddish brown. Body below whitish irrorated with brown; black, sublateral points; legs mottled brown and white. Forewings: Basal space and termen dark lilacine brown; a subbasal whitish line deeply inangled on median and again above submedian; basal space limited by a white antemedial line, outbent and slightly curved to middle of inner margin, its anterior part contiguous to a straight fuscous line, oblique to postmedial on inner margin; a reddish shade medially in cell, and an oblique white line on costa above it from which the postmedial is sharply outbent along costa, curved and vertical beyond cell and faintly incurved below vein 3, fine, dark reddish brown, outwardly edged with white, but tinged with pale brown opposite cell; a similar line on discocellular followed by pale reddish brown to postmedial; some dark subterminal spots, the largest below costa; a terminal line and base of cilia dark brown; cilia tipped with white at interspaces. Hind wings fuscous brown; cilia white. Forewings below fuscous brown; inner margin white; costal margin to postmedial line whitish ocher irrorated with brown. Hind wings below white, the costal and outer margins tinged with roseate and thickly irrorated with brown; a dark discal point; an irregular dark brown lunular postmedial line.

Expanse.—26 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23386, U.S.N.M.

OGDOCONTA GAMURA, new species.

Male.—Palpi, head, thorax, and fore wings purple brown with fine white irrorations. Abdomen with ocherous irrorations. Tarsi with yellowish white rings. Fore wings silky, the lines fine, darker brown; antemedial very indistinct, outcurved; orbicular and reniform very large, simply outlined; the postmedial forming part of outer edge of reniform, inbent and straight below it, followed by a straight inbent line from costa to inner margin; terminal space darker; a lunular subterminal shade and indistinct oblique terminal lines; cilia fuscous gray irrorated with white. Hind wings fuscous brown. Fore wings below fuscous gray, the veins terminally streaked with white; costal and outer margins irrorated with white. Hind wings below white thickly irrorated with purple brown; fine medial and postmedial lines, a faint subterminal shade; apex brown shaded.

Expanse.—30 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23387, U.S.N.M.

Nearest *O. pulverulenta* Schaus, but much darker.

GONOSTYGIA JACOPA, new species.

Female.—Head, collar, and thorax fuscous gray. Abdomen above fuscous, the basal segment whitish. Fore wings: Basal third ocherous green limited by a fine black dentate antemedial line and containing black streaks on costa, in cell, below cell, and on either side of submedian; medial space almost entirely suffused with black; a white orbicular point; a large white reniform spot; a fine black, wavy, postmedial line with ocherous green shading on either side; terminal space fuscous brown shaded with black subterminally; black and white spots on costa, some marginal greenish shading; terminal white points; cilia black, tipped with white at interspaces. Hind wings black shot with dark brown; a large opalescent white spot, not reaching base or inner margin, the costal and outer margins remaining broadly dark. Hind wings below black shot with brown, the white reniform spot larger than on upper side. Hind wings below with the white spot slightly larger.

Expanse.—19 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23388, U.S.N.M.

STIBADIUM MURISCA, new species.

Female.—Head, collar, and thorax gray mixed with dark-reddish brown hairs, the latter tipped with gray. Abdomen light gray. Fore wings light gray irrorated with brown, the veins whitish; a black spot at base; a black streak below cell to postmedial line; an antemedial small black spot on inner margin; traces of a pale line almost medial, followed by an annular whitish buff line in cell; a darker gray spot in end of cell; reniform large, defined by whitish-buff lines, meeting behind and containing a pale line on discocellular; postmedial line faint, pale, outcurved beyond cell, vertical from vein 2 to inner margin; a large brown black spot on costa before apex; a submarginal whitish line; cilia ocherous white. Hind wings whitish, the veins and outer margin grayish brown. Fore wings below fuscous gray; costal and inner margins narrowly ocherous white; a white submarginal line. Hind wings below whitish.

Expanse.—46 mm.

Habitat.—Guatemala City.

Type.—Cat. No. 23389, U.S.N.M.

BAGISARA LULUA, new species.

Male.—Body and wings above ocherous, palpi whitish at base; frons partly whitish; thorax and base of abdomen below white; legs ocherous. Fore wings: Lines very fine, brownish, and indistinct; antemedial line almost vertical; postmedial line slightly outcurved, preceded by a faint brownish shade; subterminal line parallel with postmedial; termen faintly tinged with brown, and a narrow fuscous brown shade on termen and cilia from vein 4 to near tornus. Hind wings with some darker tinged hairs along inner margin. Wings below without markings.

Expanse.—38 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23390, U.S.N.M.

PARANGITIA MULATOR, new species.

Male.—Palpi pale buff in front, laterally gray. Head gray. Collar and thorax pale brown; some black irrorations on tegulae. Abdomen brown with dorsal and lateral fuscous shading anteriorly on each segment. Fore wings with the outer margins rounded, dark silky brown irrorated with buff between the lines, inner margin narrowly buff to postmedial line; an oblique black streak from base below cell; basal line inangled in cell, then outbent to antemedial which is wavy, defined by the pale mottling; postmedial black, macular, outcurved across an oblique dark brown shade from costa to termen; a fine black line on discocellular; apical space pale buff shading to brown at apex and with a short fuscous streak below vein 8; a pale brown, lunular, terminal line from vein 3 to tornus; cilia mostly black. Hind wings silky, dark purple brown; cilia with large black spots at interspaces, tipped with white. Wings below lighter brown, the disk of fore wing dark shaded, the hind wings with a dark outcurved postmedial line, and an interrupted dark terminal line.

Expanse.—22 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23391, U.S.N.M.

PARANGITIA CORMA, new species.

Male.—Palpi pale buff with some lateral fuscous shading. Head roseate buff with a medial black line. Collar, and thorax pale buff; a medial black brown line, a black point on tegulae, and the patagia tipped with black brown. Abdomen above light brown. Body underneath pale buff. Fore wings whitish buff, the space below cell to inner margin suffused with dark gray; the lines coarse, black; an oblique basal line from base of costa, outset in cell; antemedial line angled on subcostal, then down bent and not reaching inner margin, followed in cell by a small pale edged black spot; a medial line widened in cell, incurved below it around a pale buff spot, adjoining cell between veins 2 and 3, and not extending below vein 2; reniform large, irregular, black, finely edged with pale buff; postmedial irregular, reaching inner margin, outwardly followed by a broad black brown shade from veins 2–5; subterminal space shaded with gray, with some dark streaks beyond cell; termen with some pale brownish shading and curved fuscous lines opposite cell and at tornus; cilia mottled black and brown. Hind wings fuscous brown; cilia whitish buff. Hind wings below with a postmedial row of black points.

Expanse.—27 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23392, U.S.N.M.

ANGITIA ESTHERA, new species.

Female.—Body whitish ocher. Fore wings gray brown, the markings black; base narrowly whitish ocher limited by an outbent basal line; antemedial interrupted, thick, forming a spot on costa and one below cell, otherwise less distinct; medial line outcurved, distinct as a spot on costa, and inbent line from vein 2 to inner margin; reniform large, pale, outlined and crossed by a black line on basal side, and followed by a fuscous gray shade to postmedial; postmedial outcurved, wavy, distinct; terminal space from vein 2 to vein 10 fuscous, leaving the costa and a narrow apical space above vein 6 gray brown; below vein 2 a black spot edged with dark gray; an interrupted terminal black line not reaching apex; cilia pale grayish brown with black spots at tornus, from veins 3–5 and between veins 6 and 7. Hind wings fuscous brown, narrow terminal gray scaling; cilia pale grayish brown. Wings below with faint postmedial line and a fine black streak on discocellular of hind wing; disk of fore wing suffused with fuscous.

Expanse.—25 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23393, U.S.N.M.

ANGITIA CREPUSCULA, new species.

Female.—Head, collar, and thorax mottled ocherous gray and fuscous brown. Abdomen fuscous gray; a pale ocherous shade dorsally on basal half divided by a black dorsal line; anal hairs light brown. Fore wings dark purplish gray; base below cell and inner margin narrowly brown; an irregular black antemedial line; a very irregular black postmedial, geminate, line, very indistinct on a broad fuscous brown shade from costa to vein 4, this shade outbent to termen between veins 4 and 6; the apex whitish irrorated with gray, and with darker gray spots and a black streak above vein 7; a subterminal grayish line from vein 4 to inner margin beyond which the termen is dark; an interrupted terminal black line edged with grayish. Hind wings dark purplish brown; terminal triangular black spots; cilia ocherous white toward anal angle. Wings below brownish gray; a faint postmedial fuscous line, finely dentate on hind wing where there is also a black streak on discocellular; an interrupted terminal black line; cilia chequered ocherous white and fuscous brown.

Expanse.—25 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23394, U.S.N.M.

ANGITIA ANDREVIA, new species.

Female.—Head, collar, and thorax pale lilacine ocher; some black brown scaling on vertex, collar, and patagia. Abdomen pale reddish brown above with segmental black scaling at base. Fore wings: Base lilacine ocher edged by a dentate black line; space beyond fuscous brown faintly tinged with purple, limited by the postmedial outcurved black line; an antemedial black line inwardly edged with pale ocherous; a medial black line on costa; the postmedial closely followed by some black scaling forming a spot on costa; a fuscous shade from postmedial at vein 5 to termen, the apical space above this and from postmedial lilacine ocherous irrorated with gray and pale reddish brown; the space from close below vein 5 to inner margin beyond postmedial mottled lilacine ocherous and gray, crossed by a dentate subterminal line; an interrupted terminal black line; cilia light brown chequered with black. Hind wings fuscous brown; an interrupted terminal black line; cilia light brown with some fuscous spots. Wings below with medial and postmedial curved lines.

Expanse.—27 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23395, U.S.N.M.

EUTELIA CHROMATICA, new species.

Male.—Head, collar, and thorax lilacine brown, the collar with two fine transverse white lines. Abdomen lilacine brown with dorsal dark brown spots and tufts; a V-shaped white mark on basal half and white segmental lines on three basal segments; lateral gray patches at base, and lateral white spots at middle. Throat dark brown, also base of fore femora; fore and midtarsi white; hind tibiae and tarsi white with brown spots. Fore wings: An ocherous brown spot at base and a similar shade between cell and vein 1 to antemedial line, the costa and inner margin dark brown, crossed by an inbent subbasal white line; antemedial line partly double, the first line deeply outcurved, interrupted in cell, followed on costal margin by a broad white shade to middle of cell, where it narrows and is connected with reniform by a fine white line, and contains on costa three dark points; the second line apparent from middle of cell, inset on vein 1 toward the first line; median vein from middle of cell and veins 2-4 white to postmedial line; medial and postmedial space mostly brown shaded with red on costa and above vein 1, where there is also a white spot; inner margin medially cream color and red; a red streak below vein 7 at curve of postmedial line; reniform red, elongated, partly edged with white; postmedial line white, deeply outcurved from vein 7 and almost subterminal, preceded by a fine black line from vein 6 to inner margin; a white line expanding on costa starts above the origin of the postmedial and is oblique to vein 7, then dentate and wavy to vein 2, then continuing as a fuscous shade to inner margin; a subapical white line from costa to termen at vein 5, leaves a triangular reddish costal spot and an elongate terminal grayish brown spot from apex to vein 4; a terminal silvery white line with three small black spots between apex and vein 5; some white lines on veins and diagonally break the subterminal space between veins 7 and 4 into spots; terminal space from vein 4 to tornus fuscous brown broadest between veins 3 and 4 and inwardly edged with white; subterminally there is a broad ocherous shade from vein 3 to inner margin. Hind wings: Basal half white; outer half fuscous shaded with red at anal angle; a dentate whitish line from vein 3 to inner margin. Fore wings below white thickly shaded with fuscous, leaving a white streak on basal third of costa; the inner margin broadly white, and whitish shades on terminal third; a postmedial geminate black line, finely lunular beyond cell, and preceded between veins 6 and 8 by a roseate shade. Hind wings below white; a black spot at base of costa; a black discal point, termen broadly ocherous irrorated with brown, edged and crossed by finely wavy dark lines.

Expanse.—30 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23396, U.S.N.M.

CASANDRIA MYTHIAS, new species.

Male.—Palpi and head white; a fuscous line across vertex. Collar, and thorax white thinly irrorated with dark scales. Abdomen silvery white mottled with gray. Fore wings and cilia silvery white with fine black markings; a broken basal line; a lunular, outcurved, antemedial line, geminate below cell; a medial lunular line diverging at median and forming an irregular quadrate linear spot across cell, and not extending above the subcostal; an irregular postmedial line from costa to vein 3, followed by a black streak on costa; subterminal black spots or streaks on interspaces, the spot below vein 2 larger; terminal black spots. Hind wings whitish, semi-hyaline, the veins terminally fuscous; the termen shaded with fuscous brown. Wings below white; terminal half of fore wing shaded with fuscous; some fuscous shading terminally on hind wing.

Expanse.—21 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23397, U.S.N.M.

Allied to *C. abzeusalis* Walker.

SAFIA SINALOA, new species.

Male.—Palpi dark reddish mottled with whitish ocher in front, and less so laterally. Frons yellow brown. Vertex dark reddish brown. Collar and thorax fuscus brown, the tips of patagia broadly steel black. Abdomen above reddish brown with fuscous segmental lines, the basal segment steel black; laterally and underneath fuscous mottled with gray. Tarsi steel black with ocherous white rings. Fore wings: Basal third broadly very dark brown with blue scaling at base, and on submedian; a fine blue line antemedially, shaded on either side with fuscous brown; a basal and subbasal ocherous spot on costa, and a similar spot at origin of blue line; traces of a subbasal ocherous line; costa is steel black on basal third; medial and post medial space to subterminal line ocherous; two medial straight lines, reddish brown across cell, fuscous on costa and below cell, outbent and fainter on inner margin; reniform incurved, defined by grayish lines, inwardly shaded with reddish outwardly with white; the postmedial line starts from a conspicuous fuscous brown spot on costa, widest proximally and cut by a white line which is apparently the origin of the postmedial line, which is otherwise black, very fine, and interrupted, wavily down bent to vein 3, then upbent to reniform, wavily down bent, and faintly incurved to inner margin; from vein 7 a broad black line slightly sinuous extends to inner margin, followed below vein 5 by a dark red shade, deeply dentate between veins 3 and 5, and from vein 3 to inner margin it is followed by an ocherous line; termen shaded with fuscous from below vein 5 to inner margin; a broken lunular submarginal black line, and a terminal dark broken line; terminal space above vein 5 to apex shaded with brown. Hind wings mostly bright brown; a fuscous line on discocellular edged with whitish; a finely dentate fuscous medial line; a dark red postmedial line from vein 6 to inner margin above angle, followed by a red line, deeply dentate on veins 2–5; a black shade on costa close to apex; an ocherous shade on termen below apex; terminal space from below vein 6 to anal angle fuscous irrorated with blue; a submarginal dark red broken line; followed by red shading on interspaces; cilia with fuscous shading toward anal angle. Wings below pale ocherous irrorated with black; medial and postmedial fuscous lines; black streaks divided by a white line on discocellular; an interrupted submarginal black line; a very fine terminal line; fore wings heavily shaded with black above tornus; hind wings with a very broad subterminal black shade.

Expanse.—47 mm.

Habitat.—Venadio, Sinaloa, Mexico.

Type.—Cat. 23398, U.S.N.M.

Received from Mr. B. Preston Clark.

EULEPIDOTIS AGLAE, new species.

Male.—Head, collar, thorax, and two basal segments of abdomen reddish brown; abdomen otherwise dull brown above, underneath grayish brown. Fore wings reddish brown; three steel blue lines from costa to inner margin, the antemedial and medial parallel, the postmedial almost upright, the first followed by a fine wavy fuscous line, the second and third preceded by a fuscous line, the postmedial line more widely separated on costa than on inner margin; a subterminal silver line not reaching costa or inner margin; marginal black spots forming a line from vein 2 to tornus; cilia gray. Hind wings: The costal margin fuscous to vein 6, otherwise reddish brown except base; streaks above and below cell and inner margin which are luteous gray; a postmedial black line from veins 2–5 followed by metallic blue from below vein 2 to below vein 4, the blue followed by numerous fine black lines to a marginal silver line; marginal silver spots above and below vein 4. Fore wings below brown shaded with two transverse black fasciae suffusing above the whitish inner margin. Hind wings below grayish at base, reddish brown on outer half; a black postmedial line on costa; terminal silver shading from vein 5 to anal angle.

Expanse.—32 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23399, U.S.N.M.

EULEPIDOTIS PUNCTILINEA, new species.

Male.—Head, collar, and thorax green; palpi entirely green with three dark points in front. Abdomen green, the last segments orange. Body below white faintly tinged with green. Fore wings green, the lines very fine, brownish with darker points on veins; the lines terminating in yellowish points on costa finely edged with black; antemedial and medial line oblique and parallel, the postmedial slightly outcurved. Hind wings green except a large orange yellow space at apex, extending to vein 4, and similar streaks along inner margin and below cell to termen; a postmedial black streak from vein 5 to below vein 4, and a small black spot and white line at vein 2; cilia green tipped with brown at green portion of wing, otherwise orange. Wings below pale yellow green; some dark scales at lower end of cell on fore wing; terminal dark points on interspaces; cilia mostly brown.

Expanse.—33 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23400, U.S.N.M.

EULEPIDOTIS PHILOSIS, new species.

Male.—Head green; palpi white in front with transverse black lines or spots. Collar and thorax green. Abdomen green, the last segments orange. Body underneath white; fore coxae tinged with pale green; anal tuft orange. Fore wings green, the costa finely yellowish; the lines pale brown, widening on costa and there edged with black; the antemedial and medial lines outwardly oblique from costa and parallel; the postmedial almost upright; a black point on costa before apex; three black terminal points above veins 6, 7, 8; cilia green tipped with gray and brown. Hind wings: The apex and costal margin to near base orange; wing otherwise green, except an orange streak from near base below cell, expanding at anal angle, and uniting with an orange shade along inner margin; the green portion with a fine postmedial line terminating in a fuscous spot crossed by a gray line; an interrupted fine black terminal line, surmounted by three white points on green portion. Wings below pale yellow, the fore wings with medial and postmedial parallel brown lines, interrupted and not reaching below vein 2; hind wings tinged with pale green at base, and with a terminal dark brown line inwardly edged with white.

Expanse.—31 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23401, U.S.N.M.

THIACHROIA DEILINIAS, new species.

Male.—Palpi outwardly brown, inwardly white. Frons brown with lateral white lines. Vertex white with brown spots. Tegulae lilacine brown mottled with white. Thorax, abdomen, and wings creamy yellow; a few brown specks on abdomen. Body below white; brown irrorations on tibiae and tarsi. Fore wings: The costal margin and terminal third thinly irrorated with brown; lines fine, brown; an almost imperceptible wavy antemedial line; a medial and postmedial line outcurved on costa, then parallel and inbent; a black orbicular point; a fine oval line as reniform. Hind wings: A sub-basal and medial line; some brown irrorations on outer half; a fine broken terminal line on both wings; cilia brown tipped with white. Wings below white; fine antemedial and postmedial lines; some subterminal points; fore wings heavily dusted with gray except on inner margin.

Expanse.—30 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23402, U.S.N.M.

EUCLYSTIS SUBTREMULA, new species.

Female.—Palpi dull brown tipped and irrorated with white. Antennae with white points on shaft. Head, collar, thorax, and abdomen dull brown, the latter faintly tinged with gray; white lateral lines on frons. Wings dull brown strongly tinged with iridescent bluish lilacine, the lines fine, darker, wavy; medial and postmedial lines distinct, fainter subterminal geminate lines; marginal black points on interspaces; termen crenulate with a dark line. Fore wings: Apex acute, outer margin produced at vein 4; a basal and antemedial line edged with white on costa. Hind wings produced at vein 4. Body below paler. Wings below light ocherous brown irrorated with fuscous the markings fine, black, partly interrupted by veins; antemedial black points in cell; the spot on hind wing followed by a short black streak.

Expanse.—44 mm.

Habitat.—Chejel; Cayuga, Guatemala.

Type.—Cat. No. 23403, U.S.N.M.

Most Cayuga specimens have a black spot at postmedial line of forewing below vein 2.

EUCLYSTIS CAYUGA, new species.

Female.—Head, collar, and thorax fuscous brown; palpi tipped with white; shaft of antennae with white points; lateral white lines on frons. Abdomen fuscous tinged with gray. Wings fuscous brown tinged with purple, the termen crenulate and produced at vein 4; a fine darker medial line; postmedial line very irregular, partly edged outwardly with white scaling, forming a distinct white line on costa of fore wing; a fuscous subterminal shade outwardly edged with light brown; marginal dark spots edged outwardly with white. Fore wings: A basal and an antemedial line partly irrorated with white; a large reniform spot defined by whitish scaling; termen and cilia from vein 5 to apex thickly irrorated with white and crossed by a lunular dark line, which is hardly perceptible below vein 4. Hind wings: Fuscous marginal spots outwardly edged with white and preceded by patches of white irrorations below vein 2, and above veins 4 and 5. Wings below lighter brown; antemedial black points in cell; a medial fuscous shade; postmedial line, black, irregular, outwardly edged with bluish white and followed on hind wing with similar scaling; a postmedial black shade closely followed by a fuscous gray shade; marginal black points and a dark terminal line; on hind wing the points are preceded by bluish white scaling.

Expanse.—40 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23404, U.S.N.M.

EUCLYSTIS POLYOPERAS, new species.

Male.—Palpi dark gray with a terminal black circle and white tip. Body dark olive brown. Wings silky olive brown, the lines very fine, black. Fore wings: Apex acute, the outer margin oblique and sinuous; a basal line on costa; antemedial punctiform in cell and there preceded by another black point; medial line inbent below cell, and below submedian; reniform narrowing and outbent in front, partly defined by yellowish scaling; postmedial outcurved beyond cell very irregular; a subterminal black line from costa to vein 5, geminate between 6 and 5, the space beyond whitish roseate; below vein 5 the subterminal consists of geminate spots between veins 5 and 4, and 4 and 3, below which it forms a geminate line to inner margin; marginal dark points; some black scaling at apex; cilia mostly whitish roseate. Hind wings produced and angled at vein 4; medial line nearly straight; postmedial line very irregular; subterminal dentate, geminate; marginal black points; cilia white from apex to vein 4, then partly mottled with gray. Fore wings below dull grayish brown; an orbicular black point in cell; medial line black not reaching margins, followed by a fuscous shade from a white discocellular streak to vein 2; postmedial fine, black, outcurved, wavy, outwardly edged with white; an interrupted subterminal black line irrorated with white and followed by black spots on interspaces; marginal black points; termen from vein 5 to tornus whitish. Hind wings below grayish thickly irrorated with brown; a discocellular black streak, containing a brown line; medial fine, black, followed by a fuscous shade; postmedial as on fore wing, also subterminal spots; the termen broadly whitish.

Expanse.—57 mm.

Habitat.—Venezuela.

Type.—Cat. No. 23405, U.S.N.M.

EUCYLSTIS MNYRA, new species.

Female.—Palpi dark brown with some white irrorations. Antennae dark brown with contiguous white points along shaft. Head, collar, thorax, and basal tufts on abdomen dark brown; frons triangular, a white line edging its two frontal sides. Abdomen fuscous gray shading to brown according to light. Wings dark reddish brown tinged with purple. Fore wings with the apex acute, faintly falcate, the outer margin rounded; lines fine, slightly darker; basal and antemedial lines irregular, irrorated with white on costa, medial line more evenly curved; reniform faint, containing a few white scales; postmedial lunular and outcurved to vein 3, wavy below it; some outer dark spots and broad shading on costa; subterminal dark points on interspaces. Hind wings slightly angled at vein 4; faint antemedial and medial lines followed by some white irrorations; a subterminal dark shade from apex to anal angle followed by dark points on interspaces. Wings below light brown; medial and postmedial black wavy lines with a darker shade between them; black antemedial points in cell; faint subterminal shading and points on interspaces; cilia dark brown.

Expanse.—36 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23406, U.S.N.M.

Family SATURNIIDAE.

ROTHSCHILDIA MORANA, new species.

Male.—Frons roseate brown. Vertex brown. Collar white. Thorax cinnamon. Abdomen roseate brown; a transverse basal line and anus white; paired sublateral and ventral lines. Wings cinnamon. Fore wings with a deeply outcurved antemedial white line outwardly edged with black from costa to vein 3, and from vein 2 to inner margin, veins 2 and 3 being shortly streaked with white; a large triangular hyaline spot edged with white and fuscous, its outer angle interrupting the postmedial line; postmedial white inwardly edged with black, faintly incurved twice from costa to vein 5, well incurved above vein 2, and less so below it; a broad lilacine shade follows the line from vein 4 to inner margin, its outer edge dentate; a large roseate lilacine space on costa before apex cut by an irregular white line from costa to vein 6, and followed between veins 6 and 7 by a broken black spot; termen pale gray crossed by a fine subterminal black line, wavy more deeply incurved at middle of interspaces than at veins which are also black on termen. Hind wings: Two white lines from middle of costa, the inner line inbent to subcostal, then downbent to inner margin above tornus, both inwardly edged with black, the black forming a single line above vein 7; a large hyaline spot, almost oval, the side toward apex straight. The lilacine shading beyond postmedial more extended; fuscous brown streaks near anal angle; termen pale gray, the subterminal line wavy, preceded by small reddish spots toward apex, and black spots toward and at anal angle where they are much larger. Wings below similar but without any antemedial line.

Expanse.—118 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23407, U.S.N.M.

COPAXA SOPHRONIA, new species.

Male.—Palpi, head, and collar dark brown, the latter mottled with white hairs. Body olive bister with some brownish shading on thorax and the abdomen dorsally, chiefly toward base. Wings olive bister with a hyaline spot on discocellular surrounded by an orange annulus edged on either side with black. Fore wings: Costa to beyond middle dark brown mottled with white and reddish scaling; a dark antemedial line, outbent and angled on median vein, inangled below cell, outangled on submedian, preceded in cell by a dark shade; medial and postmedial space from veins 2–7 darker shaded, except the upper portion of cell; a dark postmedial shade from costa to vein 6, beyond which is a large paler space; a fine dark line from costa before apex, dentate to vein 2, then lunular to middle of inner margin, closely followed by a third brownish line from vein 7 to inner margin; termen darkly shaded from above vein 6 to apex, preceded on costa by a small white spot partly irrorated with black. Hind wings with the basal half slightly darker shaded; a dark medial line; a dentate postmedial dark shade, beyond it a fine deeply lunular dentate dark line, with short fuscous streaks in the proximal curves, and followed by coarse brownish lunules on interspaces. Wings below paler, grayer; a dark postmedial shade, vertical on fore wings, slightly curved on hind wings; hyaline spots outwardly edged with black and pale brown; a fine indistinct outer line with short black streaks on veins, and followed by a lunular brown shade, outwardly shaded with lilacine, chiefly on hind wings; fore wings with an antemedial dark line, toothed on costa, then outcurved and almost vertical to inner margin; hind wings with a black antemedial line, straight on costa, then forming two curves to inner margins.

Expanse.—115 mm.

Habitat.—Volcan de Santa Maria, Guatemala.

Type.—Cat. No. 23408, U.S.N.M.

COPAXA JOINVILLEA, new species.

Male.—Fore wing falcate. Antennae and thorax reddish brown. Collar gray. Abdomen ocherous brown tinged with pale red dorsally. Fore wings reddish brown, the veins black, limited by an inbent thick black line from costa near apex to inner margin at three-fourths from base, this line preceded by a fine wavy black line; base of cell and costal margin fuscous irrorated with white, the costa otherwise narrowly gray; a black antemedial line, outcurved in cell and containing a small yellow spot close to subcostal, below cell inset, wavy, very slightly curved; a round hyaline spot at discocellular edge by a double black line divided by yellow; terminal space pale bister brown irrorated with gray and white, the margin narrowly orange brown. Hind wings reddish brown at base with an antemedial thick black line; medial space duller, with a smaller ocellus than on fore wing; a deeply dentate postmedial black line inwardly edged with whitish followed by another parallel line, the space between them orange brown; terminal space as on fore wing. Underneath the wings are brown thickly irrorated with lilacine white to postmedial line, which is lunular on fore wing, more dentate on hind wing; the ocelli ringed with white; inner margin of fore wing clear orange brown; an antemedial incomplete black line; hind wing with a sinuous antemedial black line outwardly shaded with white, and some subterminal white shading towards anal angle.

Expanse.—93 mm.

Habitat.—Pirahy, Brazil.

Type.—Cat. No. 23409, U.S.N.M.

Allied to *C. canella* Walker, and looking very much like a small *C. simpson* Maassen.

ARSENURA UNDILINEA, new species.

Male.—Body dark gray. Fore wings to beyond cell pale gray with some brown irrorations; the long hairs at base of inner margin darker; an antemedial line, somewhat incurved but deeply outbent to middle of inner margin followed by a straighter light brown shade; a long curved yellow brown streak on discocellular, finely edged with dark brown; postmedial space to subterminal light grayish brown the subterminal parallel with margin, fuscous brown, lunular, followed by a lilacine gray space limited by a fine white line; termen narrowly olive brown, expanding from veins 4–7, with three prolonged dentate maroon lines on interspaces; an oblique black streak irrorated with white on costa before apex. Hind wings with the basal half dark gray with traces of a curved dark line from base to middle of inner margin; postmedial space darker than on fore wing; the subterminal line somewhat incurved from costa near apex to below vein 4, then angled and dentate to inner margin, followed by a gray shade its outer edge deeply lunular; termen olive brown; on both wings the subterminal line has whitish points on veins and is closely followed by a gray line darker than the lilacine gray space it crosses. Wings below dull brownish gray with darker straight postmedial brown shades followed by a similar shade, outangled on hind wing; a dark gray subterminal and similar marginal shade.

Expanse.—120 mm.

Habitat.—Avangarez, Costa Rica.

Type.—Cat. No. 23409, U.S.N.M.

Allied to *A. championi* Druce.

AUTOMERIS MACPHAILI, new species.

Male.—Body, collar, and thorax dark brown. Abdomen red. Body below red, the tarsi brownish. Fore wings pale brownish ocher; an indistinct pale yellowish antemedial line; a faint grayish shade about discocellular defined by some black points; a fine black postmedial line, faint from costa near apex to vein 7, then very distinct to inner margin; a faint pale subterminal shade from vein 5 to inner margin; cilia partly streaked with brown. Hind wings bright yellow to the postmedial line; base and inner margin along yellow space red; a large ocellus broadly circled with black, dark purplish gray becoming paler toward the inner black spot, the latter heavily marked with white; postmedial line evenly curved black, followed by a broader fuscous line; termen the same shade as fore wing. Wings below reddish; faint dark postmedial straight lines; a large spot on fore wing, gray, edged with black and containing a white point; a white point on discocellular of hind wing.

Expanse.—95 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23411, U.S.N.M.

Named after Doctor MacPhail, the popular and greatly loved head of the Quirigua Hospital, whose assistance enabled me to obtain many new species at Quirigua.

PHRICODIA JORGENSENI, new species.

Male.—Body black mottled thinly with yellow hairs. Antennae yellow. Wings mottled pale ocherous and brown. Fore wings: The base narrowly black; lines fine, black, minutely wavy; the antemedial slightly outcurved on costa, then vertical, the postmedial slightly outcurved on costa, then a little inbent; a small black spot on discocellular; termen somewhat paler, narrowly at apex, broadly opposite cell. Hind wings: A fine short black line on discocellular; a postmedial fuscous shade. Wings below evenly colored with only very faint dark lines on discocellulars.

Expanse—90 mm.

Habitat.—La Junta, Argentina.

Type.—Cat. No. 23412.

Received through the kindness of Don Pedro Jorgensen.

ORMISCODES PARALLELA, new species.

Male.—Palpi fuscous gray, the head, collar, and thorax a little paler. Abdomen above black with segmental orange lines. Fore wings ocherous gray, darkest on terminal third; cilia on inner margin and lines fuscous gray; antemedial and postmedial lines thick, parallel, the postmedial very indistinct and slightly curved on costal margin; a black discal point; an irregular subterminal, narrow, fuscous shade. Hind wings grayish brown suffused with fuscous; a broad, black postmedial line and indistinct subterminal shade; some ocherous scaling at base. Wings below brownish gray; fore wings with a faint fuscous shade from apex to inner margin at two-thirds from base; hind wings with a darker postmedial shade preceded by a broad whitish gray shade; a dark subterminal shade.

Expanse.—105 mm.

Habitat.—Joinville, southeastern Brazil.

Type.—Cat. No. 23415, U.S.N.M.

ORMISCODES PANAMENSIS, new species.

Female.—Head, body below, and base of abdomen reddish brown. Collar and thorax grayish purple. Abdomen above orange banded with black, partly concealed by the long yellow hairs. Fore wings grayish purple; a curved antemedial whitish lilacine shade, and a similar faintly sinuous postmedial shade; a fine black line on the oblique discocellulars; termen whitish lilacine, very narrowly so at apex and tornus. Hind wings whitish lilacine with some pale reddish shading at base; a broad subterminal grayish purple shade, leaving a shade before it and the termen more distinctly lilacine; cilia dark. Wings below brownish, the termen lilacine; a faintly paler postmedial shade; a broad darker subterminal shade on hind wings partly crossed by a pale shade.

Expanse.—98 mm.

Habitat.—Panama.

Type.—Cat. No. 23413, U.S.N.M.

ORMISCODES DENTIMACULATA, new species.

Male.—Palpi dark brown. Frons pale brown. Vertex, collar, and thorax dark brown with some ocherous white hairs. Abdomen above orange with transverse black bands. Body below ocherous, the legs dark brown. Fore wings pale ocherous, thickly irrorated with brown except on terminal space, before which there is a darker brown postmedial shade diffusely encroaching on the pale terminal space; medially on costa a large brown, triangular spot edged with black and then whitish; this spot is deeply indentate on the proximal side and has three short projecting lines on the distal side. Hind wings brownish with fuscous brown postmedial and subterminal shades, the space between the two lines also the termen ocherous thickly irrorated with brown. Wings below pale yellowish ocher with faint postmedial and subterminal fuscous shades.

Expanse.—80 mm.

Habitat.—Brazil.

Type.—Cat. No. 23414, U.S.N.M.

DIRPHIA NINFA, new species.

Male.—Palpi, head, and antennae orange brown. Collar and thorax fuscous brown with some white hairs laterally on patagia. Abdomen orange with black segmental lines above; no lateral line. Fore wings: Basal third of costa whitish streaked with gray, followed by a roseate white shade from middle of costa, oblique, curved to below vein 2 and suffusing with a similar shade adjoining the postmedial line from vein 5 to inner margin; a large dark brown space below cell from base to middle of inner margin, this dark space having its anterior edge somewhat rounded, its outer edge oblique, slightly inset on submedian vein; a small dark gray shade in end of cell, and a similar shade below discocellular; a broad dark brown streak at discocellular, edged with roseate white; a large grayish brown space on costa from above end of cell to postmedial line crossed by a fuscous shade from costa to vein 5; postmedial defined by the pale shading on inner side, and a broad fuscous brown shade on outer side expanding to tornus; a black brown spot on costa at apex, edged with whitish; termen mostly brown with a dentate subterminal pale roseate line from vein 5 to tornus; cilia brown with white spots at veins. Hind wings roseate, more deeply colored at base; a thick black medial line, preceded by a thick black streak on discocellular; a broad fuscous subterminal shade; the veins on outer half streaked with brown. Fore wings below pale roseate gray, the basal half shaded with ocherous; a fine dark line on discocellular and a distinct postmedial line. Hind wings below shaded with pale brown; a straight medial line; a dentate subterminal line.

Expanse.—52 mm.

Habitat.—Jalapa, Mexico.

Type.—Cat. No. 23417, U.S.N.M.

Closely allied to *D. rosea* Druce.

DIRPHIA TUSINA, new species.

Male.—Head and collar dark brown. Thorax and base of abdomen black-brown with a few yellowish hairs. Abdomen above orange with transverse black bands; a lateral black line, a sublateral white line with black points. Abdomen below deep rose color. Thorax below brown, the legs fuscous brown. Fore wings roseate brown; a black point on base of costa; a large fuscous brown space below cell from base to middle of inner margin limited by black lunules mottled with orange scales; two small lunules in cell; medial space more roseate; a large black spot somewhat triangular suffusing with the discocellular line; a black postmedial line outbent on costa, angled on vein 7, then slightly incurved to inner margin, consisting chiefly of thick lunules mottled with orange scales; a small brown shade on costa at apex. Hind wing purple red to postmedial line, paler beyond it and on termen; a large round black spot at and beyond cell, touching the postmedial line, which is broad and black; a broad subterminal fuscous shade. Wings below roseate; fore wings with the discocellular broadly black and a black postmedial line; hind wings with a straight dark medial line and a curved black line on discocellular.

Expanse.—61 mm.

Habitat.—Tuis, Costa Rica.

Type.—Cat. No. 23418, U.S.N.M.

Belongs to the *D. rosea* group.

DIRPHIA PLACIDA, new species.

Male.—Palpi black fringed with reddish brown. Frons reddish brown. Vertex, collar, and thorax dark brown. Abdomen above deep orange with black segmental lines; a lateral black line and a sublateral white line with black points. Body below orange, the legs dark brown; fore legs black fringed with white; hind tarsi white with black rings. Fore wings pale brownish gray; a large dark brown space on basal half of inner margin, its anterior edge straight below cell, its outer edge oblique edged by three black lunules; some smaller faint black lunules antemedially across cell; a large brown spot beyond cell inwardly edged by a black line on discocellular; a brown spot on costa at apex, irregularly triangular and edged with white; a straight broken black line from below the apical spot to inner margin, mostly lunular, but straight from vein 2 to inner margin; a faint subterminal whitish shade; cilia pale with dark brown spots at interspaces. Hind wings brownish, darkest along inner margin; a fuscous line and shade at discocellular; a black postmedial line; a fuscous brown subterminal shade; the space following the postmedial and termen paler; cilia with smaller brown spots. Wings below whitish ocherous, the veins brown; fore wings with a dark discocellular line and a fine straight postmedial line outcurved to apex; hind wings with a wavy dark postmedial line and an irregular postmedial line.

Expanse.—64 mm.

Habitat.—St. Jean, French Guiana.

Type.—Cat. No. 23419, U.S.N.M.

HYLESIA DYAREX, new species.

Male.—Head ocherous. Collar and thorax brown. Abdomen dark yellow. Fore wings whitish clay color at base, limited by a fine dark antemedial line which joins the postmedial on inner margin; a fuscous streak from base of cell to near middle of inner margin; beyond the antemedial line the space from vein 4 to termen and inner margin is slightly darker; the space above vein 4 to costa and termen dark purplish gray; the fine dark discocellular line broadly edged with whitish clay color. Hind wings whitish gray; a fine dark streak on discocellular; some dull yellowish scaling at base and along inner margin.

Expanse.—45 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23420, U.S.N.M.

The apex of fore wing produced and falcate.

HYLESIA TINTUREX, new species.

Male.—Palpi and frons brown. Thorax ocherous brown. Abdomen ocherous yellow. Thorax below and legs brownish gray, a small yellow tuft at base of fore tarsi. Wings dull roseate lilacine. Fore wings: A faint whitish antemedial line, vertical to median vein, slightly incurved and outbent below cell; a dark streak on discocellular; a postmedial dark line almost vertical; termen irregularly paler. Hind wings darker shaded along inner margin and on discocellular; a postmedial broad line and termen paler. Hind wings below with a broad dark medial line.

Expanse.—34 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23421, U.S.N.M.

Apex of fore wing not produced.

HYLESIA CHIREX, new species.

Male.—Frons reddish. Vertex reddish brown. Collar and thorax lilacine brown. Abdomen above thickly clothed with dark yellow hairs and with black segmental lines, underneath reddish brown. Tarsi cinnamon. Wings dull roseate lilacine with darker lines. Fore wings: An oblique medial line suffusing on inner margin with the vertical postmedial line, a dark line on discocellular; a wavy, faintly paler subterminal shade. Hind wings: A straight postmedial line, a faintly wavy darker postmedial shade. Wings below similar in color; fore wings with a darker postmedial shade and a subterminal dentate darker shade; hind wings with the postmedial line broader and from nearer apex; a straight subterminal shade.

Expanse.—40 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23422, U.S.N.M.

The apex of forewing slightly produced and rounded.

HYLESIA CROEX, new species.

Male.—Head and thorax dark gray. Abdomen brownish yellow above, underneath dark gray. Fore tibiae fringed with ocherous, the fore tarsi dark gray. Wings rather thinly scaled, dull gray, the lines whitish gray. Fore wings: Antemedial vertical, somewhat sinuous, postmedial broadest on costa faintly inbent from vein 6 to inner margin; a pale shade at apex; a similar shade outbent from vein 6 to termen at vein 3, then broadly along termen to tornus; a dark shade on discocellular. Hind wings: A broad postmedial line; the termen broadly pale; a small dark shade on discocellular.

Expanse.—35 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23423, U.S.N.M.

Apex of forewing not produced.

Family CERATOCAMPIDAE.

ADELOCEPHALA NETTIA, new species.

Male.—Head lilacine pink with pale yellow hairs at base of antennae. Collar and patagia lilacine gray, the thorax dorsally pale yellow. Abdomen above pale red. Body underneath whitish. Fore wings: Basal third of costa and cell purple, below cell and vein 2 lilacine, shading to whitish lilacine on inner margin, and termen; an orange spot in cell with dark striae preceded by a fuscous purple shade, and followed by a large round similar spot containing a white point; the costa above this spot reddish orange; from vein 4 to costa and apex a large triangular yellow space crossed by dark striae, the terminal lilacine space adjoining with its edge lunular; some fine, indistinct, fuscous striae on the lilacine portions of wing. Hind wings yellow; costal margin purplish red; a purplish red space below cell from base not reaching termen and leaving the inner margin narrowly yellow. Wings below pale yellow; fore wings with the costa brownish gray to near apex; purple shading at end of cell with a black spot on discocellular; termen above vein 3 broadly dull lilacine, narrowing to a point at apex.

Expanse.—52 mm.

Habitat.—Joinville, Southeastern Brazil.

Type.—Cat. No. 23416, U.S.N.M.

Family NOTODONTIDAE.

NYSTALEA SCARRA, new species.

Female.—Palpi ocherous gray irrorated with brown. Head and collar dull fuscous brown, with grayish tufts at base of antennae. Thorax whitish gray. Abdomen dull dark gray, the basal segment ocherous white with a dorsal black tuft tipped with whitish gray. Fore wings whitish gray; a black line at base below cell to subbasal fuscous brown line, which is geminate somewhat outbent from costa across cell, then single and inbent; costal margin broadly tinged with brown to antemedial, which is close to middle of wing; this line is fuscous brown, geminate, vertical, and sinuous to vein 2, then lunular to inner margin, the line starting from deep black spots on costa, the inner line with black points on veins; some short black streaks and points precede the line; some brownish shading on discocellular and some black scaling behind; an outcurved faint brown shade, darker on costa and with a black spot below vein 2; the veins beyond cell streaked with black to a geminate fine line close beyond postmedial; this line is fuscous brown, almost vertical, and is closely followed by a narrow brown shade; veins 3–6 with white and black points where crossed by this shade; a subterminal black spot between veins 4 and 5 and an interrupted short black line from vein 2 to tornus; a submarginal wavy brown line from vein 8 to vein 4; large terminal black spots on interspaces from veins 2–8; the termen broadly shaded with pale brown from vein 4 to costa. Hind wings gray brown; cilia white.

Expanse.—45 mm.

Habitat.—Cayuga, Guatemala..

Type.—Cat. No. 23441, U.S.N.M.

ANTIOPHA MODICA, new species.

Male.—Palpi fuscous brown, tipped with white. Frons black-brown with lateral whitish hairs. Vertex, collar, and thorax brownish mottled with roseate ocher hair. Abdomen above dull brown, the terminal segments mottled with white; underneath white. Fore wings whitish thickly irrorated with ocherous brown, the veins remaining finely white; lines fuscous, very indistinct; antemedial wavy, vertical, followed by a small indistinct fuscous spot close below subcostal; postmedial outcurved and inbent to submedian fold, then vertical; small terminal dark brown spots above and below vein 2. Hind wings dull brown. Fore wings below brown, paler on margins; cilia brown with white points at veins. Hind wings below brownish gray, the costa narrowly white.

Expanse.—40 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23437, U.S.N.M.

EUSTEMA OPACA, new species.

Male.—Head and legs fuscous brown. Collar ocherous yellow. Thorax dark purplish brown, mottled dorsally and posteriorly with ocherous yellow hairs. Abdomen dark purplish brown, the last segment, segmental lines on terminal half, and lateral tufts ocherous yellow. Wings dark purplish brown, the veins finely black. Fore wings with a darker shade beyond discocellular and a postmedial line slightly outbent and curved to vein 4, then slightly inbent to inner margin. Wings below silky gray brown, the veins finely black.

Expanse.—50 mm.

Habitat.—Nova Friburgo, Brazil.

Type.—Cat. No. 23453, U.S.N.M.

HIPPIA GRACITA, new species.

Male.—Antennae ciliated with short scaling above on basal half. Palpi brown irrorated with white. Head, collar, and thorax mottled dark brown and gray; patagia lichen gray. Abdomen above dull gray with a black dorsal shade at base; underneath whitish. Fore wings gray; costal margin to beyond middle shaded with brown, terminally broadly white, with pale grayish shading between veins 9–11 and above vein 11; an outcurved subbasal black line; antemedial geminate, fuscous, lunular; an oblique dark streak on discocellular and a white line from it anteriorly to the white costal space; postmedial defined by black points and faint lunules, also geminate, traceable only from vein 5, followed by black and white points and streaks on veins; a large triangular brown black shade below white portion of costa; a submarginal wavy dark brown line from vein 7 to vein 2, and black spots below vein 2; a lunular marginal line and a fine terminal line, both dark brown; two black subapical points on white costa; cilia mottled grayish brown and fuscous, a black shade on inner margin before antemedial line, and a small similar shade at cell between veins 2 and 3. Hind wings fuscous, the base and inner margin shaded with ocherous; cilia mostly white. Fore wings below gray, the margins whitish; marginal black spots on interspaces; a terminal black line. Hind wings below white, the termen faintly shaded with fuscous.

Expanse.—39 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23438, U.S.N.M.

PEROARA DISCOVATA, new species.

Male.—Palpi brown tipped with white. Head, collar, and thorax brownish gray, a whitish shade across collar; patagia with lateral white tufts. Fore wings thickly irrorated with dark grayish brown, darkest at base, a short white streak at base below cell; traces of an outcurved antemedial line, defined by a pale shade on proximal side; an oblique brown line on discocellular edged with white, more broadly below subcostal and acuminate toward apex; a fine postmedial line outwardly shaded with white, followed by dark brown streaks, broad and coalescing from vein 6 to costa, fine above veins 4 and 5; from vein 4 to inner margin irregular dark brown spots outwardly edged by the subterminal white line; above vein 4 to costa the white line is more extended, less linear; termen narrowly grayish brown with a white line preceding a terminal dark brown line cut by the white tips of veins; cilia ocherous tipped with white. Hind wings whitish, the veins and inner margin pale ocherous; the outer margin broadly fuscous gray. Wings below white, the costa of fore wing with some smoky shading.

Expanse.—37 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23440, U.S.N.M.

Very similar to *P. sylvestris* Schaus from French Guiana, but the genitalia are quite distinct. In *discovata* the anellus is larger with its lateral hooklike projections longer and stouter; the aedoeagus is stouter and the strongly chitinized projections from the costa of the harpes (elements of the transtilla) are much stouter, a trifle shorter and markedly though irregularly toothed. In *sylvestris* the latter are long, rather slender, and smooth. The entire genitalia is somewhat smaller and less robust in *sylvestris* than in discovata. Beautiful slides of the two species have been prepared by Mr. Carl Heinrich.

GOPHA ? PRAXIA, new species.

Male.—Antennae with long pectinations not reaching tips. Palpi long, obliquely ascending the third joint downbent, one-third the length of second joint, both deeply fringed below, chocolate brown. Head and collar dark brown mottled with white, the collar tipped with white. Thorax dark purple, the patagia fringed with brown and ocherous. Abdomen silky brown, the anal tuft and small dorsal tuft at base black-brown. Fore wings dark dull purple brown, with lighter brown shading on inner margin just above submedian antemedially, and postmedially at veins 2–4; a gray antemedial line edged with dark brown, wavy and somewhat interrupted, outbent to within cell, then inbent to inner margin; a white spot on discocellular, with a short white upbent line projecting from it proximally, followed by a fuscous brown spot with similar smaller spots above it in a line toward apex; postmedial white points on veins, which are also minutely irrorated with white to subterminal line; four white points on costa toward apex; subterminal dark brown lunules outwardly edged with white; a terminal dark line with white points on veins. Hind wings fuscous brown shaded with whitish toward base and on costal margin; a fuscous spot and a few white scales at anal angle. Fore wings below gray brown, the costa at base and inner margin whitish. Hind wings below white, the termen shaded with brown, widely at apex, rapidly diminishing to vein 3, then very narrow at angle.

Expanse.—25 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23439, U.S.N.M.

DICENTRIA CLARITA, new species.

Male.—Head and thorax below lilacine brown. Collar outwardly and patagia in front light brown; thorax and collar dorsally fuscous and dark brown, the patagia grayish behind, irrorated with black and brown. Abdomen above brown mottled at base with dark brown and black, anal segment ocherous white. Fore wings ocherous white; a fine brown line starting from a small antemedial spot on costa, deeply outbent, indentate in cell, interrupted above median, indicated by clusters of scales above and below submedian; an olive brown streak below cell from base to medial line, edged at base by a black line; the medial line also very fine, inangled below cell, and more deeply on submedian; a fine curved brown line at discocellular followed by a dark olive gray shade, narrowing and extending as a line below vein 5 to termen; a similar line above vein 5, a gray shade below vein 4 not reaching termen, vein 5 dark brown; veins 4, 6, and 7 white; gray streaks to termen above vein 6 and below vein 7; an outbent double postmedial fine brown line on costal margin; a double gray and fuscous postmedial lunule below vein 2, and above it an oblique black and gray line to termen above vein 3; black terminal streaks on veins 2 and 3; cilia on outer half of inner margin reddish brown; cilia on outer margin white, with fine dark streaks at veins 5 to 7, and black spots at other veins; brown shading on termen and cilia on interspaces from submedian to vein 4. Hind wings white with brown shading on costa and at anal angle. Wings below white; fore wings with brown shading on costa, the cilia with dark spots; hind wings with a brown spot on cilia at anal angle.

Expanse.—47 mm.

Habitat.—Nova Friburgo, Brazil.

Type.—Cat. No. 23450, U.S.N.M.

DISPHRAGIS BOCHICA, new species.

Male.—Palpi laterally black, in front brown with a few white scales. Head, collar, and thorax dark brown; some white scales on vertex and patagia; the collar edged with white behind; vertex suffused with black. Abdomen fuscous brown. Body below creamy white. Fore wings dark brown shaded with fuscous between the fine black basal and antemedial lines, the latter geminate with two superposed white points on the inner line; black shading at end of cell, and from cell to postmedial line between veins 2 and 6; a fine velvety black line on discocellular edged with light brown; the postmedial fine, black, lunular, outbent on costa with two superposed white points, closely followed by a fainter fuscous line marked by distinct white points on veins and a short white line on inner margin; an irregular row of subterminal fuscous spots; the veins beyond postmedial line black irrorated with white and ending in white terminal points on a terminal black line; cilia light brown with some fuscous mottling at veins. Hind wings fuscous, somewhat whitish gray in disk; costal margin light brown with some whitish irrorations; a black medial line on costa; a subterminal black line from costa to vein 6, outwardly edged with white. Fore wing below fuscous, the termen and inner margin whitish, the costa more narrowly so and with small black costal points beyond a faint black postmedial line. Hind wings below white, the costal margin with long white and brown cilia.

Expanse.—31 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23424, U.S.N.M.

Allied to *D. proba* Schaus.

DISPHRAGIS STARIA, new species.

Female.—Palpi fuscous brown, fringed with gray. Head mottled brown and gray. Collar and thorax light reddish brown with white shading laterally on patagia. Abdomen fuscous gray; a large black circular line on two last segments inclosing reddish scaling dorsally. Fore wings: The base white crossed by two reddish brown subbasal lines; antemedial space and cell dull steel gray; antemedial line geminate, black, broken in places, shaded with reddish brown on costa and filled in with the same color from cell to inner margin; a dark streak on discocellular inwardly edged with white; a reddish brown spot on costa above discocellular, and similar shading beyond cell, at base of veins 3 and 4 and streaks on veins 3 and 2; an oblique gray streak from cell below vein 2 to near tornus; postmedial geminate, black, outbent on costa, vertical opposite cell and filled in with reddish brown, incurved and lunular from vein 4 to inner margin, partly obsolescent; a large gray shade beyond postmedial from costa to vein 4, and a white shade between veins 4 and 3, and narrower gray shading from below vein 3; the gray space opposite cell is outwardly shaded with fuscous, with a lunular edging; termen whitish irrorated with reddish brown more thickly so toward apex and at tornus; the veins terminally white heavily irrorated with black; a terminal reddish brown line interrupted by veins; cilia white with black spots at veins. Hind wings fuscous gray; an interrupted terminal black line; cilia white with dark shading at veins. Wings below dark gray, the cilia as above.

Expanse.—45 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23444, U.S.N.M.

CHADISRA CHORISTA, new species.

Male.—Palpi brown, broadly fringed with white irrorated with brown. Frons dark brown with some white scaling. Vertex and collar cinnamon brown. Thorax and terminal segments of abdomen white thinly irrorated with black; base of abdomen whitish, medially fuscous gray; underneath white. Fore wings white irrorated with gray; brown spots along costal margin; an antemedial fine black line shaded on either side with white sinuous and almost vertical; a small spot in cell and a streak on discocellular white finely edged with gray; postmedial fine, black, almost vertical from vein 7 to vein 4, then slightly inbent, forming a lunule on each interspace, followed by some fuscous brown shading chiefly between veins 5 and 4, and from vein 3 to inner margin; the shading between veins 2 and 3 very broad and crossed by a horizontal black line; a subterminal whitish shade; a fine black marginal line, forming large lunules from vein 5 to tornus; cilia white spotted with gray brown at veins. Hind wings whitish at base, the termen broadly fuscous; cilia white shaded with black at anal angle. Fore wings below fuscous; inner margin white but not reaching tornus; outer margin white, broadly from vein 3 to tornus; costa reddish brown with white spots on distal half.

Expanse.—38 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23442, U.S.N.M.

NAPREPA PALLESCENS, new species.

Male.—Palpi and head dark brown irrorated with ocherous; collar and patagia whitish ocher, the thorax mottled posteriorly with dark brown. Abdomen whitish ocher with the anal hairs and broad transverse bands dorsally fuscous brown except on last segment. Fore wings whitish ocher; a sub-basal brown point on costa and one below cell; an antemedial point on costa; a small dark brown shade in cell followed by a small pale brown linear and egg shaped spot on discocellular; an outcurved pale brown line to vein 4, slightly outset on vein 4, then as a thick black line inbent to tuft on inner margin; a fine double lunular line beyond postmedial, vertical from costa to vein 3, then inbent and suffusing with the black line on inner margin; a black point before this line between veins 3 and 4; a pale lilacine shade above and below median vein expanding from below vein 2 to vein 4, extending beyond the lines below vein 2; a pale reddish brown shade above vein 4 to termen below costa, and similar shades on termen between veins 3 and 4, and subterminally below vein 3; an irregular submarginal dark line irrorated with black from vein 7 to vein 3; dark terminal points on either side of veins; cilia dark brown on interspaces. Hind wings suffused with dark brown, the costa whitish ocher, also the cilia; a black spot near inner margin above anal angle. Wings below whitish, the veins brown; an interrupted postmedial brown line; brown shading in cell, below, and beyond it on forewing; a brown line above anal angle on hind wing.

Expanse.—72 mm.

Habitat.—Joinville, Southeastern Brazil.

Type.—Cat. No. 23446, U.S.N.M.

HAPIGIA DOREMA, new species.

Male.—Palpi, legs, and abdomen below yellow brown. Head and collar dark purple brown with some white scales. Thorax and abdomen above dull yellow. Tarsi with white rings. Fore wings dull yellow; a fine sub-basal reddish line across costa and cell; a similar antemedial small spot on costa, a minute spot above median, and a larger spot above submedian; a fine lunular reddish line medially from cell to inner margin, where it is preceded by a fuscous spot; postmedial line fine, straight, inbent from vein 8 to below vein 2, then down bent, reddish, narrowly edged on inner side with white, and crossing a broad reddish shade from vein 2 to inner margin, also followed by some faint grayish shades; terminal space finely irrorated with red; subterminal dark streaks obliquely outbent from black points below veins; costa finely dark reddish; a round silver spot in cell, followed by a much larger silver spot around discocellular, containing some irregular fine red lines; some gray and white shading at apex preceded by a silver lunule between veins 7 and 8, a small spot above it, and a still smaller one just below vein 7. Hind wings white. Wings below white the cilia of forewing reddish brown.

Expanse.—63 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23443, U.S.N.M.

Family LIMACODIDAE.

PEROLA JORGENSENI, new species.

Male.—Palpi gray, shaded with fuscous in front. Head and collar light reddish brown. Thorax brownish clay color, the patagia tipped with reddish brown and gray. Abdomen with dorsal light reddish brown tufts. Fore wings brownish clay color tinged with lilacine and somewhat irridescent; a few scattered black irrorations, forming a small subterminal spot on vein 3; two postmedial, parallel fuscous lines slightly outcurved on costa, then slightly inbent to inner margin, and with fine black lines on veins. Hind wings luteous with a few scattered dark irrorations. Wings below luteous.

Expanse.—20 mm.

Habitat.—Formosa, Argentina.

Type.—Cat. No. 23425, U.S.N.M.

Received from Don Pedro Jorgensen.

Family COSSIDAE.

HEMIPECTRONA, new name.

New name for *Hemipecten* Dyar (Proc. U. S. Nat. Mus., vol. 29, 1905, p. 177) not Adams Reeves (1848)

HEMIPECTRONA JULIUS, new species.

Male.—Body and fore wings creamy white; tufts on vertex mottled with light brown and fuscous; a pale brown patch on patagia anteriorly; pale brown irrorations on thorax and abdomen dorsally. Fore wings long, the outer margin very oblique, the tornus rounded; grayish brown shading on costal and outer margins; a similar streak along vein 8 terminally; a broader shade from vein 7 terminally to vein 2; the inner margin broadly shaded with whitish ocher; medially in cell a large dark cinnamon brown spot, inwardly edged by a black line, its anterior edge rounded and broad, its posterior edge on outer side incurved and descending below cell, its proximal edge less incurved, making the spot greatly constricted behind and terminating in a slight knob. Hind wings white, the fore wings below with traces of the inbent lines from termen below apex.

Expanse.—50 mm.

Habitat.—Nova Friburgo, Brazil.

Type.—Cat. No. 23448, U.S.N.M.

HEMIPECTRONA VINNEA, new species.

Male.—Body and fore wings creamy white; some pale brown mottling on vertex, collar, and thorax. Fore wings crossed by short and indistinct pale brown lines; a large round fuscous brown spot in cell; a small vertical streak below cell before middle; a short horizontal dark brown streak above inner margin antemedially; costal margin medially shaded with gray, beyond it shaded with brown; a postmedial gray line from vein 6 inbent and narrowing to submedian; finer marginal gray lines from vein 6 to near tornus at termen, and from vein 7 to vein 2. Hind wings white. Wings below white; fore wings with a large grayish spot irrorated behind with dark brown; costal margin striated with gray; traces of lines on terminal space.

Expanse.—37 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23449, U.S.N.M.

GIVIRA GNOMA, new species.

Male.—Head, collar, and thorax whitish gray. Abdomen dark gray. Basal half of inner margin from below cell dark chocolate brown, its outer edge oblique edged with white; space above it and beyond it roseate gray; some black points along costal margin; an oblique chocolate brown fascia from costa across discocellular to vein 4, somewhat constricted below subcostal vein; a broad postmedial brown shade, vertical from costa, outbent to tornus below vein 2; terminal space above vein 2 pale gray, shading to white along margin; a few dark gray striae on outer half of wing. Hind wings pale gray with some darker striae, and a dark shade medially below costa.

Expanse.—34 mm.

Habitat.—Joinville, Southeastern Brazil.

Type.—Cat. No. 23447, U.S.N.M.

Allied to *G. quadra* Schaus, which has a dark discal point and no oblique fascia from costa.

GIVIRA GUATA, new species.

Male.—Body lilacine brown, the collar darker with a fuscous shade in front; abdomen with faint fuscous segmental lines. Fore wings pale lilacine brown, slightly paler before an oblique brown shade from the middle of costal margin to tornus; irregular transverse streaks between the veins, those below cell continuous to inner margin; the streaks very faint on costa. Hind wings pale brownish gray with slightly darker lines from costa to vein 2; inner margin broadly shaded with grayish brown, the lines hardly visible. Wings below almost the same; no oblique shade on fore wing; hind wings without darker shading on inner margin but a black streak along costa.

Expanse.—36 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23426, U.S.N.M.

GIVIRA MODISMA, new species.

Male.—Palpi and frons light brown, vertex fuscous brown, collar and thorax purple brown, all mottled with whitish hairs. Abdomen dorsally mottled red brown and yellowish, laterally dull gray, ventrally as above. Tibiae and tarsi with numerous dark rings. Fore wings purple brown, shading outwardly to dull purple, crossed by numerous fine broken lines of dull fuscous; costa somewhat paler with dark brown spots; inner margin narrowly fuscous gray; cilia pale at base, followed by a fine brown line, the tips mottled. Hind wings whitish yellow; veins and a few irrorations, pale brown; a dark streak from base below cell, expanding into a triangular fuscous space from vein 2 to anal angle terminally. Fore wings below brown, the costa with yellowish irrorations between the numerous brown spots. Hind wings below yellowish white with some fine pale irrorations chiefly on veins; dark brown streaks on costal margin.

Expanse.—38 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23427, U.S.N.M.

LENTAGENA PERFIDA, new species.

Male.—Palpi, head, collar, and thorax white, thickly mottled with reddish brown; the collar behind and patagia dorsally edged with fuscous brown. Abdomen whitish with fuscous segmental lines, and paired dorsal brown tufts on second and third segments; laterally with a few dark scales; ventrally with dark brown spots largest toward base. Fore wings: Costal margin pale brown with large fuscous spots edged with white; base brown, broken into spots by a white subbasal line and veins; a broad white antemedial shade evenly outcurved; a dark gray streak in cell medially below subcostal; inner margin white, mottled with brown and crossed by fuscous striae; postmedial space mostly gray, crossed by thick fuscous brown striae; a white and yellow streak on discocellular; veins from cell yellow brown; terminal space mottled gray and brown with some white mottling near termen; a subterminal, very irregular, dull brown line edged with fuscous from vein 8 to inner margin, widest between veins 4 and 5 and veins 6 and 8; cilia dark brown with white spots at middle of interspaces. Hind wings smoky gray with faint darker striae; a white shade at base, and terminally before anal angle. Fore wings below mostly smoky gray, with darker striae and spots; costal margin white with numerous dark spots; termen mottled with white. Hind wings below white with numerous dark spots and thick striae, the latter suffusing somewhat postmedially, forming round white spots; a dark gray shade below cell.

Expanse.—29 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23428, U.S.N.M.

LENTAGENA EURECA, new species.

Male.—Palpi and throat fuscous brown. Frons dark gray, shading to dark brown on vertex. Collar whitish gray, shaded with fuscous in front. Thorax whitish gray, shaded with darker gray. Abdomen above dark gray, paler terminally, with fine fuscous segmental lines. Fore wings silky, grayish white, with some dark brown striae except on extreme costa; inner margin shaded with brown; a velvety dark brown spot from vein 2 to submedian, its inner edge straight, its outer edge rounded; from this spot to apex a fuscous gray shade expanding toward apex. Hind wings fuscous gray. Wings below fuscous gray, the inner margin of fore wings whitish with dark striae.

Expanse.—43 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23429, U.S.N.M.

LENTAGENA OPHELIA, new species.

Male.—Head, collar, and thorax white with brown irrorations. Abdomen whitish. Fore wings white with grayish transverse striae; inner margin with a few brown irrorations; a tringular fuscous brown spot on base of costal margin, not reaching the submedian, the longest side along costa, the shortest on basal side; a dark spot on discocellular, and a streak above it along costa. Hind wings white. Fore wings below without the basal spot. Hind wings below with a faint brownish shade from costa across discocellular.

Expanse.—35 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23430, U.S.N.M.

PHILANGLAUS BEATRIX, new species.

Male.—Palpi fuscous. Head, collar, and thorax white with some pale brown mottling. Abdomen dull gray; two dorsal dark spots near base. Fore wings white at base, limited by an oblique black line from costa to submedian, and a finer outbent line from inner margin; wing otherwise white tinged with ocherous, crossed by fine fuscous brown striae; a dark oblique line from costa near apex to vein 6, where it is outbent and bifurcated on termen; darker streaks between veins 3 and 5 uniting the transverse striae. Hind wings whitish gray with faint darker striae. Fore wings below grayer with only the subapical streak and terminal striae.

Expanse.—34 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23431, U.S.N.M.

HYPOPTA VASSILIA, new species.

Male.—Palpi brown with pale tips. Head gray, mottled with a few brown hairs. Collar and thorax brownish roseate, mottled with white hairs. Abdomen above paler than thorax except a large dorsal tuft near base and segmental lines; underneath whitish. Thorax below and legs pale gray. Fore wings: Veins and cilia on inner margin whitish, especially veins 2 and 3, and median at end of cell, the space between these two veins pale gray with some dark brown spots; costa fuscous cut by white lines into elongated spots; space below cell and vein 2 brown, curved white lines forming two large spots above submedian, the inner margin being broken into small spots; above vein 3 the wing is dark gray, with three large brown spots, one beyond cell edged by an outcurved white line, which crosses it near base of veins 3–5, a second spot subterminally from above vein 3 to vein 5, almost round in shape, and the third from above vein 5 to just above vein 8; some terminal dark spots inwardly edged by an almost continuous white line. Hind wings fuscous, showing the terminal dark spot and postmedial fascia of the underside. Wings below fuscous gray, the fore wing showing the subterminal spots and marginal white line; the hind wing with a broad white shade below costa.

Expanse.—30 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23432, U.S.N.M.

HYPOPTA DELICATA, new species.

Male.—Palpi brown. Body gray with some brown shading on costa behind; a triangular fuscous gray shade on abdomen near base. Fore wings white tinged with gray below cell and on outer third; dark points between costal and subcostal veins, except at base and terminally; inner margin tinged with brownish yellow to just beyond middle, where there is a short brown streak above submedian and one below vein 2; some brown streaks on inner margin; paired terminal brown spots edged with white at veins. Hind wings white;

grayish spots at veins terminally extending on cilia. Fore wings below dark gray; cilia white on interspaces.

Expanse.—28 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23433, U.S.N.M.

HYPOPTA CLYMENE, new species.

Male.—Palpi and throat dark brown. Head and collar gray. Thorax whitish gray in front, otherwise shaded with brown and with fuscous brown streaks on patagia dorsally. Abdomen dull gray with fuscous segmental lines interrupted dorsally. Body below bone color. Fore wings: Costal margin pale buff with some black striae; base and medial space below cell to inner margin brown, with some fuscous lines on inner margin; a larger subbasal black spot on costa; an antemedial spot expanding on subcostal, somewhat interrupted in cell and forming a quadrate fuscous brown spot below cell; cell medially white; a postmedial fuscous brown narrow fascia, faintly inbent and expanding obliquely below vein 2, then very narrow on inner margin, outwardly shaded with white from below vein 3; outer third of wing slate gray between veins 2 and 4 crossed by some fuscous brown lines; above vein 4 the wing is pale buff, shading to white on termen; a subapical narrow fuscous fascia bifurcated on costa by a white spot; apex bister; some terminal dark streaks above veins 2, 3, 4. Hind wings dark gray, the costa whitish; markings of underside faintly discernible. Fore wings below cream color; the postmedial line not extending below vein 2; the subapical streak as above. Hind wings below white with dark striae; heavier striae on costal margin; terminal dark spots.

Expanse.—40 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23434, U.S.N.M.

HYPOPTA ALBIPUNCTA, new species.

Male.—Palpi brown. Frons whitish gray. Vertex, collar, and thorax roseate brown thickly mottled with white hairs. Abdomen roseate brown, the dorsum broadly gray to just beyond middle. Thorax below whitish gray, the fore legs pale brown outwardly edged with white. Fore wings pale brown, shading to whitish gray on terminal third; faint traces of darker striae; the inner margin fringed with white; a white spot at end of cell; paired dark points at tips of veins. Hind wings whitish gray, darker on margins; the striae very faint. Fore wings below brownish gray with faint traces of striae; inner margin white. Hind wings below white; dark spots on costa and terminally at veins.

Expanse.—25 mm.

Habitat.—Quirigua, Guatemala.

Type.—Cat. No. 23435, U.S.N.M.

COSSULA OMAIA, new species.

Male.—Palpi brown laterally, white in front. Head, collar, and shoulders white. Thorax purple brown. Abdomen above fuscous, the two last segments and venter white. Fore wings dark purple brown, shaded with reddish brown on inner margin, and with faint darker striae; some white scaling on costal margin; a fine black line from subcostal across middle of cell to submedian; some whitish scaling on either side of discocellular; a large terminal space from veins 2–8 olive gray, preceded by some white shading crossed by fine wavy brown lines, and a vertical black line from veins 3–5 ending in black points; on the olive gray space are some horizontal black brown markings; a streak along upper side of vein 2, expanding on termen; an irregular streak along vein 4, expanding on termen to vein 5; an irregular subterminal shade between veins 5 and 7. Hind wings fuscous brown. Underneath the margins of wings are broadly whitish. The wings are long and narrow, the termen very oblique.

Expanse.—70 mm.

Habitat.—Omai, British Guiana.

Type.—Cat. No. 23436, U.S.N.M.

DESCRIPTION OF FERROANTHOPHYLLITE, AN ORTHORHOMBIC IRON AMPHIBOLE FROM IDAHO, WITH A NOTE ON THE NOMENCLATURE OF THE ANTHOPHYLLITE GROUP.

By Earl V. Shannon,

Assistant Curator, Department of Geology, United States National Museum.

INTRODUCTION.

In the summer of 1919 Mr. Frank Barker, of Kellogg, Idaho, sent to the United States National Museum for identification a lot of an asbestiform mineral which he had found in the Tamarack-Custer mine near Gem, in the Coeur d'Alene district. This material has been investigated and found to be an orthorhombic amphibole similar in properties to anthophyllite but practically free from magnesium. For this iron end member of the anthophyllite group the name *ferroanthophyllite* is here proposed. Requests for additional specimens of the amphibole and associated minerals and for detailed notes regarding the occurrence have elicited no reply from Mr. Barker. The type material is preserved in the United States National Museum (Cat. No. 93998).

OCCURRENCE.

The only facts regarding the occurrence of this interesting mineral which are available are the statement in the letter accompanying the material that it came from the mine and the fact that galena is intergrown with the amphibole in the specimens received. The latter circumstance apparently proves that the mineral occurred in the ore of a galena-bearing vein. While the Tamarack-Custer mine is located no great distance from the contact of an intrusive mass of quartz-monzonite and several dikes of quartz-monzonite porphyry are cut by the workings of the mine, the inclosing rocks are relatively unaltered quartzites in which metamorphic silicates in megascopically visible aggregates have nowhere been found. The occurrence of considerable masses of a fibrous amphibole intergrown with galena in the vein is therefore decidedly unusual. Ransome [1] found a similar asbestiform mineral intergrown with galena in the ore of the

[1] Ransome, F. L., and Calkins, F. C., Geology and Ore Deposits of the Coeur d'Alene District, Idaho: U. S. Geol. Survey, Prof. Paper 62, p. 99, 1908.

Hercules mine in the same district. This mineral, which was in amount too small for analysis, had in general the properties of anthophyllite. Determination of refractive indices made by the writer on the material of Ransome's original specimen which is preserved in the United States National Museum (Cat. No. 77071–91) indicate that this also is the iron amphibole entirely similar to that from the Tamarack-Custer mine.

DESCRIPTION.

The material as received consists of splintery-fibrous masses of a pale grayish-green color when dry and olive green when moist. In all, about 250 grams of the mineral were received. The individual fibers reach a maximum length of 6 centimeters. The material separates readily into very fine silky fibers, which are quite strong and flexible, being comparable to a poor quality of chrysotile, which the material greatly resembles. The true hardness of the mineral could not be determined as its fine fibrous structure renders it too weak to scratch any mineral harder than calcite. The specific gravity as determined on the Kraus modified Joly balance on pieces, probably not entirely free from included air, is 3.24 (mean of 5 determinations). The only associated mineral is fine granular galena, which occurs as minute veinlets cutting across the fibers, as thin fillings between the fibers, and as small nodules around which the fibers are curved.

OPTICAL PROPERTIES.

Under the microscope the ferroanthophyllite is seen to consist of aggregates of exceedingly fine fibers, which singly appear colorless and transparent. Aggregates of a number of fibers show the green color and pleochroism of the mineral. The extinction is in all cases exactly parallel to the edges of the fibers. No regular terminations could be seen nor could the shape of cross section of the fibers be determined owing to their extreme thinness. The elongation is positive, as in anthophyllite, while the birefringence is slightly lower than that of anthophyllite. The indices of refraction and the birefringence as determined by immersion are as follows:

$$\alpha=1.668\pm.003$$
$$\gamma=1.685\pm.003$$
$$\gamma-\alpha=.017\pm.003$$

The pleochroism is distinct in the aggregated fibers, as follows:

α=pale brownish green.
γ=deep brownish green.

Since the fibers are exceedingly minute and adjacent fibers are not in parallel position, the optic axial angle and the intermediate value for refractive index (β) could not be accurately determined although the axial angle ($2V$) is apparently moderately large.

CHEMICAL PROPERTIES.

An analysis made upon selected fibrous material, which optical study had shown to be pure, yielded the following results:

Analysis of ferroanthophyllite from Idaho.

Silica (SiO_2)	49.30
Alumina (Al_2O_3)	1.30
Ferric oxide (Fe_2O_3)	2.15
Ferrous oxide (FeO)	30.50
Manganous oxide (MnO)	3.48
Lime (CaO)	10.73
Magnesia (MgO)	.66
Water (H_2O) below 110° C	.18
Water (H_2O) above 110° C	2.13
Total	100.43

The above analysis yields the following ratios:

Ratios of ferroanthophyllite from Idaho.

SiO_2	0.8176	8176
Al_2O_3	.0127	262
Fe_2O_3	.0135	
FeO	.4246	7996
MnO	.0491	
CaO	.1913	
MgO	.0164	
H_2O	.1182	

For the sake of simplifying consideration of the ratios, the ferric oxide and alumina may be deducted as the gedrite molecule, $RO.R_2O_3.SiO_2$ ($\times 262$), the ratios remaining after this deduction being:

RO	7734	1×1.00
SiO_2	7914	1×1.02

The formula thus derived for the mineral is:

$$(Fe,Ca,H_2,Mn)O.\quad SiO_2$$

or $RSiO_3$ with $R=Mn:Ca:H_2:Fe=2:8:5:17$ approximately.

It will be noted that the water given off above 110° C. is here included among the bases as an essential constituent, although present views as to the occurrence of water in minerals hold that it is quite possible for such an amount of water to be mechanically held through adsorption by a mineral of this kind. In the present case the analysis requires that the water be considered basic in order that the composition of the mineral may be expressed as that of a normal metasilicate. It seems more plausible here to regard the water as constitutional than to reject it as extraneous and leave the analysis with an excess of silica which can not be otherwise accounted for Water is frequently considered to be a basic constituent of amphiboles.

PYROGNOSTICS.

Before the blowpipe the mineral fuses at a moderately high temperature to a black strongly magnetic slag. In the borax bead it reacts for iron and when fused with a large excess of sodium carbonate it reacts for manganese. It yields a small amount of water at a high temperature in the closed tube and is insoluble in acids.

NOMENCLATURE.

The above chemical and optical descriptions indicate that this asbestiform material from Idaho is an orthorhombic amphibole very similar in properties to anthophyllite yet practically free from magnesia, being in fact essentially an iron end member of the anthophyllite group despite the fact that the iron is replaced to some extent by calcium, manganese, and basic hydrogen. Search of the literature has revealed two previously described occurrences of practically pure orthorhombic amphiboles of the same sort. C. H. Warren [2] in 1903 described such a mineral, an orthorhombic pure iron metasilicate resembling anthophyllite, occurring as reaction rims surrounding inclusions of fayalite in pegmatite in the granite of Cape Ann, Massachusetts. No quantitative analysis of this material was made, but a qualitative analysis established the practical absence of alumina and magnesia. While recognizing the fact that an entirely new and distinct member of the anthophyllite group was here represented, the author did not give the mineral a distinctive name, but referred to it as anthophyllite, doubtless because enough of the mineral had not been separated for a quantitative analysis. Palmgren[3] in 1917 found a similar amphibole in the eulysite of Soedermanland, Sweden, which upon analysis gave the following results:

Analysis of orthorhombic amphibole from Sweden.

Silica (SiO_2)	47.46
Titanium dioxide (TiO_2)	.03
Alumina (Al_2O_3)	.14
Ferric oxide (Fe_2O_3)	.34
Ferrous oxide (FeO)	42.23
Manganous oxide (MnO)	3.88
Magnesia (MgO)	5.05
Lime (CaO)	1.05
Water (H_2O)	.07
Total	100.25

Palmgren also emphasizes the fact that this amphibole is distinct from anthophyllite, but, following Warren, whom he cites, he uses

[2] Warren, C. H., Anthophyllite with the fayalite from Rockport, Mass., Amer. Journ. Sci., vol. 16, p 339-340, 1903.

[3] Palmgren, John, Bull. Geol. Inst. Univ. Upsala, vol. 14, p. 133, 1917.

the name eisenanthophyllite, which becomes iron anthophyllite in English. The present writer prefers the form ferroanthophyllite as the name for the iron end member of the anthophyllite group despite the fact that the magnesium end member of the series will then require the rather unwieldy name magnesioanthophyllite. This nomenclature is in accord with that recently used by American mineralogists to designate end members of isomorphous groups.[4] The group name anthophyllite will then indicate intermediate mixtures of the two end members of the series, while the name gedrite will continue to indicate important admixture of the aluminous molecule. The possibility of occurrence of lime and of manganous members of this series is remotely indicated.

---

[4] See Wherry, E. T. (Bariohitchcockite, strontiohitchcockite, etc.), Proc. U. S. Nat. Mus., vol. 51, p. 83, 1916; Schaller, W. T. (magnesioludwigite, ferroludwigite), Journ. Wash. Acad. Sci., vol. 7, p. 29, 1917, and (manganoaxinite, ferroaxinite, etc.), Bull. U. S. Geol. Survey No. 490, p. 47, 1911.

SOME NOTES ON WASPS OF THE SUBFAMILY NYSSONINAE, WITH DESCRIPTIONS OF NEW SPECIES.

By S. A. Rohwer,

Custodian of Hymenoptera, United States National Museum.

This paper contains, besides the descriptions of a few new species, notes on some of the genera of the wasps of the subfamily Nyssoninae. In the definition of the subfamily the characterization given in the classification presented in the Hymenoptera of Connecticut[1] has been followed. The treatment here suggested differs, however, from that published in 1916 in that it places the Spheciini in the subfamily Nyssoninae. The thoracic characters of this group, as well as the venation, indicate that the genus *Sphecius* is more closely allied to other members of the subfamily Nyssoninae than to those of the subfamily Stizinae, where it was placed in the Connecticut Hymenoptera. Why this error in the placing of the genus *Sphecius* was made is hard to explain, but on the face of it one would be justified in saying the author neglected to study the insect and just blindly followed previous "systems."

In some few members of this subfamily the defining suture or carina of the prepectus is feeble, and while it is impossible to say that the use of this character will be entirely reliable, the groupings obtained by it are on the whole natural and deserving of further study. In *Ammatomus* Spinola the prepectus is practically wanting yet it is evidently a member of the tribe Gorytini. In *Trichiogorytes* Rohwer the dorsal part of the prepectal suture is obliterated and because of the presence of a suture below the tubercle it seems to be present between the tubercle and tegula. The rest of the body is typically that of the tribe Gorytini, where it undoubtedly belongs.

Besides the character of the prepectus members of this subfamily have the following characters in common: Basal vein joining the subcosta close to the stigma (not its length or more basad as in the Bembecidae); basal lobe of the hind wings small; middle tibia with two calcaria; intermediate coxae well separated.

[1] Bull. 22, Conn. Geol. and Nat. Hist. Survey, 1916, p. 653.

Key to tribes of subfamily Nyssoninae.

1. Mesopleura without a dorsal plate; propodeum with its dorsal angles dentate; second cubital cell petiolate (or rarely wanting by absence of first intercubitus); stigma small . . . . **Nyssonini.**
   Mesopleura with a dorsal plate (poorly defined in *Ammatomus* and present only posteriorly in *Sphecius*); dorsal angles of propodeum not dentate . . . . 2.
2. Pronotum long, subequal in length with the scutellum; suture between the meso- and meta-pleura angulate so the metapleura is wider above; second cubital cell periolate; stigma large . . . . **Alysonini.**
   Pronotum short, normal; suture between the meso- and mata-pleura straight so that part of the metapleura is nearly parallel sided; second cubital cell sessile . . 3.
3. Stigma very small; no suture from below tegula to prepectus; sternauli wanting . . . . **Spheciini.**
   Stigma large, well developed . . . . 4.
4. Sternauli well defined . . . . **Hoplisini.**
   Sternauli wanting . . . . **Gorytini.**

Tribe NYSSONINI.

Genus NYSSON Latreille.

For the time being, and until the species from other regions can be studied, it seems best to consider the various North American groups of Nyssonini as subgenera. That this will be the final or more logical arrangement is, however, to be doubted, because the differences between *Zanysson* and *Nysson* are of greater importance than the differences between *Nysson* and *Brachystegus*. The subgenus *Foxia* is also distinctly limited and may be a genus.

Key to the North American Subgenera of Nysson.

1. Metanotum bilobed; hind tibiae serrate on their outer margin; cubitella arising well beyond end of anallen cell; apical tergite of male usually with four or more teeth . . . . **Zanysson**, new subgenus.
   Metanotum not bilobed . . . . 2.
2. Hind tibiae serrate on their outer margins; first intercubitus wanting; both recurrents joining the first cubical cell . . . . **Metanysson** Ashmead.
   Hind tibiae not serrate on their outer margins, at most spinose . . . . 3.
3. Second recurrent joining the third cubital cell; sides of apical tergites armed with spinelike protuberances; cubitella arising well beyond the end of anallen cell . . . . **Foxia** Ashmead.
   Both recurrents joining the second cubital cell; apical tergites without spinelike protuberances . . . . 4.
4. Cubitella arising before or nearly interstitial with nervellus . . . . . **Nysson** Latreille.
   Cubitella arising far beyond nervellus . . . . 5.
5. Third intercubitus present . . . . **Brachystegus** A. Costa.
   Third intercubitus wanting . . . . **Hyponysson** Cresson.

ZANYSSON, new subgenus.

Paranysson Cresson, Trans. Amer. Ent. Soc., vol. 9, 1882, p. 273.—Ashmead, Can. Ent., vol. 31, 1899, p. 326 (not Guérin 1844 or Turner 1914).

Genotype.—*Nysson texanus* Cresson.

According to Turner[2] both Cresson and Ashmead were wrong in placing the North American species of *Nysson* which have the meta-

[2] Ann. Mag. Nat. Hist., ser. 8, vol. 14, 1914, p. 338.

notum bilobed in the genus *Paranysson* Guérin. Turner considers Guérin's genus to be the same as *Heliorygctes* Smith and makes it the type genus of a subfamily containing *Zoyphium* Kohl, *Sericophorus* Smith, and *Sphodrotes* Kohl. The subfamily Paranyssoninæ is not closely allied to *Nysson*, and it is evident that the group of North American species which Cresson assigned to *Paranysson* needs a new name. As none of the synonyms of *Nysson* are available, I propose the name *Zanysson* for *Paranysson* Cresson, not Guérin.

In the bilobed metanotum this subgenus differs from all other groups of *Nysson*, and it may later be desirable to consider the group of generic value. The male of *Metanysson* has not been described, but from the other North American[3] groups the male of *Zanysson* can easily be distinguished by the greater number of teeth on the apical tergite. The venation of *Zanysson* is the same as *Brachystegus*.

Key to North American species of subgenus Zanysson.

Besides the species here treated there are in the National Collection males, which appear to represent three other species, but inasmuch as they are not associated with females and there is some doubt as to the value of the number of teeth on the apical tergite it seems best to leave them undescribed until more material is available.

1. Legs black .... **fuscipes** (Cresson).
   Legs largely ferrugineous .... 2.
2. Males .... 3.
   Females .... 5.
3. Third antennal joint but little shorter than the fourth; apical tergite very coarsely sculptured as is also the last; median teeth of apical tergite large and close to the lateral ones; fourth tergite with a yellow spot .... **aureobalteatus** (Cameron).
   Third antennal joint not more than half as long as fourth .... 4.
4. Apical tergite with four apical teeth; posterior face of the propodeum with the median carinae complete, well defined .... **texanus** (Cresson).
   Apical tergite with five apical teeth; posterior face of the propodeum with the median carinae obsolete below .... **plesia**, new species.
5. Pygidium distinctly bipunctate, large pits and smaller punctures; dorsal aspect of propodeum with a distinct inclosure; third antennal joint less than half as long as fourth .... **plesia**, new species.
   Pygidium nearly uniformly striato-punctate (punctures confluent forming ridges) but occasionally there may be a few pits at the base; third antennal joint more than half as long as the fourth .... **texanus** (Cresson).

NYSSON (ZANYSSON) FUSCIPES (Cresson).

This species is confined to the western coast states. The United States National Collection contains two males, one from the Fox collection, the other collected by J. R. Horton on *Helianthus* at Lindsay, California, August 29, 1911.

[3] The Cubean *armatus* Cresson has only two teeth on the apical tergite.

NYSSON (ZANYSSON) AUREOBALTEATUS (Cameron).

Nysson aureobalteatus Cameron, Trans. Amer. Ent. Soc., vol. 27, 1901, p. 313.

The National Collection contains two males, one collected at Tucson, Arizona, by F. H. Snow, the other from Paris, Texas, collected July 11, 1904, by F. C. Bishopp.

NYSSON (ZANYSSON) TEXANUS (Cresson).

Paratype.—Cat. No. 1713, U.S.N.M. One of each sex.

Besides the above-mentioned paratypes the National Collection contains other Texas specimens from the Belfrage collection and a male from St. Louis, Missouri, collected by Phil Rau under his number 2456.

NYSSON (ZANYSSON) PLESIA, new species.

Closely allied to *texanus* but may be distinguished by the characters given in the above key.

Female.—Length, 6 mm. Anterior margin of clypeus with a broad, nearly truncate, low process, which has sharp lateral angles; median ridge between bases of antennae sharp, rather prominent; front with separate, distinct punctures on a granular surface; tubercles between lateral ocelli low, elongate, well separated; antenna slightly thicker apically, the third joint not half as long as fourth, fourth and fifth subequal, apical joint obtusely pointed and distinctly longer than the preceding; dorsal surface of pronotum quadrangular, with a small, acute tooth at the anterior angles; scutum impressed medianly, with large, close punctures; scutellum with lateral margins reflexed, the surface more coarsely sculptured than the scutum; dorsal aspect of propodeum with a more or less distinct inclosure set off by a foveolate furrow, the inclosure with strong rugae; posterior aspect of propodeum with the median area present but not sharply defined, V-shaped in outline, lateral median areas rugose; tergites with distinct separate punctures, closer and larger on anterior ones; pygidium narrowly rounded apically, its surface bipunctate; sternites with large, distinct, separate punctures. Black; mandibles and scape beneath piceous; legs below coxae rufous; first three tergites with yellow spots laterally; body clothed with slightly golden pile, which is especially dense on the face, pronotum, propodeum and base of first tergite and forms a narrow shinning band on apical margins of all tergites; wings dusky; venation dark brown.

Male.—Length, 5.5 mm. Median carinae of posterior face of propodeum obsolete, the surface without coarse sculpture; apical tergite with five teeth, the median one the shorter.

Type locality.—Louisiana.

Type.—Cat. No. 23511, U.S.N.M.

Described from two females (one type) and one male (allotype) from Louisiana under C. F. Baker number 2392, and from a female paratype (*c*) from St. Louis, Missouri, collected by Phil Rau and under his number 2391; and from a female paratype (*d*) from Utica, Mississippi.

NYSSON (FOXIA) SECUNDA, new species.

Closely allied to *pacifica*, but differs in being smaller, in having the abdomen entirely rufous and in the slightly separate punctures of the first two tergites.

Male.—Length, 5.5 mm. Head coarsely, closely punctured; ocelli in a low triangle and without tubercles between the lateral pair; postocellar line distinctly longer than the ocellocular line; third antennal joint slightly longer than the fourth, the apical joint rounded apically and but little longer than the preceding; pronotum coarsely punctured, the lateral anterior dorsal angles rounded; mesoscutum very coarsely punctured, with the punctures confluent in some places; scutellum not margined laterally, sculptured similarly to scutum; dorsal median part of propodeum coarsely reticulate; lateral angles with short, acute teeth; posterior face of propodeum coarsely coriaceous, with two median carinae which converge but do not meet ventrally; abdomen coarsely punctured on a granular surface, anteriorly the punctures are separated by a distance about equal to their width, but on the apical segments they become contiguous; lateral spines on tergites curved, broad at base; spines on apical tergite small. Black; body, especially the head and thorax with dense silvery pile; abdomen rufous with a very obscure yellowish spot on lateral apical margin of first tergite, narrow apical margin of all the tergites with a silvery hair band; legs black, except the posterior pair which beyond coxae are rufous; wings hyaline, slightly dusky apically; venation black.

Type locality.—Claremont, California.

Type.—Cat. No. 23456, U.S.N.M.

Described from one male collected by C. F. Baker.

NYSSON (NYSSON) AURINOTUS Say.

A female from Milwaukee, Wisconsin, agrees well with the original description and also with the description given by Handlirsch. There seems to be but little doubt that this represents Say's species, and while it is allied to *aequalis* Patton, it may be separated from that species by the abundant golden pile at the base of the first tergite; and the black scutellum and pronotum. The pronotum is black but densely covered with golden pile, which Say described as follows: "* * * collar with an obscure golden margin, terminating in a spot."

NYSSON (NYSSON) INTERMEDIUS (Viereck).

The National Collection contains three males and one female of this species. Two males and the female come from San Bernardino County, California (collected by Coquillett), and the other male from Mesilla

Park, New Mexico, collected on *Chilopsis* June 9, 1898, by T. D. A. Cockerell.

NYSSON (NYSSON) SPHECODOIDES Bradley.

A female, which agrees well with the original description of the male, was collected in the mountains near Claremont, California, by C. F. Baker, and is now in the National Collection.

NYSSON (NYSSON) MARLATTI, new species.

In habitus and general appearance like *aurinotus* Say, but the scutellum is not margined laterally.

Female.—Length, 7 mm. Anterior margin of clypeus narrowly depressed, nearly truncate, not dentate; front and vertex with large, distinct, close punctures; no tubercles between the ocelli; frontal carina obsolete; antenna slightly thickening apically, the third joint slightly longer than the fourth, the apical joint distinctly longer than the preceding, obtusely pointed apically; lateral angles of pronotum rounded, the surface sculptured like the scutum; scutum with a median, longitudinal impression anteriorly, the surface with large, distinct, close punctures and with small, inconspicuous punctures in the interspaces; mesepisternum coarsely punctato-reticulate; scutellum not margined laterally, coarsely rugoso-punctate; dorsal, basal middle of propodeum with irregular raised lines, the spines long, rather stout; posterior face of propodeum with a median carina ventrally, the lateral carinae complete, strong, the area between irregularly reticulate; nervellus postfurcal by its width; abdomen with large, distinct punctures which are usually separated by two or three times their width, the punctures of the preultimate segment coarser and closer; pydidium well defined, broad, narrowly rounded apically, the surface coarsely, closely, irregularly punctured. Black, the head and thorax with slightly golden pile, which is especially dense on the front, dorsal margin of pronotum and dorsal lateral part of propodeum (but not on first tergite); legs below coxae, first tergite and second sternite rufous; first four tergites with elongate yellow spots; wings subhyaline, venation black.

Type locality.—Neuecest, Texas.

Type.—Cat. No. 23512, U.S.N.M.

Described from one female collected April 28, 1896, by C. L. Marlatt, for whom the species is named.

NYSSON (NYSSON) MINIMUS, new species.

Allied to *lateralis* Packard and *fidelis* Cresson, but is smaller and differs in details of punctuation. It can hardly be the female of *simplicornis* Fox as the sculpture of the abdomen is coarser, the sculpture of the mesoscutum is different, and there is no marked difference in sculpture between the scutum and mesopleurae.

Female.—Length, 4.5 mm. Anterior margin of the clypeus depressed, truncate, the surface with distinct, separate, small punctures;

frontal carina fine, incomplete; front and vertex shining, with distinct punctures which are separated from each other by about their diameter; no tubercles between the ocelli; antenna stout, the third and fourth joints subequal, apical joint blunt, distinctly longer than the eleventh but not much longer than the tenth; anterior lateral angles of pronotum rounded; mesoscutum with a faint median, longitudinal depression anteriorly, the surface with rather coarse, close punctures which are often confluent and form what at first glance appears as a coriaceous surface; mesepisternum sculptured similar to the scutum but there is a tendency to irregular reticulations; scutellum not margined laterally, sculptured similar to the scutum; propodeum dorsally with strong, rather regular rugae; the propodeal spines small, sharp; posterior face of propodeum without carinae, coarsely reticulate; nervellus interstitial; abdomen shining, the two basal tergites with rather large, close (sometimes confluent) punctures, apical tergites more sparsely punctured; pygidium truncate apically, with large, irregular punctures. Black with rather dense, silvery pile which on the clypeus almost hides the sculpture; mandibles with an obscure yellowish spot medianly; first two tergites with small, lateral yellow spots; wings dusky hyaline, venation dark brown.

Type locality.—St. Louis, Missouri.

Type.—Cat. No. 23153, U.S.N.M.

Described from one female collected June 13, 1918, by Phil Rau and under his number 3535.

NYSSON (BRACHYSTEGUS) FOXII, new species.

In Bradley's key [4] runs to *mellipes* but may readily be distinguished from that and similar species by the absence of tubercles between the ocelli, larger size, and continuous bands on first tergites.

Male.—Length, 8.5 mm. Apical portion of clypeus with large punctures; head with rather large, separate punctures and with smaller punctures in the interspaces; ocelli in a low triangle; the postocellar line subequal with the ocellocular line; no tubercles between the ocelli; antenna short, not reaching the tegula, stout, thickening apically, the third joint a very little longer than the fourth, apical joint somewhat longer than the preceding, not curved, obliquely truncate apically; pronotum rounded, not angulate or acute laterally; mesoscutum with large, sometimes contiguous punctures on a finely punctured surface; scutellum sharply margined laterally, very coarsely striato-punctate; basal dorsal area of propodeum with longitudinal ridges, the three median ones being better defined and parallel; the posterior face of propodeum with four carinae and with irregular transverse ridges; abdomen with distinct, separate (on three basal

[4] Trans. Amer. Ent. Soc., vol. 46, 1920, p. 122.

tergites separated by twice their width) punctures, which become closer on the apical tergites, so on the terminal one they are contiguous; apical segment truncate, with sharp, rather short spines laterally. Black; body with short, appressed silvery pile which is especially dense on head, propodeum and anterior face of first tergite; mandibles, scape, pedicellum, basal four joints of flagellum beneath, and tegulae, dark rufous; legs, beyond coxae, clear rufous; dorsal margin of pronotum, anterior margin of scutellum, broad apical bands on first two tergites and lateral spots on third and fourth, yellow; wings dusky hyaline, venation blackish.

Type locality.—Granjeno (about 10 miles west of Santa Rosa) Texas.

Type.—Cat. No. 23458, U.S.N.M.

Described from a single male collected May 20, 1895, by C. H. T. Townsend.

Dedicated to W. J. Fox in recognition of his useful work on the wasps of this genus.

NYSSON (BRACHYSTEGUS) BARBERI, new species.

Allied to *Nysson* (*Brachystegus*) *gagates* Bradley, but differs from the description in the truncate apical joint of the antenna, different sculpture of mesonotum and abdomen and presence of tubercles between the ocelli.

Male.—Length, 6 mm. Head with rather large, close punctures which are closer on the front, on the vertex in the interspaces are smaller, somewhat inconspicuous punctures; a low, elongate tubercle on inner margins of each lateral ocellus; third and fourth antennal joints subequal, the apical joint distinctly longer than the preceding and obliquely truncate; dorsal margin of pronotum rectangular, the lateral anterior angles subacute; mesoscutum with coarse, nearly confluent punctures, and with smaller punctures in the interspaces; scutellum not margined, punctured like the scutum but more coarsely so; dorsal surface of propodeum with regular radiating striae; the lateral angles acute but without a prominent spinelike tooth; posterior face of the propodeum with prominent median carinae, and with transverse rugae; abdomen with distinct, rather large punctures which on the two basal segments are separated by about twice their width but on the apical segments become coarser and contiguous so the two apical segments are striato-punctate; second sternite punctured like the tergite except the punctures are more widely separated. Black, rather densely clothed with silvery pile; first three tergites with elongate, lateral, pale yellow spots on their apical margins, those on the first the largest and separated by about their length; wings dusky hyaline, slightly clouded along anterior margin of radial cell, venation blackish.

Type locality.—Bair's Ranch, Redwood Creek, Humboldt County, California.

Type.—Cat. No. 23459, U.S.N.M.

Described from one male collected June 12 by H. S. Barber, for whom the species is named.

NYSSON (BRACHYSTEGUS) OPULENTUS, var. DAKOTENSIS, new variety.

Male.—Length, 7.5 mm. Differs from the typical form in having the markings more distinctly yellow, in the apical band on the first two tergites being complete and in having a transverse yellow spot on the first tergite before the apical band. The punctures on the first two tergites are also a trifle larger.

Type locality.—New England, North Dakota.

Type.—Cat. No. 23457, U.S.N.M.

Described from a single male collected by C. N. Ainslie.

Tribe HOPLISINI.

The definition of this tribe is changed from that given in the Connecticut Hymenoptera only by the omission of the phrase, "mesepisternum without an oblique suture from below tegula to prepectal carina." This change permits the inclusion of the genus *Arpactus* Jurine and certain species of *Hoplisoides* which would otherwise be excluded.

At least in some cases the convergence of the eyes toward the clypeus is a secondary sexual character.

Key to the North American Genera.

1. Nervellus straight, antifurcal; mesepisternum with an oblique suture from below tegula to the prepectal carina..............**Arpactus** Jurine (=**Dienoplus** Fox).
   Nervellus long and strongly curved, interstitial or postfurcal.**Hoplisus** Lepeletier.

Genus HOPLISUS Lepeletier.

Of the three subgeneric groups tabulated below it seems probable that more material will make it difficult to satisfactorily separate *Hoplisus* in the restricted sense and *Hoplisoides*, but the smooth propodeum makes it easy to recognize species belonging to *Pseudoplisus*.

Key to North American subgenera of Hoplisus.

1. Propodeum smooth and shining, practically without sculpture; propodial inclosure well defined; nervellus distinctly postfurcal..........**Pseudoplisus** Ashmead.
   Propodeum sculptured, the inclosure usually striate..........................2.
2. Propodeal inclosure well defined; nervellus postfurcal......**Hoplisus** Lepeletier.
   Propodeal inclosure not or scarcely defined; nervellus interstitial,
   Hoplisoides Gribodo.

Tribe GORYTINI.

Key to genera in the National Collection.

1. Abdomen sessile, the first tergite broad and shorter, its apex nearly as wide as the base of the second tergite........2.
   Abdomen subpetiolate, the first tergite longer and its apical width much less than the basal width of the second tergite........6.
2. First recurrent nearly or quite interstitial with the first intercubitus and not causing the cubitus to be angled; second recurrent interstitial or nearly with the second intercubitus; nervellus nearly perpendicular and strongly antefurcal; propodeal inclosure well defined........**Clytemnestra** Spinola.
   Both recurrents received well within the second cubital cell and pulling the cubitus down so it is angled........3.
3. Nervellus interstitial........**Arigorytes** Rohwer.
   Nervellus antefurcal........4.
   Nervellus postfurcal........**Ceratostizus**, new genus.
4. Anterior tarsi of female with a comb; inner margins of eyes in female subparallel; body with much appressed pile........**Trichiogorytes** Rohwer.
   Anterior tarsi of female without a comb; inner margins of eyes not subparallel; body without appressed pile........5.
5. First tergite without a transverse depression before apex; body black and yellow........**Gorytes** Latreille.
   First tergite with a transverse depression before apex; body black.
   Gorytes, subgenus, **Argogorites** Ashmead.
6. Nervellus perpendicular and antifurcal; recurrents interstitial or nearly with the intercubiti and not causing the cubitus to be angled; inner margins of the eyes strongly converging below........**Paramellinus** Rohwer.[5]
   Nervellus strongly reclivous; recurrents well within the second cubital cell and causing the cubitus to be pulled down........7.
7. Inner margins of the eyes subparallel........8.
   Inner margins of the eyes strongly converging below........9.
8. Nervellus slightly antifurcal........**Mellinogastra** Ashmead.
   Nervellus interstitial........**Mellinogastra**, subgenus, **Hypomellinus** Ashmead.
9. Nervellus antifurcal; prepectus present; mesopleura with a distinct dorsal plate.
   Hapalomellinus Ashmead
   Nervellus postfurcal; prepectus poorly defined or obsolete; mesopleura without a distinct dorsal plate.....**Ammatomus** Spinola (=**Magalomma** Smith, Ashmead).

CERATOSTIZUS, new genus.

Genotype.—Gorytes moneduloides Packard.

Eyes large, occupying most of the side of the head, strongly converging below; antennae strongly thickening apically; no suture from tegula to prepectal carina; propodeum more or less sculptured, with a well-defined inclosure; tarsal comb of female present, but not long; first tergite shorter than the second, its apical width as great as the basal width of the second; stigma well defined; both recurrents received well within the second cubital cell and drawing

[5] Both Mickle and Bradley prefer to follow Ashmead and use the name *Euspongus* Lepeletier for this genus. I have not seen the genotype and they may be correct, but it seems doubtful inasmuch as the species, other than the genotype, which were originally assigned to the genus, do not agree with *bipunctatus*, the genotype of *Paramellinus*.

the cubitus down; nervulus postfurcal; nervellus straight, long, and postfurcal by more than half its length.

The above generic name was suggested by Ashmead but, as far as I know, never published.

CERATOSTIZUS MONEDULOIDES (Packard).

Gorytes moneduloides Packard, Proc. Ent. Soc. Phila., vol. 6, 1867, p. 424.—Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 523.

Gorytes belfragei Cresson, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 224.

The above synonymy was first pointed out by Handlirsch. The type of *belfragei* is in the National Collection, Cat. No. 1710.

Tribe SPHECHNI.

This tribe is represented only by the genus *Sphecius* Dahlbom in which there is no propodeal inclosure and the nervellus is strongly curved and postfurcal. In the postfurcal nervellus this genus is like *Ceratostizus* and *Ammatomus*.

DESCRIPTION OF VIVIANITE ENCRUSTING A FOSSIL TUSK FROM GOLD PLACERS OF CLEARWATER COUNTY, IDAHO.

By Earl V. Shannon,

Assistant Curator, Department of Geology, United States National Museum.

The only locality for the ferrous phosphate, vivianite, in Idaho which has heretofore been mentioned in mineralogic literature is the Silver City mining district, in Owyhee County, in the southwestern part of the State. The mineral occurs as crystals embedded in clay in the veins of several silver mines. A large crystal from this locality has been described and figured by Farrington and Tillotson.[1] The purpose of the present short paper is to call attention to several vivianite specimens which are now in the United States National Museum (Cat. No. 87220) and which occurred under very different conditions in Clearwater County in the northern part of the State. These, which are broken parts of what was originally one mass, were received as a gift from Messrs. Charles Brown and John Pearson, of Dent, Idaho, through Mr. W. B. Compton, who writes that the material was found in a gold placer mine 17 feet below the surface. The extreme fragility of the specimen proves conclusively that the mineral was formed in the situation where found. The largest specimen, which is illustrated in Plate 93, has the form of a hollow, curved, tapering cone, which is somewhat triangular in cross section and is composed entirely of crusted crystals of vivianite. The general shape of the object was so suggestive of that of a horn or tusk that it was submitted for examination to Messrs. James W. Gidley and Charles W. Gilmore, of the Division of Vertebrate Paleontology in the United States National Museum, who both agree that the deposit represents the mold of a horn or tusk, but owing to the total removal of all of the original material and the absence of definite structure in the crystalline vivianite remaining, definite opinions could not be given as to the exact character of the animal to which it belonged. Mr. Gidley thinks that the original object was probably the horn of a long-horned bison or the tusk of a walrus, the point being too acutely tapering to be the tip of a mammoth tusk. Mr.

[1] Farrington, O. C., and Tillotson, E. W., jr., Field Col. Mus. Bull., Geol. Series, vol. 3, p. 163, 1908.

Gilmore, however, has pointed out a tendency of tusks of the mammoth to develop a cone-in-cone structure and to separate upon weathering into a succession of horn-shaped segments having much the form of the interior cavity of the vivianite specimen. On chemical grounds the writer is inclined to eliminate horn from consideration, as the tip portion of a horn of this length, owing to its relatively low content of mineral matter, would scarce supply the amount of phosphoric acid represented by the vivianite.

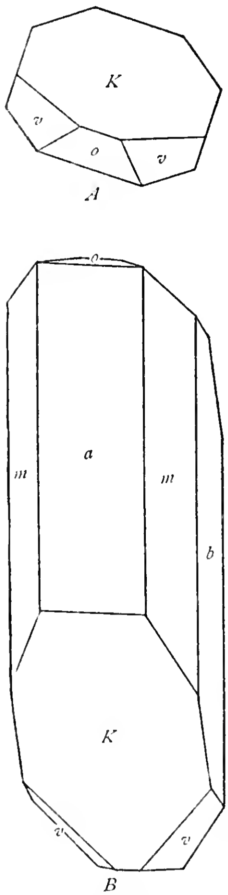


Fig. 1.—Crystal of vivianite.

The exterior of the specimen, as shown by the photograph, is made up of masses of vivianite crystals. The crystals are grown outward from a thin platy layer which, while also consisting of vivianite, apparently outlines the original object and has a remotely fibrous appearance as though deposited between thin plates of bony material which had exfoliated somewhat under the influence of weathering. Inside the cone there is a second layer of vivianite crystals which have grown inward from the platy layer. The latter are much smaller than those of the exterior layer. The central cavity of the specimen is in part filled with sandy material, grains of which are embedded in the surfaces of the crystals of the interior crust. Under the microscope this sandy material is seen to consist of angular grains of quartz, small masses of partly kaolinized feldspar containing green hornblende, plates of muscovite, hexagonal scales of green chlorite, and angular fragments of garnet embedded in a clayey matrix largely composed of sericitic muscovite. None of these mineral grains are water worn and the material is such as might result from the residual decomposition of a granitic rock.

The crystals of the exterior crust are well formed and are aggregated into groups the individuals of which deviate a few degrees from strict parallelism. These are developed in a manner showing that they grew freely without interference, and there are no grains of sand or of other substance attached to the crystals nor do the faces contain the impressions of any such grains. Some of the intercrystal recesses contain a peculiar waxy limonite which appears to have been a gelatinous colloid which shrunk upon drying, becoming thus filled with shrinkage cracks. This limonite is readily brushed away from the vivianite crystals, leaving them smooth and bright. In just what sort of medium these could have developed is not clear. It must have been either a yielding homogeneous fine grained muck or an open cavity. If it were muck the sand which occupies the center of the specimen must have been packed in the interior of the original object when it was deposited. It is possible that the crystal crust grew upon a shell formed around the sand on the interior of the original tusk and found space to grow in the cavity formed by the solution and removal of the tusk itself.

Individual crystals of the vivianite reach a maximum length of 2 centimeters with a diameter of 1 centimeter, while aggregates of crystals in nearly parallel position reach a length of 4 centimeters with a thickness of 2 centimeters.

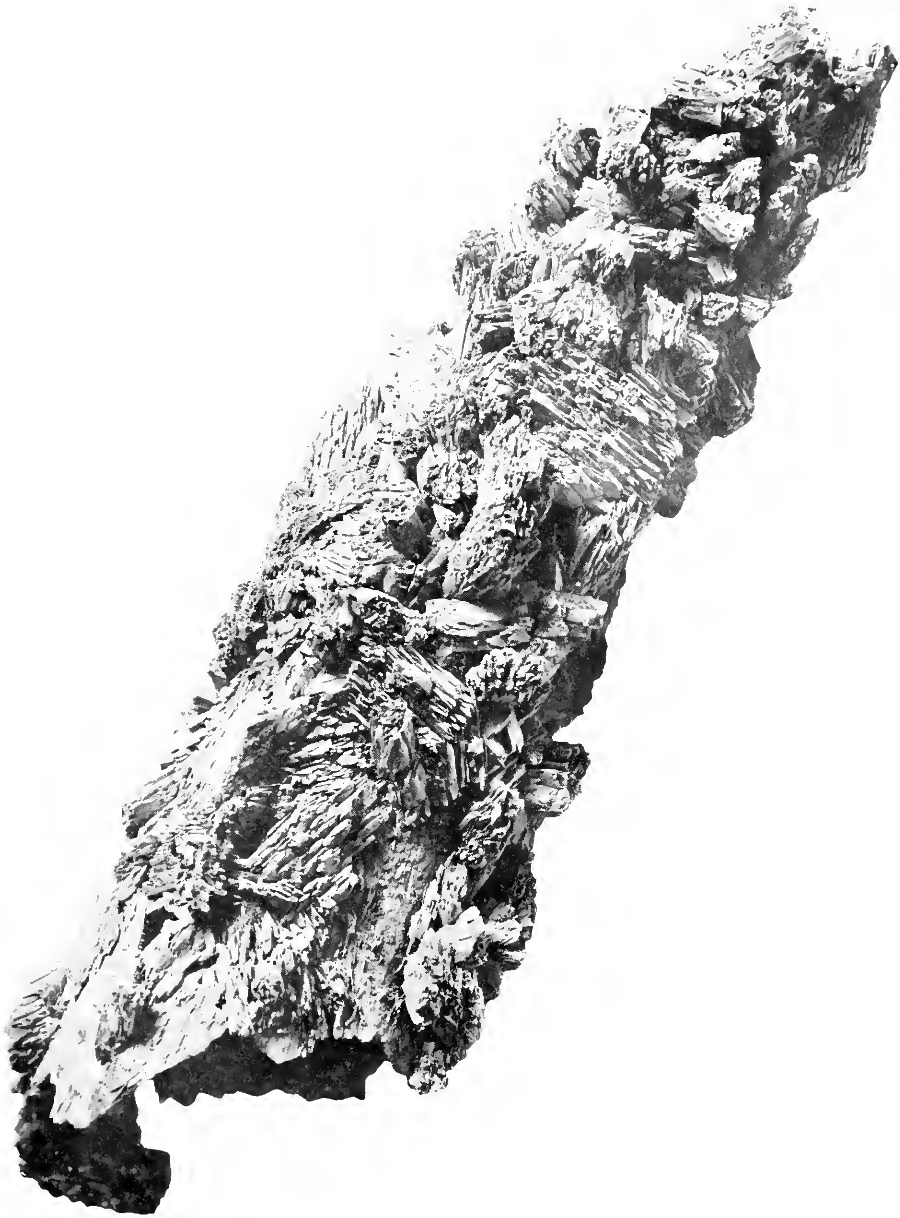
The crystals are all alike in development, being prismatic by elongation of the prism $m(110)$, the orthopinacoid $a(100)$, and the clinopinacoid $b(010)$. The terminations are wedge shaped and consist of $o(\bar{1}03)$, $v(\bar{1}11)$, and $K(\bar{3}01)$, the dominant orthodome $K(\bar{3}01)$ being a form not previously recorded on vivianite. The form and development of the crystals are as shown in orthographic and clinographic projections in figures 1*A* and 1*B*. The faces of $m(110)$ are in all cases clear and brilliant, yielding excellent reflections of the signal. The orthopinacoid $a(100)$ is always more or less irregular, while $b(010)$ is usually dull. The terminal planes are always more or less etched and dulled, sometimes to such an extent that no light is reflected at all. The new dome $K(\bar{3}01)$, while present as a broad face, yielded blurred signals which did not permit accurate measurements. The average angle obtained from several readings is as follows:

Angles of dome $K(\bar{3}01)$ on vivianite.

Letter.	Miller.	Gdt.	Calculated.		Measured.	
			ϕ	ρ	ϕ	ρ
K	$\bar{3}01$	$\bar{3}0$	90°00′	68°37′	90°24′	67°45′

Since the calculated and observed angles are nearly 1 degree apart and the reflections were of poor quality, this must be regarded as a somewhat doubtful form.

In color the vivianite is light greenish blue, although this is obscured by the presence between and around the crystals of a pulverulent deep blue alteration product. The cleavage parallel to $b(010)$ is very prominent, yielding flexible laminae. Under the microscope the pleochroism of some grains is very striking and beautiful.



VIVIANITE ENCRUSTING TUSK FROM IDAHO.

FOR EXPLANATION OF PLATE SEE PAGE 415.

THE CRYSTALLOGRAPHY AND CHEMICAL COMPOSITION OF CREEDITE.

By William F. Foshag,
Assistant Curator, Division of Mineralogy, United States National Museum.

INTRODUCTION.

The mineral creedite was found by Dr. E. S. Larsen, of the United States Geological Survey, in the fluorite deposits of Wagon Wheel Gap, Creede Quadrangle, Colorado, and was described by Larsen and Wells.[1] Since their description Doctor Larsen has collected a large suite of specimens which has now been deposited in the United States National Museum (Cat. No. 93117, U.S.N.M.). This material is better suited for study than the original and contains a number of specimens showing well-developed and measurable crystals. At Doctor Larsen's suggestion this mineral was further studied and the writer wishes to express his appreciation for the interest taken by that gentleman in this investigation.

OCCURRENCE.

The creedite was found in two modes of association. One type of occurrence is with fluorite, either as crystals in cavities or as embedded radiated masses of crystals in the white, sacharroidal spar. The fluorite itself is banded and shows a weak radiated structure. Very minute crystals of hematite are sometimes found in the cavities in the fluorite masses.

The second type shows loose, doubly terminated crystals embedded in a white, evenly textured clay described by Larsen and Wherry[2] as halloysite. These crystals range up to 1 centimeter in size. Their distribution in the halloysite is very uneven, ranging from a few scattered crystals to masses of almost pure creedite. Rarely small groups of divergent crystals are met with in this clay.

[1] Proceedings of the National Academy of Science, vol. 2, p. 360, 1916.
[2] Journal of the Washington Academy of Sciences, vol. 7, p. 178, 1917.

PHYSICAL PROPERTIES.

Creedite is ordinarily colorless, but many of the radiated masses show broad bands of a beautiful, delicate purple color. The luster is vitreous. The cleavage is pinacoidal, parallel to the 100 face. The mineral is brittle and breaks with a conchoidal fracture. The hardness is 4. The specific gravity, determined by the pycnometer method, is 2.713. (Larsen and Wells give the specific gravity as 2.730.) The common mode of aggregation is in radiated masses.

OPTICAL PROPERTIES.

The optical properties given below are those determined by Larsen. The indices of refraction of the new material were measured and found to agree with those given below. The mineral is optically negative. The optic axial angle as measured is:

$$2V_{Li} = 64° \ 30' \pm 10'; \ 2V_{Na} = 64° \ 22' \pm 10'; \ 2V_{Tl} = 64° \ 20' \pm 10'.$$

The dispersion was perceptible only on one axis. Extinction angle $42° \ 30' \pm 30'$. Optical orientation, $Y = b$.

The indices of refraction are:

$$\alpha = 1.461 \pm 001$$
$$\beta = 1.478 \pm 001$$
$$\gamma = 1.485 \pm 001$$

The axial angle calculated from these indices is 65°, agreeing well with the observed ones.

CRYSTALLOGRAPHY.

There are two main habits of crystals, those of the first type occurring in the fluorite, those of the second in the halloysite. The crystals of type 1 are prismatic with an equal development of the front and rear pyramids. The base on these crystals is sometimes absent but generally well developed and sometimes sufficiently large to reduce the pyramids to narrow faces. The crystals of the second type are also prismatic, are doubly terminated, and with a very prominent development of the front pyramid. The rear pyramid and base are reduced to almost minute size. The figures show some of the various types drawn so as to bring the plane of the clinopinacoid to the front.

In the calculation of the elements only the faces of the unit pyramid could be used. The orthodome zone, including the base, was in all cases when present considerably etched. The crystals from the clay were brilliant, but the faces were invariably curved and yielded a number of signals. The following are the angles for the unit pyramid as measured and designated as excellent.

ϕ $(111, 1\bar{1}1)$		ρ $(111, 111)$		ϕ $(1\bar{1}1, \bar{1}11)$		ρ $(1\bar{1}1, 111)$	
°	′	°	′	°	′	°	′
34	34	54	37	28	48	52	59
34	27	54	37	28	59	52	51
34	23	54	31	28	44	53	08
34	13	54	37	28	49	53	00
34	28	54	37	28	50	52	52
				28	44	52	41
Av.=34	29	54	36	29	10	53	08
				28	50	52	51
				28	57	52	59
				Av.=28	52	52	57

From these $x'=0.7181$, $y'=1.1597$, $e'=0.0786$, $\mu=85°\ 30'$ $\beta=94°\ 30'$. Since these are x' and y' for the unit form, $p'_0=0.7181$, $q'_0=1.1597$. These reduce to the monoclinic elements $p_0=0.7159$, $q_0=1.1562$, $e=0.0785$. Also $a=1.6199$ and $c=1.1597$.

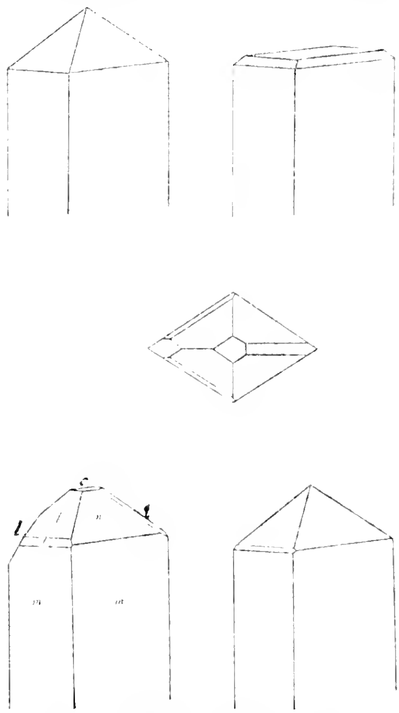


Fig. 1.—Creedite crystals, Type I.

The following forms were observed:

$c=0$ (001). This face varies in size from minute to large. Usually dull and etched.

	ϕ	ρ
Measured.......	89° 15′	4° 42′
Calculated.....	90° 00′	4° 30′

$a=\infty 0$ (100). Sometimes occurs as a very narrow face with faint but distinct signal.

	ϕ	ρ
Measured......	90° 00′	90° 00′
Calculated.....	90° 00′	90° 00′

$m=\infty$ (110). This is the only prism observed. It is usually bright and gives sharp signals. On the second type of crystals it is somewhat curved and gives a multiple signal.

	ϕ	ρ
Measured....................................	31° 45′	90° 00′
Calculated..................................	31° 45′	90° 00′

$l=+20$ (201). Occurs occasionally as dull faces yielding no reflections and measured by the position of maximum illumination. The face is generally of good size.

	ϕ	ρ
Measured....................................	89° 00′	56° 15′
Calculated..................................	90° 00′	56° 25′

$i = -10$ ($\bar{1}01$). Observed in several cases as a dull face yielding no signal but measured by the position of maximum illumination.

	ϕ	ρ
Measured	90° 00′	32° 10′
Calculated	90° 00′	32° 35′

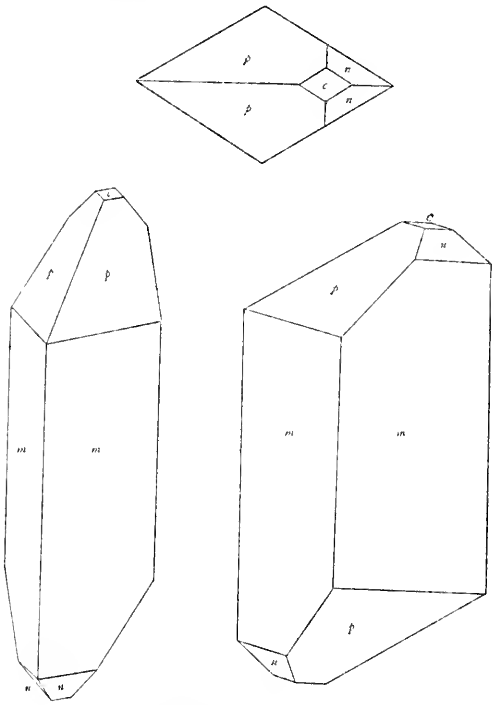


FIG. 2.—CREEDITE CRYSTAL, TYPE II.

$d = +2$ (221). Often present as narrow to line faces on both types of crystals.

	ϕ	ρ
Measured	33° 15′	70° 08′
Calculated	33° 09′	70° 09′

$p = +1$ (111). This is the most prominent pyramid face and is generally bright, yielding excellent reflections. In the second type of crystal it reduces the negative pyramid to small faces.

	ϕ	ρ
Measured	34° 29′	54° 36′
Calculated	34° 30′	54° 36′

$n = -1$ ($\bar{1}11$). This face is the same size as p in the first type of crystal, but is small on the second. It is bright and yields excellent reflection.

	ϕ	ρ
Measured	28° 52′	52° 57′
Calculated	28° 52′	52° 56′

The elements and calculated angles are brought together in the table given below.

Creedite.—Monoclinic.

$a = 1.6199$ $c = 1.1597$ $\mu = 85° 30'$	$lg\ a = 0.209501$ $lg\ c = 0.064345$ $lg\ h = 9.998659$	$lg\ a_0 = 0.145156$ $lg\ b_0 = 9.935655$ $lg\ e = 8.894643$	$lg\ p_0 = 9.854844$ $lg\ q_0 = 0.063004$ $lg\ \frac{p_0}{q_0} = 0.791840$	$a_0 = 1.3969$ $b_0 = .8623$ $h = .9969$	$p_0 = 0.7159$ $q_0 = 1.1562$ $\epsilon = .0785$

	Gdt.	Miller.	ϕ	ρ	ξ_0	η_0	ξ	η	x' prisms x; y.	y'	$d' = \tan \rho$.
			° ′	° ′	° ′	° ′	° ′	° ′			
c	0	001	90 00	4 30	4 30	0	4 30	0	0.0785	0	0.0785
a	∞ 0	100	90 00	90 00	90 00	0	90 00	0	∞	0	∞
m	∞	110	31 46	90 00	90 00	90 00	31 46	58 18	0.6192	∞	∞
l	+20	201	90 00	56 25	56 25	0	56 25	0	1.5061	0	1.5061
i	−10	$\bar{1}01$	90 00	32 35	32 35	0	32 35	0	.6387	0	.6387
d	+ 2	221	33 09	70 09	56 34	66 40	30 57	51 57	1.5147	2.3195	2.7760
p	+ 1	111	34 30	54 36	38 33	49 14	27 29	42 13	.7969	1.1596	1.4071
n	− 1	$\bar{1}11$	28 52	52 56	32 36	49 14	22 39	44 20	.6394	1.1596	1.3238

CHEMICAL COMPOSITION.

Creedite is easily and completely soluble in hydrochloric and sulphuric acids. For the analysis clear, colorless crystals were selected, crushed, and examined under the microscope. The material so selected was homogeneous and without a trace of foreign matter. The mineral was dissolved in sulphuric acid and evaporated to dense fumes to expel the fluorine, and the lime and alumina determined in this portion by the ordinary methods. Sulphate was determined in a separate portion dissolved in hydrochloric acid by precipitation as barium sulphate. Fluorine was determined by Penfield's method, volatilizing as silicon fluoride and absorbing in a 50 per cent alcoholic solution of potassium chloride and titrating this solution with

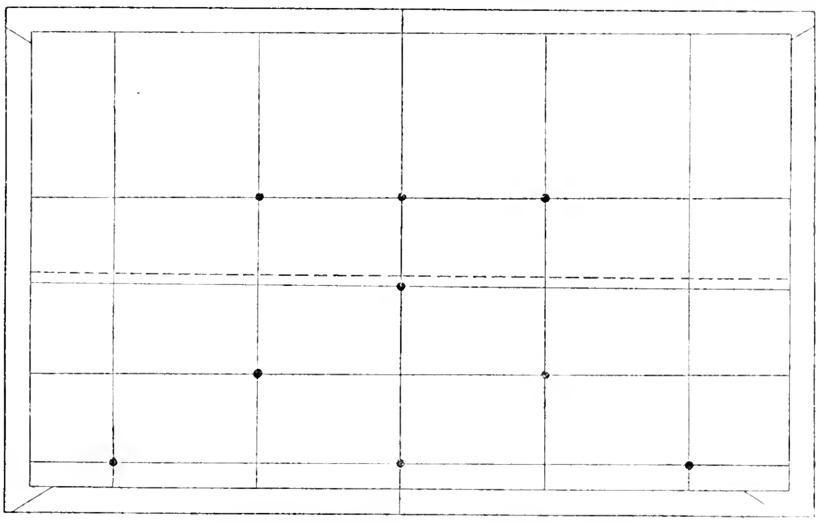


FIG. 3.—GNOMONIC PROJECTION OF THE FORMS ON CREEDITE.

standard sodium hydroxide. Preliminary tests of this method with the apparatus employed gave somewhat high results, due, perhaps, to the imperfect condensation of the sulphur trioxide fumes. Water was determined by Penfield's method. The results together with the ratios derived therefrom are given in the following table:

Analysis and ratios of creedite.

Constituent.	Per cent.	Ratios.		
H_2O	10.72	H_2O	0.610	3.0
SO_4	19.10	SO_4	.199	1.0
F	30.30	F	1.595	8.1
Al_2O_3	21.42	Al	.435	2.2
CaO	35.18	Ca	.595	3.0
	116.72			
−O=F	17.28			
	99.44			

These figures compare well with those of Wells's as given below, recalculated to conform with method of statement used by Wells.

Analyses of creedite.

	New analysis.	Wells's analysis.
Al	11.74	11.58
Ca	23.72	23.98
SO_4	19.10	18.32
H_2O-	.06	.72
H_2O+	10.72	11.08
O	4.36	3.97
F	30.30	30.35
	100.00	100.00

Larsen and Wells write the formula for creedite as $CaSO_4$. $2CaF_2$ $2Al(OH)_3$. $2H_2O$. It may also be written $3CaF_2$. $Al(OH,F)_2SO_4$. $2H_2O$. A determination of the water at various temperatures showed a loss of only 0.08 per cent at 250°. However, if we consider the water as all constitutional it becomes difficult to assign a simple formula to the mineral.

RELATIONS.

Creedite does not appear to be very closely related to any known mineral. Since it is predominately a fluoride it is best classed with them. Among these it stands closest to pachnolite with two molecules of sodium fluoride replaced by one of calcium sulphate. Its apparent relationship can be brought out by doubling the formula for pachnolite:

Pachnolite........................ $2CaF_2$, $2AlF_3$, $2H_2O$, $2NaF$.
Creedite........................ $2CaF_2$, $2Al\ (OH,F)_3$, $2H_2O$, $CaSO_4$.

Creedite can then be grouped with pachnolite in a systematic classification until some closer relations can be shown.

THE NORTH AMERICAN SEMIPARASITIC COPEPODS OF THE GENUS CLAUSIDIUM.

By Charles Branch Wilson,

Of the Department of Biology, State Normal School, Westfield, Massachusetts.

INTRODUCTION.

There has been much discussion with reference to those copepods which are found upon echinoderms, worms, mollusks, etc., as to whether they were to be regarded as free-swimmers, semiparasites, or true parasites.

A number of closely related forms are constantly found in the open ocean and are apparently genuine free-swimmers. And yet even some of these, like *Sapphirina*, are known to infest various pelagic animals at times. The fact that the parasitism is usually temporary, the copepods easily changing hosts or moving about freely in the water, is the disturbing element. There seems to be an unwritten opinion that once a parasite always a parasite ought to be the prevailing rule.

And when we come to examine the mouth parts we find that they are not suited either for mastication or for suction. They are rather adapted for licking up nourishment from the surface of the various organisms or from the walls of their inner (branchial) cavities.

And yet Sars has shown in his Crustacea of Norway (vol. 6, p. 142) that there is no doubt about the parasitic nature of these copepods.

One of the more sedentary forms is the genus *Clausidium*, which lives in the branchial cavity of certain *Callianassa* species.

DESCRIPTIONS OF GENUS AND SPECIES.

Genus CLAUSIDIUM Kossmann.

Hersilia Philippi, Wiegmanns Archiv für Naturgeschichte, vol. 5, 1839, p. 128.
Clausidium Kossmann, Verhandlungen der phys.-med. Gesellschaft, n. s., vol. 7, 1875, p. 11.

In 1839 Philippi established a new genus and species which he named *Hersilia apodiformis*. Thirty-six years later Kossmann found specimens of the same copepod and, not knowing Philippi's paper, again made of them a new genus and species with the name *Clausidium testudo*.

Unfortunately, the name *Hersilia* had been twice preoccupied, once in 1816 by Savigny for an Arachnid genus and again in 1834 by Déjean for a genus of Coleoptera. Consequently it can not stand for a copepod genus, and we must accept Kossmann's generic name *Clausidium* and the specific name *apodiforme* given by Philippi. With the suppression of the name *Hersilia* the family name Hersiliidae must also be dropped, and Clausidiidae substituted in its place as has already been done by Sars.[1]

The family is chiefly characterized, as Sars stated, "by the non-prehensile posterior antennae, the form of the anterior lip, the peculiar armature of the maxillae, and partly also by the structure of the maxillipeds." [2] The genus *Clausidium* may be thus diagnosed.

External generic characters of female.—General form short, broad, and strongly flattened; first thorax segment fused with the head, second and third segments free, fourth and fifth segments fused, and covered with a single plate. No eyes visible. Genital segment of varying length, abdomen three-jointed; egg strings very short, eggs multiseriate. First antennae seven-jointed, setose; second antennae nonprehensile, tipped with long setae; mandibles bearing a tooth and a tuft of hair; first maxillae knoblike, armed with short spines; second maxillae biramose, the endopod a bipartite spine, the exopod one or more plumose setae; maxillipeds with stout basal joints and small terminal joint, tipped with plumose setae. First four pairs of legs biramose, the endopods armed with sucking disks, the first pair still further modified for prehension; fifth pair uniramose, flattened.

External generic characters of male.—General form elongate, slender, much smaller than the female. Second, third, and fourth segments free, the dorsal plate on the latter covering the base of the fifth segment.

Genital segment with rudimentary sixth legs on the lateral margins. Abdomen three-jointed. Appendages like those of the female except the maxillipeds, which are two-jointed and armed with teeth and spines.

Characteristic habit of the genus.—The male and female are fastened together in 90 per cent of the adult specimens obtained. The male clings to the abdomen of the female by means of his maxillipeds and first legs, with his dorsal surface in the same direction as hers, and this adherence is maintained even in alcohol and preservatives.

Type of the genus.—*Clausidium apodiforme* (Philippi), monotypic.

KEY TO THE SPECIES.

1. Genital segment with rudimentary sixth legs on its lateral margins; maxillipeds two-jointed and tipped with spines and teeth, males........................2.
1. Genital segment with smooth lateral margins; maxillipeds four-jointed and tipped with long plumose setae, females..3.

[1] Crustacea of Norway, vol. 6, pt. 11, 1917, Copepoda Cyclopoida, p. 144.

[2] Idem, footnote.

2 Posterior corners of cephalothorax, second, and third segments prolonged backwards outside each following segment; spines at the posterior corners of genital segment.. *dissimile*, new species.

2. Posterior corners of cephalothorax, second, and third segments prolonged backwards outside each following segment; no spines on genital segment; fifth leg with fine hairs between the setae................ *vancouverense* (Haddon), 1912.

2. Posterior corners of cephalothorax, second, and third segments not prolonged; no spines at posterior corners of genital segment; cephalothorax widest at posterior margin .... *apodiforme* (Philippi), 1839.

3. Cephalothorax twice as wide as long; dorsal plate of fourth segment covering the base of the fifth legs, not reaching the abdomen; anal laminae a half longer than wide.. *dissimile*, new species.

3. Cephalothorax a quarter wider than long; dorsal plate of fourth segment covering the whole of the fifth legs and most of the abdomen; anal laminae three to four times as long as wide............................ *apodiforme* (Philippi), 1839.

3. Cephalothorax a quarter wider than long; dorsal plate of fourth segment covering the base of the fifth legs, not reaching the abdomen; anal laminae as wide as long....................................... *vancouverense* (Haddon), 1912.

3. First antennae half as long as the body, with short rigid hairs; abdomen and genital segment half the body length, but with only three segments in both............ *caudatum* (Say), 1818.

CLAUSIDIUM DISSIMILE, new species.

Host and record of specimens.—Twenty-five specimens, including both sexes, were obtained by Prof. S. I. Kornhauser at Cold Spring Harbor, Long Island, in the summer of 1915 from the gill chamber of a species of *Callianassa* dug up on the beach. Besides the adults of both sexes there were also obtained many development stages. A male and female, fastened together in the characteristic manner already noted, and mounted in balsam, have been selected to serve as types of the new species, and have been donated by Doctor Kornhauser to the National Museum, Cat. No. 54080, U.S.N.M.

External specific characters of adult female.—First thorax segment fused with the head to form a cephalothorax, which is twice as wide as long and whose posterior corners are produced laterally and backward.

The antennal area is well marked, but there are no eyes, the places mistaken for them by Kossmann being probably the points of attachment of the second antennae. Second and third segments as wide as the cephalothorax, but only a third as long, and also produced laterally and backward. Fourth and fifth segments fused and covered with a single dorsal plate, which is twice as long as those on the second and third segments, but only three-fourths as wide, with rounded lateral angles and a strongly convex posterior margin. This plate projects far enough laterally to cover the entire basal joints of the fourth and fifth legs, but their rami project far beyond its posterior margin.

Through the center of the body the various dorsal plates are thoroughly fused together, but their prolonged lateral margins are separated by narrow sinuses. The genital segment is short and wide, the width to the length in the proportion of 3 to 2.

The abdomen is three-jointed, the joints about the same length, but diminishing in width backward. The anal laminae are oblong, square-cornered, and convergent; each is armed with two setae, the inner of which is twice as long as the outer. The egg strings are attached to the sides of the genital segment, are about the same width as the latter, are three times as long as wide, and are slightly curved. The eggs are large and spherical, 25 or 30 in each string.

The first antennae are seven-jointed, the second joint the longest, the fourth the shortest, and all the joints heavily armed with setae. These antennae are attached to the ventral surface of the head, and in preserved specimens are turned inward and backward along the ventral surface of the carapace so as to be invisible in dorsal view.

The second antennae are three-jointed; the basal joint carries a long seta at its distal anterior corner; the terminal joint has a row of four long setae across the tip and one on the dorsal surface near the outer margin. The first maxillae are somewhat like those of *Ergasilus*, consisting of a short process armed with four setae. The second maxillae are biramose; the endopod is made up of a stout spine, bipartite at the tip, the inner branch longer than the outer; to the outer margin at about the center and to the ventral surface near the base are attached slender plumose setae, one in each place. The exopod consists of a stout plumose seta bearing on its inner margin near the base a secondary slender seta, the two being the same length as the endopod spine. The maxillipeds are made up of four joints, two longer basal joints and two shorter terminal ones. Each of the former carries two plumose setae on its inner margin at the center; the terminal joint is tipped with a tuft of plumose setae while the penultimate joint carries a single seta on its outer margin.

In the peculiarly modified first legs the large flattened spine or plate on the inner margin of the endopod is short and blunt, quite different from the slender, acuminate-pointed plate of *apodiforme*. The spine at the inner margin of the second joint is foot-shaped, with a bluntly rounded toe; the spine at the base of the process on the third joint is stout and bluntly pointed. The process itself is wide, longer than the spines and tipped with a claw; it is armed with three sucking disks. The exopod is three-jointed; the two basal joints each have a single spine on the outer margin, while the terminal joint has two on the outer margin and two at the tip, of which the inner one is considerably the longer. The second, third, and fourth legs are similar to those of *apodiforme*, with slight differences. In the fifth legs there are three spines at the tip, of which the central one is the longest and a fourth on the outer margin near the center.

Total length, 1.40 mm. Width of cephalothorax, 1 mm. Length of egg strings, 0.40 mm.

External specific characters of immature female.—General body form elogate and slender, the exact reverse of that in the mature adult. In the latter the total length is to the width of the cephalothorax as 10 to 7, while in this immature female the proportion is nearly as 3 to 1. The cephalothorax is elliptical, the length and width being about the same; the prolongations at the posterior corners take more of a backward and less of a lateral direction. The second and third segments are considerably narrower than the cephalothorax, and are prolonged at their posterior corners similarly. The dorsal shield on the fourth segment is strictly confined to that segment and does not overlap even the fifth segment; it is about the same width as that on the third segment. The fifth and genital segments are uncovered and wholly visible in dorsal view. The fifth segment is contracted anteriorly into a sort of neck and then widened through the bases of the fifth legs. The gential segment is trapezoidal in outline. The abdomen is three-jointed and three times as long as wide; the anal laminae are slender, much longer than wide, and each is armed with two short setae on the outer margin and two much larger ones at the tip, of which the inner is fully twice the length of the outer.

The first antennae are relatively longer than in the adult, and the other appendages are about the same, except the swimming legs, whose rami have only two joints instead of three.

Total length, 0.90 mm. Width of carapace, 0.32 mm.

External specific characters of male.—General body form about halfway between those of the mature and immature females. It is not as slender as the young female and much less thickset than the mature adult. The cephalothorax is nearly orbicular, the same width and length. The second and third segments are considerably narrower and quite short. Their posterior corners and those of the cephalothorax are prolonged backward; those of the third segment reach well beyond the center of the fourth segment and are bluntly rounded. The dorsal plate of the fourth segment is quadrangular, three-fourths as long as wide, and overlapping the bases of the fifth legs. The genital segment is also quadrangular and carries the rudiments of a sixth pair of legs on its lateral margins at about the center; at each posterior corner is a long spine. The abdomen is three-jointed, the last joint irregularly divided. The anal laminae are oblong and like those of the female, but each carries four setae, three at the tip and one on the outer margin. The inner one at the tip is the longest and is fully twice the length of the next in size. The appendages are very similar to those of the female, the chief differences being found in the maxillipeds and first legs, both of which are used as prehensile organs.

Total length, 0.67 mm. Width of cephalothorax, 0.30 mm.

CLAUSIDIUM CAUDATUM (Say).

Binoculus caudatus SAY, Journ. Acad, Nat. Sci., Philadelphia, vol. 1, 1818, p. 437.

Host and record of specimens.—This parasite was found in considerable numbers on various parts of the body of *Callianassa major* Say, dug from the sand of the bay shore of the St. John River in Florida by Thomas Say.

External specific characters of female.—Body subovate; cephalothorax semioval or parabolic, posterior edge retuse for the reception of the free thorax; anterior antennae horizontally extended, more than half as long as the body, with short, rigid hairs. Basal segments of free thorax very short, transverse; terminal segment longer, semiorbicular, narrower than the preceding ones and concealing the genital segment; abdomen and genital segment half as long as the body, with three segments, the basal one (genital segment) longitudinally quadrate, the second one transversely quadrate, the third segment bifid and bisetous at the tip. Length, 0.82 mm.

In nine-tenths of the specimens the two sexes were taken together, the male clinging to the abdomen of the female so as to conceal by his body the two terminal segments.

Remarks.—The above description is modified from the one given by Say and somewhat condensed. The nomenclature has been changed to agree with that now in use for the copepods, but otherwise the statements are as Say gave them. They leave no doubt of two things—first, that he was describing a species of *Clausidium*, and second, that it differed from the other species in important particulars. In referring the species to its genus Say declared: "I have placed this parasite in Geoffroy's genus *Binoculus*, not in consequence of the particular definition of that genus, but from a general resemblance in the outline and similarity in the number and proportion of the segments of the body, which it unquestionably bears, to the singular animal discovered by that author, now the type of the genus." This "singular animal" was the European *Argulus foliaceus*, and it is very evident that Say was not dealing with anything belonging to that genus.

Accordingly we may transfer his species to the genus *Clausidium* and retain its specific name until future research can furnish us the details necessary to fully establish it.

EXPLANATION OF THE PLATES.

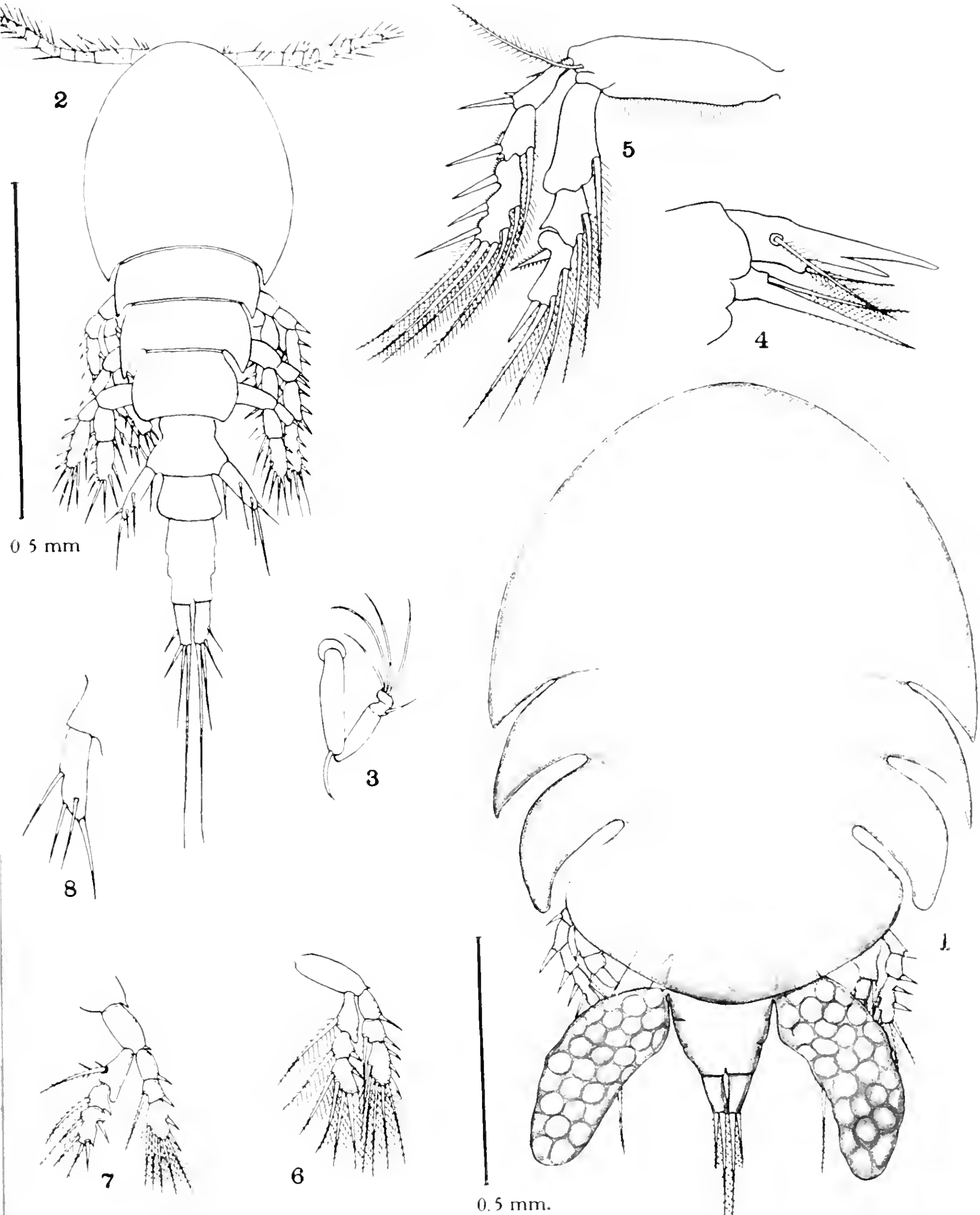
Plate 94.

Clausidium dissimile, new species.

Fig. 1. Dorsal view of adult female.
2. Dorsal view of immature female.
3. Second antenna of female.
4. Second maxilla of female.
5. Second legs of adult female.
Figs. 6-8. Third, fourth, and fifth legs of male.

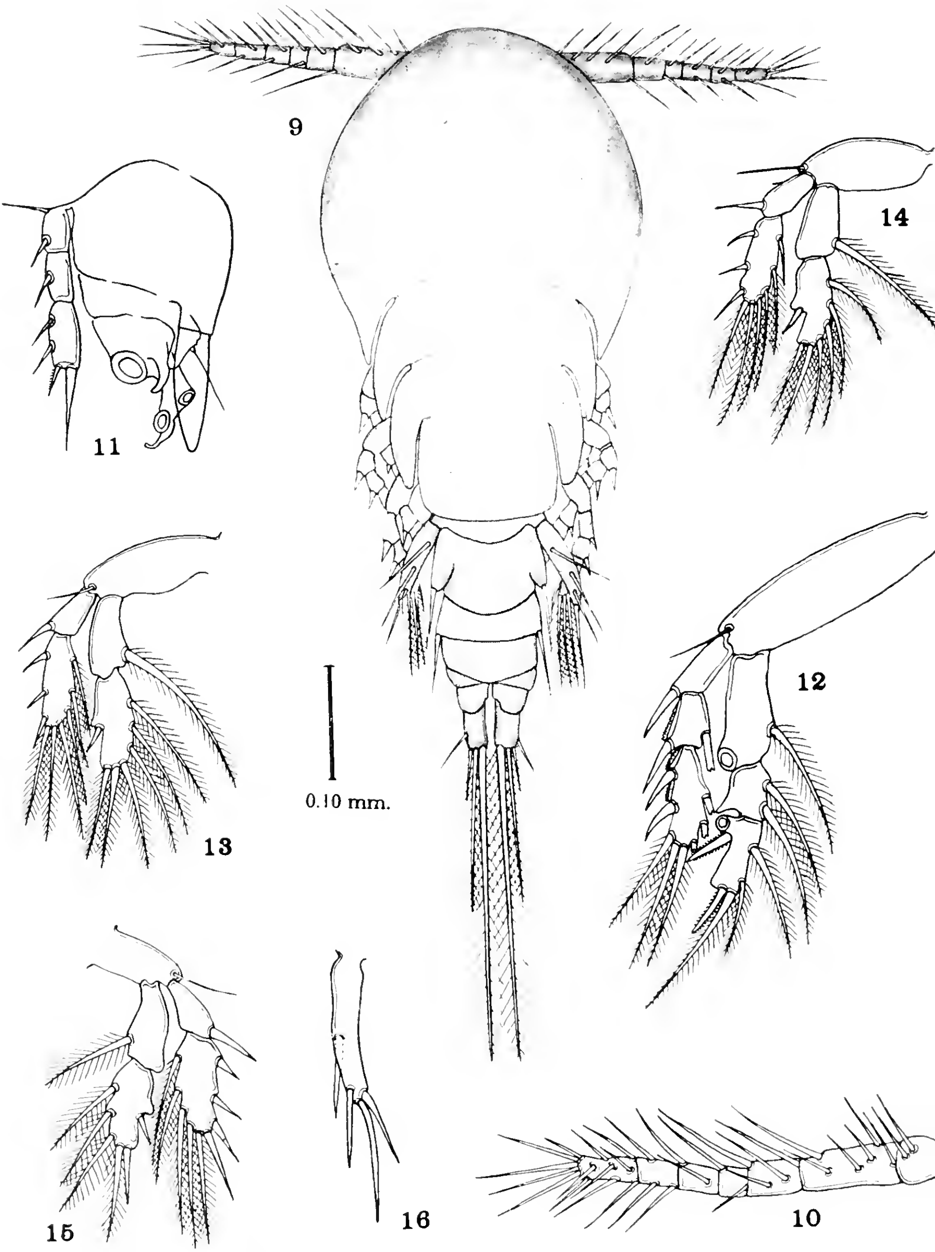
Plate 95.

Fig. 9. Dorsal view of male.
10. First antenna of female.
11. First swimming leg of female.
12. Fourth swimming leg of female.
Figs. 13-15. Second, third, and fourth swimming legs of immature female.
Fig. 16. Fifth leg of adult female.



CLAUSIDIUM DISSIMILE, A NEW SPECIES OF COPEPOD.

FOR EXPLANATION OF PLATE SEE PAGE 431.



CLAUSIDIUM DISSIMILE, A NEW SPECIES OF COPEPOD.

FOR EXPLANATION OF PLATE SEE PAGE 431.

NOTES ON CERTAIN GENERA OF PARASITIC CYNIPIDAE PROPOSED BY ASHMEAD WITH DESCRIPTIONS OF GENOTYPES.

By Lewis H. Weld,

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

In his classification of the superfamily Cynipoidea [1] Dr. W. H. Ashmead proposed several new generic names in his key, designating as the type in each case a new species which neither at that time nor since has received fuller description. Eight of these new genera were recognized by Ashmead in a collection of South American Hymenoptera made by H. H. Smith and since acquired by the Carnegie Museum of Pittsburgh. He had planned a paper on the South American Cynipoidea and drawn up a rough outline, but descriptions of species were never written out and the paper was never finished. Although his report on the Chalcidoidea of South America published by the Carnegie Museum states that the Cynipoidea have been returned except for a set of duplicates in his possession, the actual return seems not to have been carried out and the small collection of about 40 specimens has remained in the United States National Museum until the present time substantially as he left it. If these are the "duplicates," the bulk of the collection is not yet located. Without making a full report either on this collection or on the Cynipoidea of South America known to date it seems advisable to write out descriptions of these genotype species whose names are in the literature so that the collection may now be returned to the Carnegie Museum and publish figures of them so that they may be be available to students of the South American fauna. Through the courtesy of Dr. W. J. Holland, director of the Carnegie Museum, an exchange has been arranged so that these genotypes, together with seven species of *Liopteron,* three of which were described by Ashmead, may remain in the United States National Museum, where is located probably the largest collection of American parasitic Cynipidae. The balance of the H. H. Smith Cynipid collection has now been returned to the Carnegie Museum. To this attempt to make the relationships of these South American genera better understood are appended a few notes on other genera correcting some errors in the Dalla Torre and Kieffer Monograph of 1910.[2]

[1] Psyche, 1903, vol. 10.

[2] Das Tierreich, Lief. 24.

The figures are by the author. Those of antennae and wings from balsam mounts by use of a projection microscope: the others are drawn to scale under a compound microscope by use of a filar micrometer and a two-thirds objective.

Subfamily ANACHARITINAE Dalla Torre.

Genus ACANTHAEGILIPS Ashmead.

Acanthaegilips Ashmead, Psyche, vol. 8, 1897, p. 67.

Genotype.—*Acanthaegilips brasiliensis* Ashmead. Monobasic (fig. 1).

This genus was founded on a single specimen (Cat. No. 23645, U.S.N.M.) from which the following notes have been made supplementing the original description. It was captured in April.

The head seen from in front is triangular, malar space two-thirds eye and with a fine groove, cheeks not margined. Mounted in balsam the first segment of antenna is longer than the third, which in turn is longer than the fourth, 5–12 gradually decreasing, last one and three-fourths times preceding. Truncature of pronotum with a short median tooth above, sides areolate. Mesoscutum broader than long, strongly arched. Scutellum with a median ridge running up the spine and with a triangular polished groove on either side, separated from mesoscutum by a distinct suture. Propodeum prolonged into a neck behind, its upper surface bearing two parallel carinae, between which are several transverse ridges and a median. Petiole of abdomen nearly twice as long as broad and longitudinally ridged. Radial cell three times as long as broad. Second segment of abdomen not distinctly tongue-shaped, not striate, three-fourths as long as the third, which occupies the remainder of the abdomen. Length, 2.85 mm.

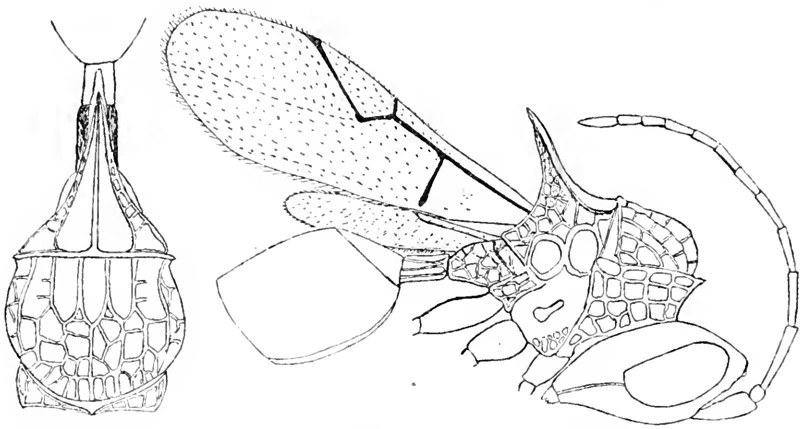


FIG. 1.—ACANTHAEGILIPS BRASILIENSIS ASHMEAD X 24.9. DORSAL VIEW OF THORAX. SIDE VIEW.

Subfamily FIGITINAE Dalla Torre.

Genus KIEFFERIELLA Ashmead.

Kiefferia ASHMEAD, Psyche, vol. 10, 1903, p. 10 (not Mik 1895 in Diptera!).—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 369.

Kiefferiella ASHMEAD, Ent. News, vol. 14, 1903, p. 159; Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221.—DALLA TORRE and KIEFFER, Das Tierreich, 1910, Lief. 24, pp. 83, 887.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, p. 369.

Genotype.—*Kiefferiella rugosa* Ashmead. Monobasic.

Head and thorax very coarsely rugose, head not broadened behind the eyes, cheeks margined, malar space without groove, antennae of female filiform, third shorter than fourth, all flagellar segments long-cylindrical. Pronotum subtruncate in front, the truncation not margined, but with upturned sharp margin behind. Parapsides percurrent. Scutellum rounded behind; two large deep smooth pits at base separated by a narrow septum. Mesopleura separated from sternum by a carina. Wing with closed marginal cell, no areolet, pubescent and ciliate. Abdomen laterally compressed much as in *Ibalia*, longer than head and thorax, second tergite not tongue-shaped, bare, as long as third and fourth united. The character of "hairy eyes" is a very obscure one seen only with high magnification.

The genus may be readily recognized by the use of the Tierreich key.

KIEFFERIELLA RUGOSA Ashmead.

Kiefferia rugosa ASHMEAD, Psyche, vol. 10, 1903, p. 10 (sine desc.).

Kiefferiella rugosa ASHMEAD, Ent. News, vol. 10, 1903, p. 159 (sine desc.); Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221 (sine desc.).—DALLA TORRE and KIEFFER, Das Tierreich, 1910, Lief. 24, p. 83.

Female.—Black with sparse short white pubescence on head and thorax. Head broader than thorax, rugoso-punctate with radiating ridges about mouth, facial line 0.75 transfacial, interocular line 0.58 transfacial, and area 1.4 times as broad as high, malar space 0.7 eye, frons with two smooth impressions above antennae making an elevated triangle with ocelli at broad upper end, antennae said to be 13-segmented (now broken beyond eighth), first longer than third, second almost globular, third three times as long as broad, 4–6 subequal and each about 1.4 times third, eighth longer than third. Pronotum reticulate on sides. Mesoscutum as long as broad, rough with sharp transverse ridges running across the shallow parapsides, anterior lines very short, trace of median behind. Scutellum coarsely reticulate, half as long as mesoscutum, with hind margin vertically ridged and slightly overhanging. Propodeum with two square impressed areas side by side. Mesopleurae with two polished and two sculptured areas, separated from sternum by longitudinal ridge. Front wing with brown veins, radial cell three times as long as broad, cubitus reaching basal, areolet absent, clouded on marginal cell and uo distal half of first and proximal part of third cubital cells, surface pubescent, margin ciliate, not reaching to tip of abdomen. Hind tarsus longer than tibia, second and fifth subequal, claws weak and simple. Abdomen smooth and shining, strongly laterally compressed, longer than head and thorax, second tergite not tongue-shaped, not striate, bare, as long as third and fourth united, the latter subequal, fifth longer than fourth, sixth longer than fifth, seventh short and triangular, the last three being microscopically punctate on sides with a few white hairs near dorsal margin, ventral valves protruding posteriorly, hypopygium plowshare-shaped.

Length, 5.3 mm. Abdomen, 3.25 mm. by 1.45 mm. wide. Wing, 3.5 mm.

Described from one female.

Type.—Cat. No. 23454, U.S.N.M. Type female on tag and parts on slide.

Type locality.—Santa Cruz Mountains, California. C. F. Baker, collector.

Genus (THYREOCERA Ashmead=)FIGITES Latreille.

Thyreocera Ashmead, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 154.—Dalla Torre, Cat. Hym., vol. 2, 1893, p. 4.—Kieffer in Andre Spec. Hym. Eur., vol. 7, 1902, p. 247, footnote.—Dalla Torre and Kieffer in Wytsman, Gen. Ins. Cynipidae, 1902, p. 7.—Ashmead, Psyche, vol. 10, 1903, p. 10.—Dalla Torre and Kieffer, Das. Tierreich, Lief. 24, 1910, pp. 95, 890.—Rohwer and Fagan, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 376.

Genotype.—*Figites laeviscutum* Provancher (=*nigrifemora* Ashmead).

This genus was distingusihed from all other known Figitinae by having "*a small erect club on its disk posteriorly near the tip.*" It was proposed in September and *Thyreocera nigrifemora* Ashmead, described from one specimen from Ontario, was the only included species. In January of the same year, however, Provancher's description under the name of *Figites laeviscutum* had preceded Ashmead's [3] so that the type must be known as *Thyreocera laeviscutum* Provancher. The specimen on which Ashmead founded the new genus is in the United States National Museum (Cat. No. 23607), and an examination shows that the erect club on the scutellum is nothing more than a small black cinder stuck on at that point. The specimen is a true *Figites* and should be placed in that genus and the name *Thyreocera* should disappear in synonomy.

Genus (FIGITODES Ashmead=)TRISCHIZA Foerster.

Figitodes, Ashmead, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 150.—Dalla Torre and Kieffer, Wytsman Gen. Ins. Cynpidae, 1902, pp. 4, 8.—Ashmead, Psyche. vol. 10, 1903. p. 11.—Dalla Torre and Kieffer, Das. Tierreich, Lief. 24, 1910, pp. 98, 886.—Rohwer and Fagan, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 367.

Figitides, Cockerell, Trans. Kansas Acad. Sci., vol. 16, 1899, p. 213.

This genus was first proposed by Ashmead in 1887 in a key separating it from *Figites*, but no species was mentioned. In 1896 he

[3] Addit. faun. Canad. Hym., 1887, p. 170.

described a *Figitodes atricornis* [4], which, being the first included species, must be the genotype. His subsequent designation in 1903,[5] accepted by Rohwer and Fagan, of *Figites quinquelineata* Say as the type is therefore erroneous.

Examination of the type specimen of *atricornis* in the United States National Museum (Cat. No. 23069) shows it to be a *Trischiza* as was stated by Dalla Torre and Kieffer in 1902.[6] *Figitodes* Ashmead thus becomes a synonym of *Trischiza* Foerster.

Subfamily EUCOILINAE Dalla Torre.

Genus ZAMISCHUS Ashmead.

Zamischus Ashmead, Proc. Ent., Soc. Wash., vol. 5, 1903, p. 221; Psyche, vol. 10, pp. 60, 68.—Dalla Torre and Kieffer, Das Tierreich, Lief. 24, 1910, pp. 101, 891.—Rohwer and Fagan, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 378.

Genotype.—Zamischus brasiliensis Ashmead. Monobasic.

Propodeum produced posteriorly into a long tapering neck as long as hind coxae and the abdomen attached to this by an abnormally long slender petiole making a remarkably long and slender body. Petiole as long as rest of abdomen which is laterally compressed, without ring of hair at base, ovipositor exserted. Antennae of female nearly as long as body, third segment smooth, slightly bent, shorter than fourth, distal half of flagellum gradually broadened and laterally compressed as in genus *Peras* Westwood instead of being "gradually thickened toward apex" as stated by Ashmead. Venation of fore wing reduced to basal and one longitudinal vein, costal and margined cells confluent, areolet absent, surface sparsely pubescent, margin ciliate.

This remarkable genus is easily recognized in both the Ashmead and Tierreich keys. The origin of the abdomen and flattened antennae relate it to certain of the Liopterinae.

ZAMISCHUS BRASILIENSIS Ashmead.

Zamischus brasiliensis Ashmead, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221 (sine desc.); Psyche, vol. 10, 1903, p. 60 (sine desc.).—Dalla Torre and Kieffer Das Tierreich, Lief. 24, 1910, p. 101.

Female.—Black; legs, except hind coxae, flagellum and base of second tergite brownish. Head smooth and polished with scattered setigerous punctures, cheeks not margined, broader than thorax; seen from above elliptical, axial line three-fourths the transfacial; seen from in front facial and transfacial about equal; interocular space 0.44 transfacial and area 0.73 times as broad as high, malar space 0.4 eye and with fine groove, antennae arising above middle

[4] Trans. Amer. Ent. Soc., vol. 23, p. 182.
[5] Psyche, vol. 10, p. 11.
[6] Wytsman's Gen. Ins. Cynipidae, p. 8, footnote.

of eye, said to be 13-segmented (now broken beyond 10), 3 longer than 1 plus 2, slightly curved, smooth, six times as long as broad and 0.73 length of fourth, 4–10 subequal, longitudinally ridged, from about the seventh on vertically compressed so that in side view the antennae are broadened toward apex, tenth two and one-half times its greatest width. Truncation of pronotum about 0.4 width of head and with two prominent triangular teeth above, its sides polished and produced posteriorly. Mesoscutum somewhat triangular, longer than broad, parapsides represented by rows of punctures, slightly sculptured posteriorly. Scutellum rounded behind, cup large, its surface convex and slightly punctured, tapering in front into septum between the two deep pits, disk punctate axillae longitudinally striate. Propodeum as long as width of head, its neck with two almost parallel carinae above and two less prominent ones on each side. Mesopleurae finely aciculate. Hind coxae cylindrical. Front wing with only the first cross vein and one longitudinal, the apical abscissa of subcosta, cubitus, median, areolet, and costal hinge wanting, radial cell long and narrow, open at base and at margin, cell to wing ratio 1:6, surface sparsely pubescent, margin ciliate. Petiole of abdomen longitudinally ridged, as long as rest of abdomen which is ovate, laterally compressed, bare at base, second tergite largest, ovipositor projecting at tip.

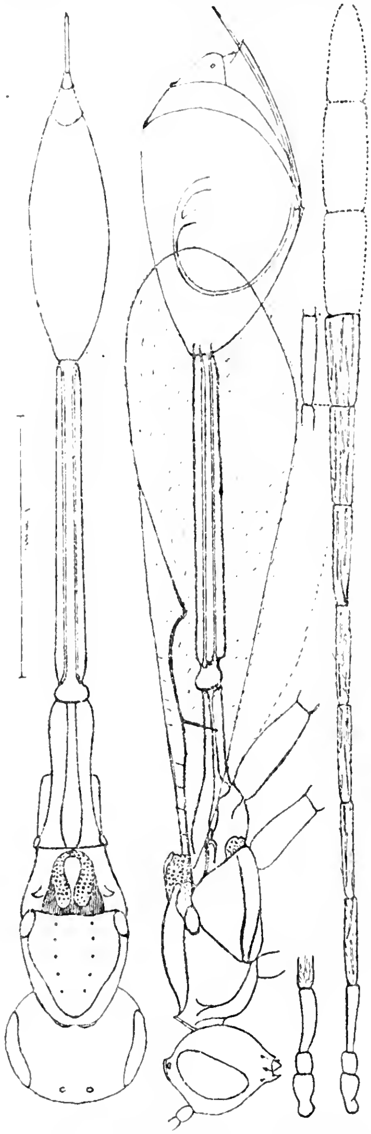


FIG. 2.—ZAMISCHUS BRASILIENSIS ASHMEAD. DORSAL AND SIDE VIEW OF BODY AND ANTENNA.

Length, 4.1 mm. Antennae, about 3.8 mm. Wing, 2.4 mm. by 0.65 mm. Abdomen, including petiole, 2.5 mm.

Described from one female captured in November by H. H. Smith.

Type.—Cat. No. 23646, U.S.N.M. Body on tag. Wing and abdomen on slide.

Type locality.—Brazil; Santarem.

Genus DIEUCOILA Ashmead.

Dieucoila ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222 (April 6).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, pp. 101, 884.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 364.

Dieucoela ASHMEAD, Psyche, vol. 10, 1903, pp. 65, 71. (April 15).—SHARP in Zool. Record, vol. 40, 1904, Insects, p. 244.

Genotype.—*Dieucoila subopaca* Ashmead. Monobasic.

Head broader than thorax, longer than broad, eyes bare, cheeks not margined,malar space less than half eye, antennae arising above middle of eyes and facial outline in side view angled at this point, 13-segmented in female, 15-segmented in male with third excavated, not longer than fourth and all flagellar segments cylindricial. Pronotum truncate. Mesoscutum without parapsides or carinae. Scutellum not ending in a spine, cup well raised, narrow, tapering gradually into a prominent median carina which separates the two large pits at base, axillae prominent but not ending in distinct teeth, disk alveolate, rounded or crenate behind. Front wing normal in shape and size, pubescent and ciliate, radial cell closed. Abdomen with hairy ring at base, only normally compressed.

Among the characters used by Ashmead to distinguish this genus was the peculiarity of the dull and sculptured head and thorax and this character alone has been used by Dalla Torre and Kieffer to separate it from all the rest of the *Eucoilinae*. The H. H. Smith South American collection also contained representatives of two other species with the habitus and other generic characters of this genus, and from them it is seen that the above mentioned sculpture is merely a specific character although both show traces of it on the head. The lack of a club in female antennae is evidently a specific character also. The genus is closely related to *Miteucoela* Kieffer whose genotype has a five segmented club and a body without sculpture. It is separated from *Aglaotomidea* Rohwer and Fagan by the lack of an abnormally long third antennal segment in the male.

DIEUCOILA SUBOPACA Ashmead.

Dieucoila subopaca ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221 (sine desc.).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 101.

Dieucoela subopaca ASHMEAD, Psyche, vol. 10, 1903, p. 65.

Female.—Reddish-brown, legs and flagellum yellowish. Head and thorax seemingly aciculate but the sculpture really consists of a series of fine ridges, dull, not polished. Head broader than thorax, facial line 1.06 times transfacial, interocular line 0.4 transfacial and area two-thirds as broad as high, malar space 0.43 eye, radially striate about mouth, antennae arising above middle of eyes and facial outline in side view angled at that point, antennae 13-segmented, 3–6 slender, long-cylindrical and closely joined, 7–13 cylindrical but rounded at ends, becoming somewhat stouter but none broader than second, not forming a club, last three infuscated, third five times as long as broad; relative lengths as 7:6:15:17:17:16:14:13:11:11:10:10:12. Pronotum with truncature 0.42 times width of head. Mesoscutum broader than long. Scutellum 0.74 length of mesoscutum, disk coarsely alveolate, rounded behind, cup narrow, tapering in front into a narrow septum which separates the two deep pits which are longer than broad, cup not as broad as a pit, and at its posterior end is a small pit in front of which is a prominent tooth making the cup in side view resemble the open mouth of a snake, axillae aciculate. Mesopleura separated from sternum by a sharp carina with a fainter carina above. Hind tarsus longer than tibia, claws simple. Veins in fore wing pale, radial cell closed and three times as long as broad, cell to wing ratio 1:4.7, no areolet, pubescent and ciliate, reaching far beyond tip of abdomen. Abdomen only normally compressed, longer than broad, truncate behind, second segment occupying whole length and with hairy ring at base.

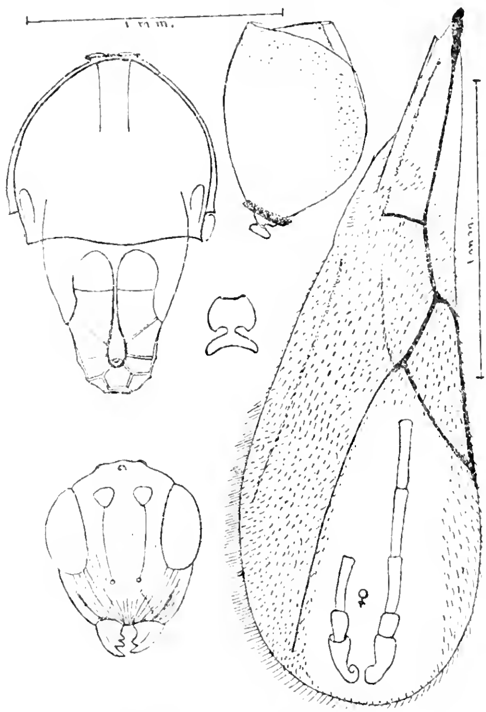


FIG. 3.—DIEUCOILA SUBOPACA ASHMEAD, WING, ANTENNA AND FACE AT SAME MAGNIFICATION.

Length, 1.8 mm. Wing, 2.3 mm. Antenna, about 2 mm.

Male.—Antennae 15-segmented, 3–5 equal, third excavated and longer than 1 plus 2, 6–14 gradually shorter, last slightly longer than preceding, distal half infuscated. Abdomen longer than broad, truncate behind.

Length, 1.5 mm. Wing, 1.95 mm. Antenna, over 2.5 mm.

Described from three specimens, one male and one female captured in September and one female in April.

Type.—Cat. No. 23652, U.S.N.M. Type female, allotype, one female paratype with parts on slide.

Type locality.—Brazil: Chapada (H. H. Smith, collector).

Genus ODONTEUCOILA Ashmead.

Odonteucoila ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222; Psyche, vol. 10, 1903, pp. 64, 71.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, pp. 102, 888.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 371.

Odontoeucoila (typographical error) ASHMEAD, Psyche, vol. 10, 1903, p. 64 last line.

Genotype.—*Odonteucoila chapadae* Ashmead. Monobasic.

Disk of scutellum rugose and prolonged into a tapering blunt spine extending horizontally backward but not reaching beyond hind end of propodeum. Cup narrow, not reaching three-fourths way back to end of scutellum, with the usual pit near hind margin and a slight elevation and a few punctures in front of it. Head broader than thorax, cheeks not margined, malar space less than half eye, antennae arising above middle of eyes, long, filiform, with the third segment shorter than fourth and 4–6 long-cylindrical, flagellum gradually thickened toward apex without distinct club. Wing with closed marginal cell, pubescent and ciliate. Abdomen with hairy ring at base.

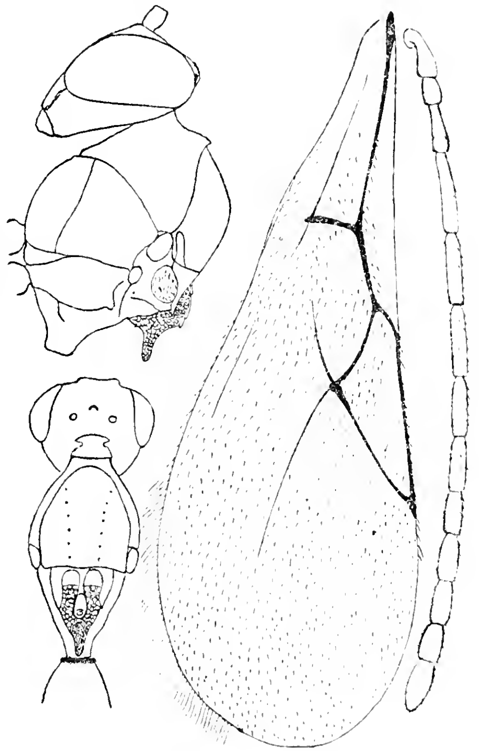


FIG. 4.—DETAILS OF ODONTEUCOILA CHAPADAE ASHMEAD.

Related to *Trissodontaspis* Ashmead whose cup extends to tip of scutellum and whose axillae form prominent teeth in either side. In the other two genera with scutellum ending in a spine (*Gonieucoela* Kieffer and *Acantheucoela* Ashmead), the spine is produced on the sloping surface of the cup in front of the usual pit and not made by a prolongation of the disk of the scutellum.

ODONTEUCOILA CHAPADAE Ashmead.

Odonteucoila chapadae ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, p. 222 (sine desc.); Psyche, vol. 10, 1903, p. 64 (sine desc.).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 102.

Female.—Dark red, head and distal part of antennae infuscated, legs yellowish. Head polished, thorax micro-aciculate yet shining.

Head broader than thorax, seen from in front longer than wide, facial and transfacial lines equal, interocular space 0.42 transfacial and area 0.6 as broad as high, malar space 0.3 eye and with groove, eyes bare, antennae arising above middle of eyes, 13-segmented, 3 equal to 1 plus 2 and 0.56 length of 4, 5 and 6 equal and slightly shorter than 4, gradually shorter to 12 which is 1.6 times as long as broad, last 1.2 times preceding, gradually stouter from about 9 without distinct club. Pronotum truncate, truncation 0.39 width of head and emarginate above. Mesoscutum longer than broad, parapsides represented by a few setigeous punctures. Scutellum 0.83 length of mesoscutum, cup extending back slightly over halfway. Cup one-third width of disk and narrowed in front into a low septum between the two deep smooth pits. Surface of cup bears usual pit near hind margin with a slight elevation and a few punctures in front of it. Disk rugose or reticulate, tapering behind into a blunt horizontal spine. Carinae on propodeum angled in middle, inclosed space longer than broad. Mesopleura separated from abdomen by a distinct carina, another finer one about one-third way up. Fore wings hyaline, radial cell closed, 3.3 times as long as broad and cell to wing ratio 1:4.6, first abscissa of radius shorter than second, no areolet, pubescent and ciliate, extending beyond abdomen. Abdomen normally compressed, longer than broad, second tergite occupying whole length, hairy ring at base.

Length, 1.9 mm. Wing, 2.05 mm. Antenna, 1.9 mm. Abdomen, 0.9 mm.

Described from one specimen. Ashmead stated that the male has 15-segmented antennae. There were once in the collection two other specimens now lost from the tags and one or both of these may have been males.

Type.—Cat. No. 23647, U.S.N.M. Type female on tag and parts on slide.[7]

Type locality.—Brazil: Chapada. Collected by H. H. Smith in August.

Genus TRISSODONTASPIS Ashmead.

Trissodontaspis ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222; Psyche, vol. 10, 1903, pp. 65, 71.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, pp. 102, 891.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 377.

Genotype.—Trissodontaspis rufipes Ashmead. Monobasic.

Head broader than thorax, cheeks not margined, antennae filiform, flagellar segments all long-cylindrical, third smooth, slightly curved and shorter than fourth. Truncation of pronotum deeply emarginate above making two triangular teeth. Mesoscutum without parapsides or carinae and like head and axillae polished. Scutellum with prominent median carina which is dilated posteriorly into a narrow cup whose distal portion including the pit is vertical—

[7] After drawing was completed the body was unfortunately lost from tag.

hence the cup resembles a funnel. The axillae form prominent slightly upturned teeth on either side of the two large pits making the scutellum tridentate from above, the median being the longest and formed of the cup and disk together and truncate at end. The disk is margined postero-laterally and rugose-punctate. Propodeum as long as scutellum. Wing with closed marginal cell, pubescent, ciliate. Abdomen with a ring of hairs at base.

TRISSODONTASPIS RUFIPES Ashmead.

Trissodontaspis rufipes ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222 (sine desc.); Psyche, vol. 10, 1903, p. 65 (sine desc.).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 102.

Female.—Polished black, legs and abdomen red, the latter infuscated on median dorsal line. Head broader than thorax, with scattered setigeous punctures on face, facial and transfacial equal, interocular space 0.47 transfacial and area 0.8 as broad as high, malar space 0.42 eye with a very fine groove, eyes with sparse microscopic hairs, cheeks not margined, antennae arising above middle of eyes, 13-segmented, flagellum of long-cylindrical segments, third segment slightly curved, smooth, equal to 1 plus 2, slightly shorter than 4, 6–8 longest, 9–12 decreasing, the last 1.15 times preceding. Pronotum truncate, truncation 0.44 width of head with deep angular notch above, usual lateral indentations and tuft of pubescence on either side. Mesoscutum as broad as long, no parapsides and but few punctures. Scutellum two-thirds as long as mesoscutum, cup reaching to tip; two large smooth pits longer than broad at base separated by a septum which runs back as a longitudinal ridge becoming broader and bearing four punctures on its top and trun-

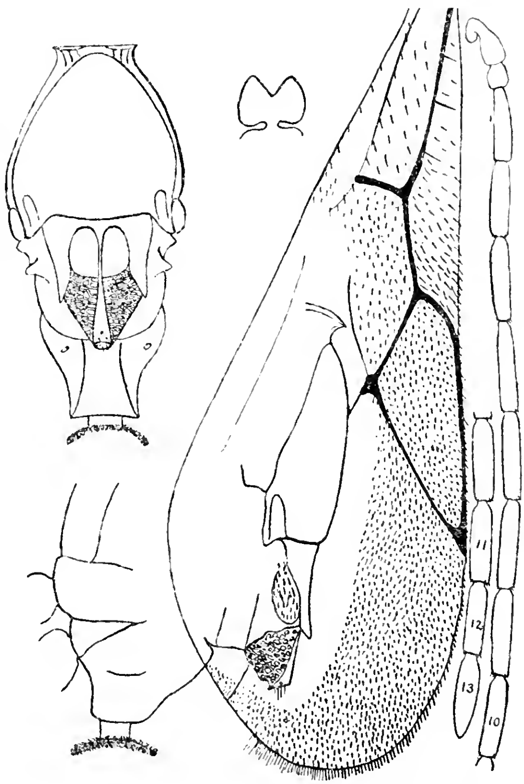


FIG. 5.—DETAILS OF TRISSODONTASPIS RUFIPES ASHMEAD.

cate like a funnel at the end. The disk rugoso-punctate, margined on sides and prolonged so as to form with above cup a blunt spine On outer edge of each pit the axilla forms a prominent tooth which reaches a little beyond middle of scutellum. Propodeum somewhat prolonged into a neck, the carinae converging in front. Mesopleura separated from sternum by distinct carina with a finer ridge just above it. Metapleura pubscent with bare spot above. Wings dusky, reaching beyond abdomen, radial cell closed, three times as long as broad, cell to wing ratio 1:3.8, first abscissa of radius shorter than second, no areolet, surface pubescent, margin ciliate. Abdomen longer than broad, normally compressed, obliquely truncate behind, second tergite occupying 0.7 and with ring of hairs at base.

Length, 3.35 mm. Antenna, 3.8 mm. Wing, 3.15 mm.

Described from one specimen, captured in April.

Type.—Cat. No. 23649, U.S.N.M. Type female on tag and parts on slide.

Type locality.—Brazil: Chapada (H. H. Smith).

Genus ZAEUCOILA Ashmead.

Zaeucoila ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222 (April 6).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, pp. 102, 891.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 378.

Zaeucoela ASHMEAD, Psyche, vol. 10, 1903, pp. 66, 71 (April 15).—SHARP in Zool. Record, vol. 40, 1904, Insects, p. 244.

Genotype.—*Zaeucoila unicarinata* Ashmead. Monobasic.

Short, robust. Head not broader than thorax, cheeks margined, antennae in male with first segment of flagellum slightly longer than second, all flagellar segments oblong-oval, twice as long as broad (not "about thrice" as stated by Ashmead with "first joint of flagellum not longer than second"). Pronotum truncate. Mesoscutum shorter than broad, polished, with a low median ridge which is widest in front and tapers gradually to a point at or near hind margin, short grooves just over fore wings. Scutellum rounded behind, cup large, almost circular, over half as wide as disk, reaching nearly as far back as disk, pits at base large and deep, disk rugose. Mesopleura separated from sternum by carina. Radial cell short, closed, wing surface pubescent and margin ciliate. Abdomen with ring of hairs at base.

Separated from *Moneucoela* Dalla Torre and Kieffer, *Frireniella* Kieffer, and *Rhabdeucoela* Kieffer, which all have a median longitudinal ridge on mesoscutum, by the short and *closed* radial cell.

ZAEUCOILA UNICARINATA Ashmead.

Zaeucoila unicarinata ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222 (sine desc.).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 103.

Zaeucoela unicarinata ASHMEAD, Psyche, vol. 10, 1903, pp. 66, 71.

Male.—Black, legs and flagellum piceous. Head as broad as thorax, with scattered setigerous punctures on polished face, interocular space 0.45 transfacial and area 0.8 as broad as long, malar space less than half eye and with striate line to mouth, eyes bare, cheeks margined, occiput concave, antennae 15-segmented, third slightly bent, in balsam slightly longer than fourth, rest ellipsoidal, twice as long as broad, the last slightly longer than preceding. Pronotum truncate, truncation 0.6 transfacial, arcuately emarginate above. Mesoscutum 0.6 as long as broad, without parapsides, polished, a low smooth but distinct median ridge tapers gradually from front margin to a point at or near scutellum, two short grooves just above fore wings. Scutellum nearly as long as mesoscutum, with two transverse pits at base, cup large, 0.69 width of disk, oval, surface slightly concave with a depression in center surrounded by 6–7 punctures, disk rugose, rounded behind. Carinae on propodeum slightly bent outward, converging to a polished median area above the foramen. Mesopleura smooth, separated from sternum by a carina, traversed by a longitudinal carina. Wing with heavy veins about the short closed radial cell, which is 1.6 times as long as broad, cell to wing ratio 1:4.5, first cubital cell and course of median vein slightly clouded, surface pubescent, margin ciliate, reaching beyond tip of abdomen. Abdomen longer than broad, slightly shorter than thorax, normally compressed, only second tergite visible, with hairy ring at base.

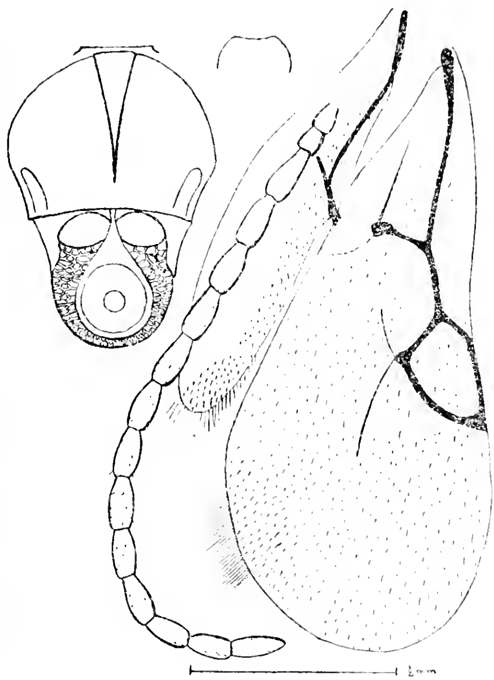


FIG. 6.—DETAILS OF ZAEUCOILA UNICARINATA ASHMEAD.

Length, 1.3 mm. Wing, 1.5 mm. Antenna, 1.68 mm.

Described from one specimen collected in August.

Type.—Cat. No. 23650, U.S.N.M. Type male on tag and parts on slide.

Type locality.—Brazil: Rio de Janeiro (H. H. Smith, collector).

Genus PROMIOMERA Ashmead.

Promiomera ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221 (April 6).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, pp. 104, 889.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, p. 373.

Promiomoera ASHMEAD, Psyche, vol. 10, 1903, pp. 63, 70 (April 15).—SHARP in Zool. Record, vol. 40, Insects, p. 244.

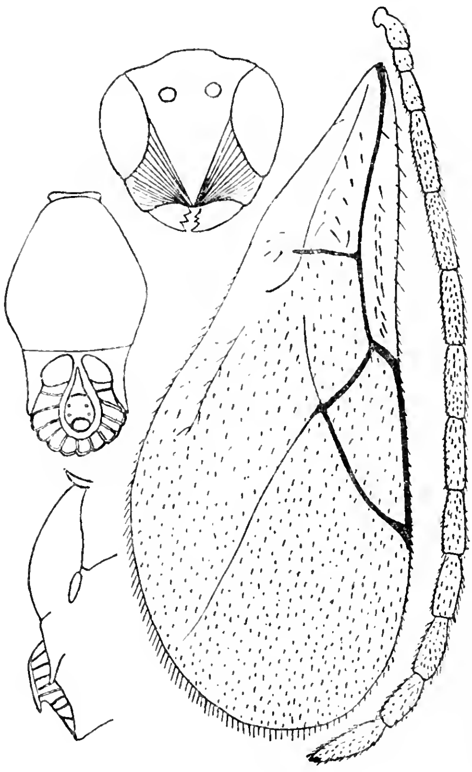


FIG. 7.—DETAILS OF PROMIOMERA FILICORNIS ASHMEAD.

Genotype.—*Promiomera filicornis* Ashmead.

Head broader than thorax, cheeks not margined, malar space less than half eye, antennae of male filiform, third slightly bent and not over half length of second, rest of flagellar segments long, cylindrical. Pronotum truncate. Mesoscutum smooth and polished without grooves or carinae. Scutellum with two pits at base, cup high and circular, half as wide as disk and not reaching back to its hind margin; disk areolate, rounded behind. Mesopleura separated from sternum by carina. Wing with closed radial cell, pubescent, ciliate. Abdomen with ring of hairs at base.

PROMIOMERA FILICORNIS Ashmead.

Promiomera filicornis ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221 (sine desc.).—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 104 (sine desc.)

Promiomoera filicornis ASHMEAD, Psyche, vol. 10, 1903, pp. 63, 70.

Male.—Red, head infuscated. Head broader than thorax; seen from in front facial line 0.8 transfacial, interocular space 0.44 transfacial and area 0.79 as broad as long, malar space 0.36 eye, face covered with striae radiating from mouth upward except on a median V-shaped polished area, eyes bare; seen from above axial line 0.54 transfacial, occiput slightly truncate but cheeks not margined, antennae arising above middle of eyes, 13-segmented, flagellum segments all long-cylindrical, third slightly bent, not longer than first and only half as long as fourth, 5–7 equal and 3.5 times as long as broad, 8–12 gradually shorter, last equal to fourth. Pronotum truncate, truncation 0.4 width of head and emarginate above, usual notches below with pubescent patches on front margin on sides. Mesoscutum as long as broad, smooth, polished. Scutellum 0.72 length of mesoscutum, cup large, circular, reaching back 0.85 of its length, depressed in front into septum between the two smooth deep pits; cup with a thin whitish rim, a shallow circular depression on top in which is a transverse pit near hind margin and a few punctures; disk areolate, crenate behind and margined, overhanging metathorax. Propodeum face perpendicular, carinae angled. Mesopleura smooth, separated from sternum by a carina and crossed obliquely by a longitudinal ridge. Hind tibia equal to tarsus, claws simple. Front wing hyaline, veins brownish, radial cell closed, 2.6 times as long as broad, cell to wing ratio 1:4, first abscissa of radius about half of second, areolet wanting, cubitus not reaching basal, surface pubescent, margin ciliate, reaching beyond tip of abdomen. Abdomen polished, normally compressed, longer than broad, second tergite occupying entire length, with ring of hairs at base.

Length, 2.1 mm. Wing, 2.6 mm. Antenna, 3.1 mm.

Described from one specimen collected in August.

Type.—Cat. No. 23651, U. S. N. M. Type male on tag and parts on slide.

Type locality.—Brazil: Chapada (H. H. Smith).

Genus TROPIDEUCOILA Ashmead.

Tropideucoila ASHMEAD, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 377.

Tropideucoela ASHMEAD, Psyche, vol. 10, 1903, pp. 61, 68.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, p. 240.

Genotype.—*Tropideucoila rufipes* Ashmead. Monobasic.

Robust. Head not broader than thorax, cheeks margined, malar space less than half eye and with groove, antennae arising above middle of eyes, stout, submoniliform, third not distinctly longer than fourth, 5–12 long oval, not twice as long as broad. Mesoscutum with five longitudinal carinae which do not converge and meet before reaching scutellum but remain distinct and parallel and well separated clear to base of scutellum, the four broad grooves between them shallow and polished, short grooves over fore wings. Scutellum with two pits at base, cup large, half width of disk, longer than broad; disk sculptured and truncate. Mesopleura separated from sternum by carina. Wing with open radial cell, pubescent and ciliate. Abdomen *with* (not without, as stated by Ashmead) a narrow circle of hairs at base, normally compressed.

Related to *Trisseucoela* Kieffer, from which it is separated by the ring of hairs at base of abdomen.

TROPIDEUCOILA RUFIPES Ashmead.

Tropideucoila rufipes Ashmead, Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221 (sine desc.).

Tropideucoela rufipes Ashmead, Psyche, vol. 10, 1903, p. 61 (sine desc.).—Dalla Torre and Kieffer, Das Tierreich, Lief. 24, 1910, p. 240.

Female.—Black, antennae rufous, infuscated toward apex, legs brownish. Head almost as broad as throax, polished, bare except for a transverse pubescent line below each lateral ocellus; seen from in front facial line 0.92 transfacial with a notch at vertex above median ocellus, interocular line 0.44 transfacial and area 0.7 as broad as long, malar space 0.36 eye with a few striae to mouth, eyes bare, antennae arising above middle of eyes, stout, 13-segmented, third slightly shorter than fourth, both tapering slightly toward base, 5–12 subequal, oblong-oval, last scarcely longer than preceding, 3–6 gradually stouter, 7–10 about 1.6 times as long as broad, slightly tapering beyond 10; seen from above head is transverse, axial line 0.54 transfacial, cheeks margined behind eyes. Pronotum truncate, truncation margined, undulate above with two pubescent spots on top, 0.7 as wide as head, sides areolate. Mesoscutum broader than long, with five longitudinal carinae, the three dorsal ones and the four broad shallow polished grooves being conspicuous in top view, the median ridge is narrow and bare but abruptly broadened at front and gradually enlarging slightly behind, parapsidal ridges percurrent, almost parallel, bearing setigerous punctures, lateral ridges bare and broader than median, a short groove over each fore wing. Scutellum 0.9 as long as mesoscutum, cup large, high, half as wide as disk, longer than broad, tapering in front into a septum between the two large transverse pits; surface of cup bears

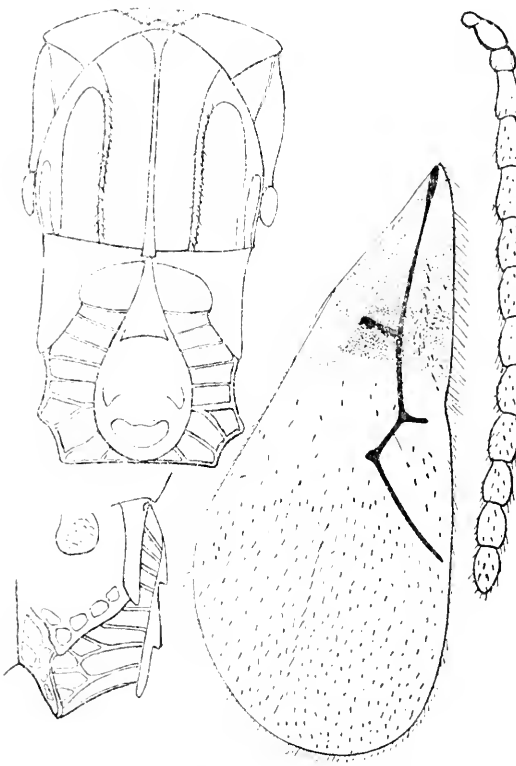


Fig. 8.—Tropideucoila rufipes Ashmead.

a reniform impression behind, two low teeth near middle and a transverse ridge near front (best seen in profile), margin of cup thin; disk areloate, prominent ridges running up under cup, truncate behind with a prominent notch and two teeth at each hind corner, sides margined. Mesopleura polished, separated from sternum by carina, with two longitudinal ridges above. Hind tarsus shorter than tibia, claws simple. Basal third of wing dusky, rest hyaline, apical abscissa of subcosta bent up perpendicular to front margin, radial cell open, neither vein quite reaching margin, one and seven-eighths times as long as broad, cell to wing ratio 1:3.5, areolet, cubitus and median wanting, surface pubescent and margin ciliate, reaching beyond tip of abdomen. Abdomen smooth and polished, slightly longer than broad, second tergite occupying whole length, with narrow fringe of hairs at base, normally compressed.

Length, 1.75 mm. Wing, 1.9 mm. Antenna, 1.8 mm.

Described from one specimen collected in April.

Type.—Cat. No. 23648, U.S.N.M. Type female on tag and parts on slide.

Type locality.—Brazil: Chapada (H. H. Smith).

Genus ACANTHEUCOELA Ashmead.

Acantheucoela ASHMEAD, Trans. Ent. Soc. London, 1900, p. 333.—DALLA TORRE and KIEFFER, Wytsman Gen. Ins. Cynipidae, 1902, p. 36.—ASHMEAD, Psyche, vol. 10, 1903, pp. 67, 72.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 248.—ROHWER and FAGAN, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 359.

Genotype.—*Acantheucoela armata* (Cresson). Monobasic.

In both of the Dalla Torre and Kieffer papers mentioned above this genus is placed at the end of the Eucoilinae and not numbered as if it were either doubtfully included in this subfamily or its relationships uncertain. The genus was founded on a single specimen from Cuba and originally described as *Cynips? armatus* Cresson and now in the collection of the American Entomological Society in Philadelphia. The United States National Museum has one specimen of this species, compared with the type by Mr. H. L. Viereck, collected in May, 1910, by H. A. Ballou on Montserrat, in the Lesser Antilles. From this specimen the following notes on generic characters and drawings (fig. 9) have been made. The head is longer than broad, cheeks margined, malar space with groove, shallow sculptured grooves from upper corners of clypeus upward along inner margins of eyes to level of antennae. Sides of pronotum with longitudinal ridges. Mesoscutum with faint parallel anterior lines. Mesopleura separated from sternum by a carina and traversed by a longitudinal ridge.

Acantheucoela belongs in the Eucoilinae and is closely related to *Gonieucoela* Kieffer, which may prove to be a synonym of it. In both of these genera the scutellum is angled so that it presents a dorsal and a nearly vertical or backward-looking surface, both deeply hollowed out. The cup is situated at the angle where these two slopes meet and it itself arched so that the posterior part bearing the usual pit faces backward. Just in front of this depression is the spine, which projects back horizontally. The spine is thus produced on the dorsal surface of the cup and does not involve the disk, which is rounded behind or truncate. In *Acantheucoela* the carinae on propodeum are parallel anteriorly, suddenly diverging about middle to twice former distance apart and then gradually converging to former distance apart at posterior margin. In *Gonieucoela* the ridges are said to approach in front of middle and diverge toward either end. In *Acantheucoela* the pits of scutellum are normal, rounded, not reaching over halfway to base of spine on cup, and the disk behind the cup bears *three* ridges to posterior margin. In *Gonieucoela* the pits are quadrangular, reaching whole length of dorsal slope of scutellum, that is to base of spine and behind the cup there are *two* carinae diverging to hind margin.

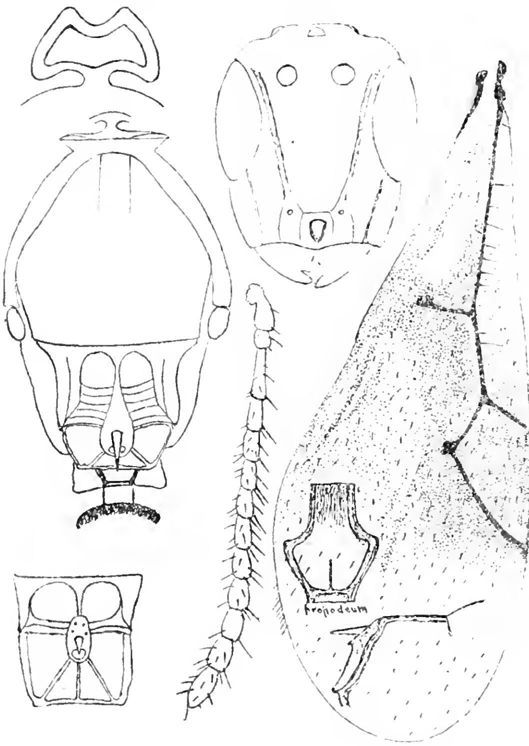


FIG. 9.—DETAILS OF ACANTHEUCOELA ARMATA (CRESSON).

Genus DICERATASPIS Ashmead.

Genotype.—*Diceratuspis grenadensis* Ashmead.

The genus *Diceratuspis* was founded by Ashmead on a unique female, described in 1896[8], which was said to have the abdomen bare at the base. Later[9] he described the male from two specimens, one of which is in the United States National Museum. It has a distinct hairy ring at base of the second tergite. Through the kind-

[8] Proc. Zool. Soc. London (1895) p. 744.

[9] Trans. Ent. Soc. London (1900) p. 246.

ness of Mr. James Waterston I am able to state that the genotype female in the British Museum also has this hairy ring at the base of the abdomen. These hairs are fine and although close together stand up straight so that when viewed from certain positions the girdle might be easily overlooked as it has not the glistening white, woolly, or felt-like appearance characteristic of certain genera. In order that the genus may be recognized it should be transferred to a different section of the Dalla Torre and Kieffer key where it will stand close to *Piezobria* Foerster whose scutellum is emarginate behind and hence only obscurely two-toothed. The posterior angles of the scutellum of *Diceratuspis* are prolonged into distinct teeth. *Diceratuspis* is also closely related to the neotropical genus *Dissodontaspis* Kieffer, described in 1909[10], which may prove a synonym of it.

[10] Bull. Soc. Hist. nat. Metz vol. 26, p. 59.

A NEW CRETACEOUS RUDISTID FROM THE SAN FELIPE FORMATION OF MEXICO.

By Timothy W. Stanton,

Custodian of Mesozoic Invertebrate Fossils, United States National Museum.

The geology of the Tampico region in eastern Mexico is so important in its relation to the world's oil resources that any fact that will aid in classifying the rocks of that region more accurately is welcome. This fact as well as the interesting character of the fossil itself are excellent reasons for describing a single characteristic fossil which establishes the Cretaceous age of the San Felipe formation in its typical exposures west of Tampico. This formation, which overlies one of the chief oil-bearing horizons of the region, has yielded few determinable fossils. By correlation with fossiliferous beds at distant localities some geologists have referred it to the Cretaceous while other have considered it Eocene. The species herein described belongs to the family Radiolitidae, which, like the Hippuritidae, the only other family of the Rudistae, is strictly confined to Cretaceous rocks.

The fossil was presented to the United States National Museum by Mr. E. DeGolyer, chief geologist of the Compania Mexicana El Aguila, S. A., who furnished the following statement concerning the local geology:

> The San Felipe is a formation consisting of 600 to 800 feet of alternating thin-bedded argillaceous limestone and shale known as the San Felipe beds. The limestones in the San Felipe are hardly ever more than 8 inches to 2 feet thick and the interbedded shales are quite similar. The limestones are much harder at the bottom of the section, becoming more and more argillaceous toward the top until where last seen they are really more bands of calcareous shale than limestone. The type locality lies between the stations of El Abra and Valles in the State of San Luis Potosi. The San Felipe beds are here exposed on the west flank of an asymmetrical anticline which brings up the Tamasopo limestone and forms the topographically prominent Sierra del Abra. The San Felipe is so called from a small ranch which lies 4 or 5 kilometers west of the El Abra station. The fossil was collected on the north side of the track at a point north 8° west magnetic from the fourteenth telephone pole [about ½ mile] east of Puente Diablo (Bridge of the Devil). The fossil was found in a hard blue limestone, weathering gray, overlain by 3 to 4 inches of limy yellow clay, and it in turn overlain by another thin limestone, all evidently belonging to the lower part of the San Felipe. Stratigraphically, I should say it was found at 80 to 100 feet above the base of the San Felipe. The formation where the fossil was collected strikes north 35° west magnetic and shows a dip of 10° to the southwest.

The specific description, based on a single incomplete and somewhat weathered lower valve, is as follows:

SAUVAGESIA DEGOLYERI, new species.

Plates 96 and 97.

Lower valve large, elongate-conical, apparently slightly curved; shell thick, cellular, the cell walls forming a coarse reticulation in cross section, such as is characteristic of the genera *Sauvagesia* and *Durania;* cross section probably nearly circular when perfectly preserved but subelliptical in the type which shows evidence of some compression; internal ligamental ridge well developed, indicating reference to *Sauvagesia* rather than *Durania;* surface ornamented by about 20 to 25 moderately strong longitudinal costae which are apparently broader than the interspaces; siphonal bands not distinctly recognized on account of the weathered condition of the specimen.

Height of imperfect lower valve, 190 mm.; greater diameter at top, 95 mm.; smaller diameter at top, 70 mm.

Weathering has almost removed the costae so that their exact number and form are not determinable, but the bottoms of the grooves between the principal costae remain, and the weathering gives longitudinal sections of the costae showing the cells in each costa arranged in curved lines with the irregular concavity upward.

This species has a superficial resemblance to *Barrettia monilifera* Woodward, but the shell structure is totally different from that characteristic of the genus *Barrettia.* In size, form, general appearance, and minute shell structure *Sauvagesia degolyeri* is very much like an undescribed species of *Sauvagesia* in the United States Geological Survey collection from the upper part of the Brownstown marl near White Cliff, Arkansas. This suggests that the San Felipe formation may be on approximately the same horizon as the Brownstown marl; that is, within the zone of *Exogyra ponderosa,* but the evidence is not sufficient to justify making the positive correlation. It is certain, however, that the lower part of the San Felipe formation in which this *Sauvagesia* was collected is of Upper Cretaceous age.

Type.—Cat. No. 32482, U. S. N. M.

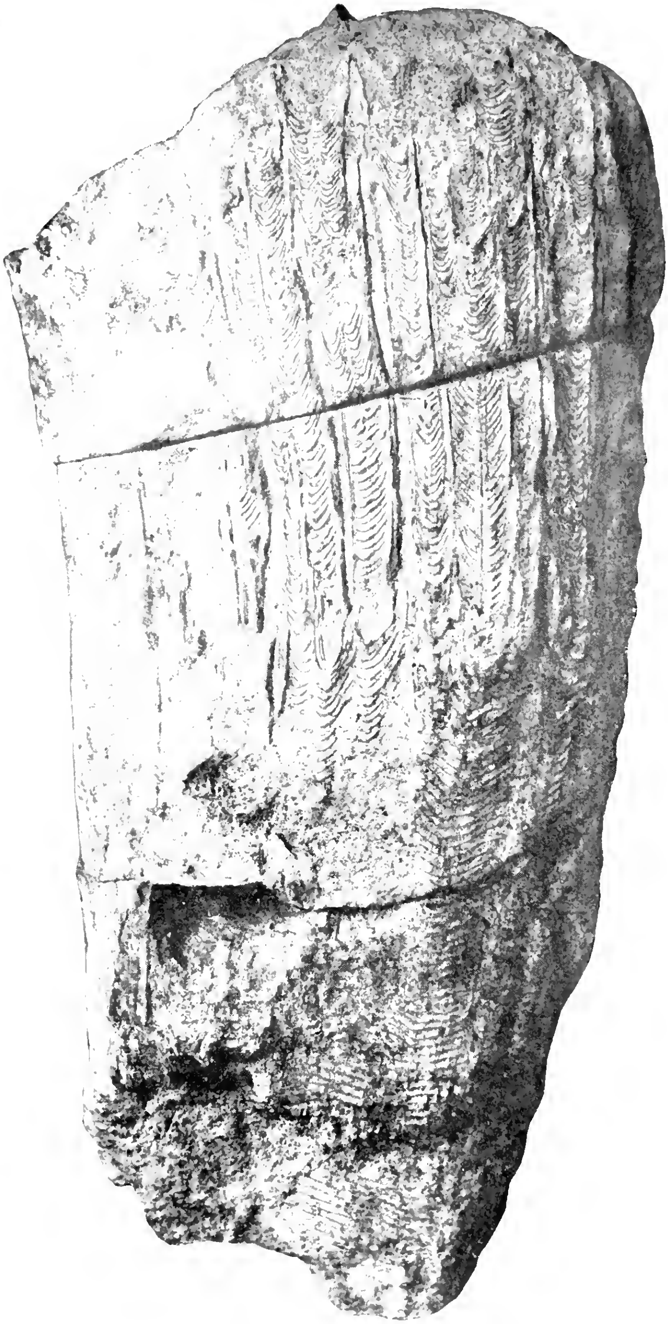
EXPLANATION OF PLATES.

Plate 96.

Sauvagesia degolyeri Stanton. Side view of type, slightly less than natural size. Cat. No. 32482, U.S.N.M.

Plate 97.

Sauvagesia degolyeri Stanton. Cross section of type, slightly less than natura size. Cat. No. 32482, U.S.N.M.



SAUVAGESIA DEGOLYERI STANTON.

FOR EXPLANATION OF PLATE SEE PAGE 454.

SAUVAGESIA DEGOLYERI STANTON.

FOR EXPLANATION OF PLATE SEE PAGE 454.

SOME EOCENE INSECTS OF THE FAMILY FULGORIDAE

By T. D. A. Cockerell and Grace Sandhouse,
Of the University of Colorado, Boulder.

The remarkable abundance and variety of the Homopterous family Fulgoridae in the Rocky Mountain Eocene has already been commented upon. Many of the species were broad-winged insects resembling moths, such as exist to-day in the oriental region. To the already long list we add three more, one a new generic type. We also find an additional example of *Detyopsis packardi* Cockerell from Roan Mountain, Colorado (U. S. G. S., 180), which is here figured as plate 98, fig. 1.

HAMMAPTERYX TRIPUNCTATA, new species.

Plate 98, fig. 3.

Tegmen 14.3 mm. long as preserved, the total length probably about 15.5 mm.; greatest width about 7.3 mm.; general appearance, with broad, gently rounded outer margin, as in the other species. The tegmen is pallid, suffused with fuscous on the upper third (the veins here appearing light on a dusky ground), and there are three conspicuous dark fuscous (probably black in life) spots. The outermost and largest of these is irregularly subcrescentic, somewhat over 1 mm. long, placed 2 mm. below the costal margin and about 4 mm. from apex of tegmen. The innermost spot is small and subtriangular, placed 11.6 mm. from apex and 2.3 mm. from costa. The third spot, which is a broad vertical bar about 1.2 mm. long, is 4 mm. from costa and 9 mm. from apex. The costal area in middle is about 1.2 mm. wide, and its oblique cross veins are about 7 in 2 mm.

U. S. G. S. 217 and (reverse) 211. Roan Mountain, Colorado, in rocks of Green River age. From the Scudder collection.

Holotype.—Cat. No. 67717, U.S.N.M.

This is larger than *H. ceryniiformis* Cockerell and *H. reticulata* Scudder, but somewhat smaller than *H. lapidoides* Cockerell. From all of these it is readily distinguished by the form and arrangement of the spots. The general appearance suggests the living *Hilavrita trimaculata* Distant, from Ceylon, but that is much smaller and has the spots differently placed.

LITHOPSIS DUBIOSA, new species.

Plate 98, figs. 4, 5.

Tegmen 9 mm. long and 3.7 wide; costa very strongly arched and elevated basally, beyond that straight, even a little concave; costal area in middle about 1 mm. wide, with about five cross veins in 1 mm.; veins fuscous, and costal and apical areas suffused with fuscous. The radius branches 1 mm. from base of tegmen. Media branching about 3.3 mm. from base, each of these branches again dividing, the upper about 6 mm. and the lower about 6.5 mm. from base of tegmen. Cubitus branching about 5.3 mm. from base. The anal veins in the claval area unite about 4.5 mm. from base of tegmen, inclosing a pointed cell, the base of which is strongly curved upward.

U. S. G. S. 105 and (reverse) 106. Roan Mountain, Colorado (Scudder). U. S. G. S. 123 and (reverse) 129, from the same locality, seems to be the same species.

Holotype.—Cat. No. 67718, U.S.N.M.

In its general characters this closely resembles the living *Corethrura fuscovaria* Hope, from the Oriental region (Burma, etc.). Compared with the fossil *L. simillima* Cockerell, this differs by the subcosta, terminating about 4 mm. from base, radius branching nearer base, and in the details of the media. The apex of the tegmen is distinctly more produced. It is also distinct from *L. fimbriata* Scudder by the narrow costal area and other characters. We were in some doubt whether to consider this a variety of *L. simillima,* but there is so much difference in the venation that we can only treat it as distinct.

Scudder, in his account of *Lithopsis,* states that the two anal veins in the clavus are distinctly separated throughout. As this seemed improbable, and disagreed with our species assigned to that genus, we asked Dr. N. Banks to examine Scudder's types in the Museum of Comparative Zoology. He reports:

I have examined the specimens of *Lithopsis,* and can not be sure about termination of the anal veins. In one (probably basis of fig. 36) the first anal appears to run as he shows it beyond where the second anal ends, but I can not trace it to the end, nor see where it ends in the marginal vein, although I think I can make out ending of the second anal plainly. In other specimen the anals look as if more approaching each other, but can not make out ending of either. In one (probably basis of fig. 36) it looks as if marginal vein was forked, so there is probably part of another wing under it. If there is part of wing under the elytron, then what appears as continuation of the first anal may be a vein from this underlying wing.

THAUMASTOCLADIUS, new genus.

Tegmen of moderate size, the costa straight beyond the basal third; costal region broad, with numerous oblique cross veins; radius apparently simple, only branching apically; media and first cubitus united to near middle of tegmen, then forking, the lower or cubital division forking again toward apex; sutural vein (second cubital of Tillyard) forking no great distance beyond the union of the anals; second anal (Tillyard) running parallel with margin and close to it, the first anal having a double curve and joining it not much before middle of tegmen; lower margin strongly angulate subbasally.

Type.—Thaumastocladius simplex, new species.

THAUMASTOCLADIUS SIMPLEX, new species.

Plate 98, fig. 2.

Represented by a tegmen lacking part of base and apex, the length as preserved 8 mm.; probable total length, 9 mm.; width in middle, 3.3 mm.; veins fuscous. Mediocubital fork about 1.2 mm. anterior to fork of sutural, the latter about 5 mm. from base of tegmen; junction of anals about 4 mm. from base; costal area about 1 mm. wide.

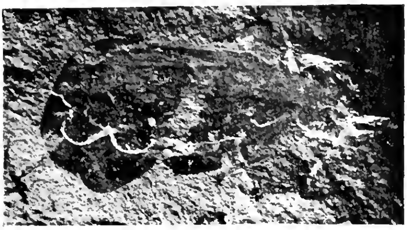
U. S. G. S. 774. Green River shales, Green River, Wyoming.

Holotype.—Cat. No. 67719, U.S.N.M.

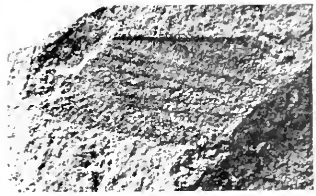
This is evidently a Fulgorid, but the combination of a broad costal area with simplified discal veins and a definitely forked sutural excludes it from any genus known to us. There is, however, a close general resemblance to the oriental genera *Gaja* Distant and *Bochara* Distant. In *Fulgora maculata* Olivier, from Ceylon, the sutural vein may fork a short distance before the apex, or may be simple.

DESCRIPTION OF PLATE 98.

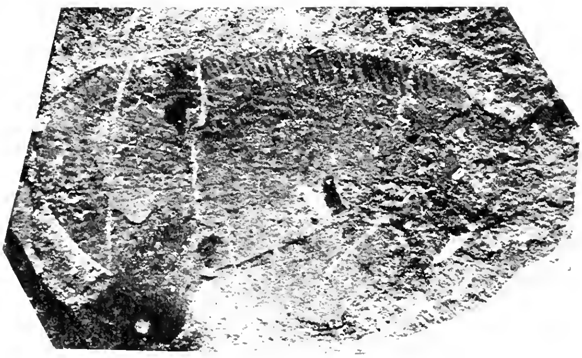
FIG. 1. *Detyopsis packardi* Cockerell. ×4.
2. *Thaumastocladius simplex*, new species. Type, ×4.
3. *Hammapteryx tripunctata*, new species. Type ×4.
4. *Lithopsis dubiosa*, new species. Reverse of type, ×4.
5. *Lithopsis dubiosa*, new species. Type, ×5.



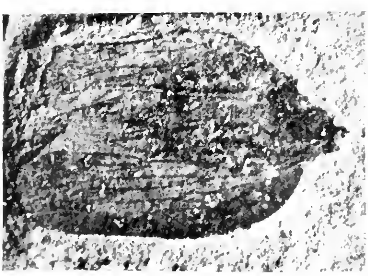
1



2



3



4

5

EOCENE INSECTS OF THE FAMILY FULGORIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 457.

CRUSTACEA FROM LAKE VALENCIA, VENEZUELA.

By A. S. Pearse,

Of the University of Wisconsin.

The writer collected in Lake Valencia and its tributaries during July, 1918. The following list includes all the species of crustaceans collected. Thanks are due to Dr. Mary J. Rathbun and to Prof. C. B. Wilson, who identified the the decapods and the argulids, respectively.

COPEPODA.

DIAPTOMUS CONIFER Sars.

This species was abundant in the lake and was taken at various depths in townets on July 18 and 25, 1918.

CYCLOPS LEUCKARTI Claus, variety EDAX Forbes.

Taken in townet in open lake at various depths and in the shore vegetation with a Birge net in all places where collections were made.

CYCLOPS SERRULATUS Fischer.

Collected among the shore vegetation.

CYCLOPS PHALERATUS Koch.

Found in the vegetation alongshore.

CYCLOPS VIRIDIS Jurine.

Found in the vegetation alongshore.

CLADOCERA.

MOINODAPHNIA MACLEAYII (King).

This little cladoceran was abundant in the open lake where it was captured with townets, and was found once inshore in a Birge net collection.

LATHONURA RECTIROSTRIS (O. F. Müller).

A cladoceran, apparently this species, was collected among the shore vegetation with a Birge net, July 25, 1918.

AMPHIPODA.

HYALELLA INERMIS S. I. Smith.

Specimens of both sexes were collected from the lake in the rushes near Maracay, July 25, 1918. The males have 14 segments in the flagellum of the seond antenna.

ISOPODA.

METOPONORTHUS PRUINOSUS Brandt.

Three specimens (University of Michigan, Museum of Zoology, Cat. No. 52003) were collected under some logs at the paper mill near Maracay, July 20, 1918.

LEPTOTRICHUS PITTIERI, new species.

Type.—University of Michigan, Museum of Zoology, Cat. No. 52002. On shore of Lake Valencia, by paper mill at Maracay, Venezuela, July 23, 1918, under log.

Surface of body covered with peculiar processes; epimera and appendages with many small spines. Head with prominent lateral

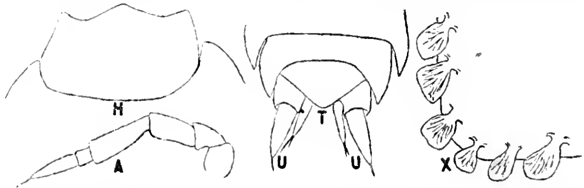


FIG. 1.—LEPTOTRICHUS PITTIERI, NEW SPECIES. A, SECOND ANTENNA; H, HEAD; T, TELSON; U, UROPOD; X, TIP OF TELSON ENLARGED, SHOWING ORNAMENTATION CHARACTERISTIC OF ENTIRE BODY.

lobes, which are rather angular anteriorly; frontal margin making an obtuse angle. Eyes very small. Second antenna with fourth segment of peduncle longest; second segment of flagellum nearly thrice the length of first. Thoracic segments with lateral parts broadly expanded; the first a little longer than the others, which are subequal in length. First two abdominal segments with lateral parts undeveloped. The third, fourth, and fifth are broadly expanded laterally and form a continuous line with the margin of the thoracic segments. Posterior segment with postero-lateral margins very slightly concave, rounded at apex; extending half its length beyond the preceding segment. Basal segment of uropod half the length of the exopod, which is slender and conical; endopod linear and two-thirds as long as exopod.

AEGATHOA LAZZARI, new species.

Aegathoa lazzari PEARSE (nomen nudum), Univ. Wisconsin Studies in Science, No. 1, p. 39, 1920.

Type.—University of Michigan, Museum of Zoology, Cat. No. 52001. In Lake Valencia, Venezuela. at mouth of Rio Bue, July 20, 1918. Parasite on Sardina Paleta (*Astyanax bimaculatus* Linnaeus). (Paratype, Cat. No. 53772, U. S. N. M.).

Body.—3.7 mm. long; 1.3 mm. wide. Head wider than long, and narrower posteriorly. Eyes large, ellipsoidal; with about 48 facets; almost covering postero-lateral angles. First antennae with seven segments, second antennae with eight segments. Maxillipeds bearing a two-segmented palp, which is armed at the tip with two hooks. First maxilla slender, armed at tip with three pairs of hooks; second maxilla robust, armed at tip with two pairs of hooks. First segment

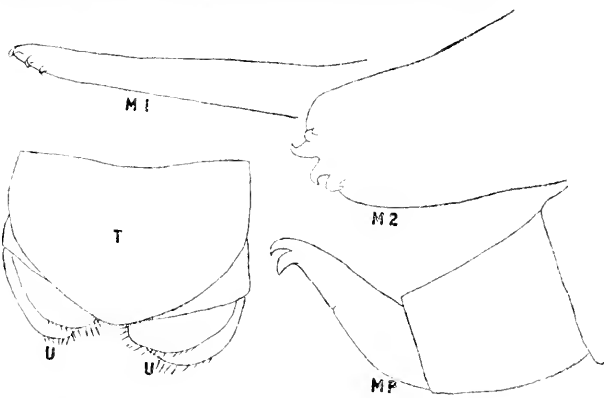


FIG. 2.—AEGATHOA LAZZARI, NEW SPECIES. M^1, FIRST MAXILLA; M^2, SECOND MAXILLA; MP, MAXILLIPED; T, TELSON; U, UROPOD.

of thorax longest, 0.5 mm. The following segments progressively shorter. The epimera of all segments except the first separated on the lateral margins. Abdomen somewhat narrower than the thorax; length, 1.8 mm. Segments as long as those of the thorax. Sixth or terminal segment broadly rounded and obtusely pointed posteriorly. Uropoda extending beyond tip of terminal segment. Both rami of uropoda rounded posteriorly. Posterior margins of the uropoda and the terminal abdominal segment are fringed with hairs. All the legs are prehensile and end in long curved dactyli. They are without spines.

This species was also found on a sardina (*Gephyrocharax valenciae* Eigenmann) collected in shallow water near Maracay (Lake Valencia) July 24, 1918.

DECAPODA.

TRICHODACTYLUS (DILOCARCINUS) DENTATUS (Randall).

Two specimens of this crab, females, were collected at the mouth of the Rio Bue with a minnow seine July 19, 20; and one male and one female specimen from the Rio Tuy, El Concejo, August 1, 1918.

MACROBRACHIUM ACANTHURUS (Wiegmann).

A number of very small shrimps belonging to this species were collected at the mouth of the Rio Bue July 20, 1918.

MACROBRACHIUM JAMAICENSE (Herbst).

Six specimens of this shrimp were collected in the Rio Tuy, El Concejo, August 1, 1918.

SEXUAL DIFFERENCES IN COLORATION IN THE SPOTTED TURTLE, CLEMMYS GUTTATA.

By S. F. Blake,

Assistant Botanist, Bureau of Plant Industry, United States Department of Agriculture.

Very few instances of sexual differences in coloration among the Chelonia are on record. In Boulenger's Catalogue of the specimens of this order in the British Museum mention is made of only two species which present sexual differences in coloration.[1] One of these is *Kachuga trivittata* (Duméril and Bibron), an Indian species not represented in the United States National Museum. Boulenger remarks [2] in his description of this species: "The male *B.* [lege *K.*] *trivittata* is characterized by three black longitudinal bands on the carapace, which are absent in the female according to Theobald, whose opinion I am disposed to indorse rather than that of Anderson, who makes a distinct species (*B. iravadica*) for the specimens (female and yg. male) without bands." The synonym *Batagur iravadica* Anderson, however, is cited by Boulenger with a mark of interrogation, and the existence of a sexual difference in coloration in this species (*Kachuga trivittata*) can not be regarded as definitely established. Gray[3] remarks: "This colour [i. e., the three black streaks] appears to be laid on the shell, and flakes off."

The other species in which a sexual difference in coloration is described by Boulenger is *Emys orbicularis* (Linnaeus), the commonest of European turtles, the soft parts of which are described [4] as follows: "Head dark brown or black, with lighter dots, which are yellow in the female and pale brown in the male. . . ." I have not been able to confirm this statement in an examination of the few alcoholic specimens of this species in the United States National Museum, as those of each sex appear to be spotted alike with pale yellow.

[1] Under *Cinosternum integrum* (p. 42), Boulenger describes the color of the shield as follows: "Carapace brown, with small blackish dots in the male. . . ." Only three adult specimens are listed—an insufficient series for establishing a sexual difference in color; and Dr. L. Stejneger informs me that the supposed difference is non-existent.

[2] Cat. Chelon. Brit. Mus., pp. 55-56, 1889.

[3] Suppl. Cat. Shield Rep., vol. 1, p. 56, 1870.

[4] Cat. Chelon. Brit. Mus., p. 113, 1889.

Among American turtles, the only species in which a sexual difference in color is recorded seems to be *Terrapene carolina* (Linnaeus), the common box turtle, in which the eye of the male is red and that of the female brown.

During the years 1908 to 1912 I collected in Stoughton, Massachusetts, and adjacent towns a series of 18 specimens of the spotted turtle, *Clemmys guttata* (Schneider). All of these were prepared as skins, mounted specimens, or skeletons, and the sex (with the exception of a single young specimen) was determined by dissection in every case. At the close of the first season's collecting I drew up from my series, then amounting to 10 specimens, a table of the sexual differences in coloration, which was confirmed in nearly every respect by later collections of the species. In addition to the material in my own collection, I have been able, through the kindness of Dr. Leonhard Stejneger, to examine the considerably larger series in the United States National Museum, representing various localities throughout the range of the species. The total number of adult or nearly adult specimens in good condition examined is 60 (24 male, 36 female), 17 of which are skins or mounted specimens in my own collection and 43 alcoholics in the National Museum. The sex of the specimens in the latter series has been determined by the ordinary external sexual characters of this group—shape of plastron and proportions of tail—and their examination has fully borne out the differences I had found to exist in my own material. The single specimen which departed from these characters was a male, which possessed some of the color characters of the female. It will be described more in detail later in this paper.

The sexual differences shown in the series examined may be listed in the order of their constancy, as follows:

1. The horny portion of both jaws in the male is dusky, in the female pale yellow. No exception.

2. The plastron of the male is distinctly concave along the midline near the anterior margin of the femoral shields; that of the female is flat or slightly convex essentially throughout. Occasional females have a slight transverse depression extending across the plastron at about the anterior margin of the femorals, but this never assumes the character of a central depression such as is found in the males.

3. The female has a conspicuous yellow or orange mandibular stripe reaching about half the length of the neck; the male has a few spots or almost none, or rarely a weak streak about 5 mm. long. The only exception is the aberrant male mentioned above, which has a rather strong mandibular stripe.

4. The throat of the male is black, with sparse and usually obscure, rarely numerous, small yellow specks; that of the female is heavily streaked and spotted with yellow. usually aggregated for-

ward into a blotch which occupies most of the space between the sides of the lower jaw. The only exceptional specimen is the male just mentioned, which has well-developed throat markings.

5. The anal opening is situated much nearer the base of the tail in the females than in the males. This character and character No. 2 above are those commonly used for the discrimination of the sexes in museum material, but the measurements which I have made of the series of alcoholics in the National Museum show that there is some overlapping in this character. In 15 males the total length of the tail, measured in a straight line along its underside from the notch in the anal plates to its tip, varied from 30 to 43 mm. (in an exceptional case only 23 mm.) and averaged 36.8 mm. The distance from the notch in the anal plates to the middle of the anal opening varied from 11 to 16 mm. (in two cases only 8 mm.) and averaged 12.7 mm.; the length from the middle of the anal opening to tip of tail varied from 20 to 28 mm. (in two exceptional cases 15 and 17 mm.) and averaged 24 mm. In the 27 females measured the tail varied from 20 to 37 mm. (with a single exceptional specimen of 40 mm.) in length, with a average of 29.6 mm.; the preanal measurement was 2 to 7 mm. (in two exceptional specimens 10 mm.), with an average of 5 mm.; and the postanal length 15 to 33 mm., with an average of 24.6 mm. From these figures it will be seen that the tail of the male averages 36.8 mm. in length, that of the female 29.6 mm.; its preanal length in the male averages 12.7 mm., in the female 5 mm.; while the postanal portion of the tail is essentially the same in both sexes (24 mm. in males, 24.6 mm. in females). There is some overlapping in each of these measurements, which is least in the case of preanal length of the tail. The shape of the tail is subject to considerable variation in both sexes. On the whole the tail of the female is perhaps more slender than that of the male, but the variation seems too great to make this difference of any diagnostic value.

6. The female has a well-developed supra-auricular line of yellow or orange spots, which are usually aggregated into a streak. In the male this is much less developed, except in the case of the abnormal specimen, to which reference has already been made. A few of the more weakly marked females, however, are not distinguishable in this regard from the more heavily marked males.

7. The female has almost invariably a few yellow spots on the crown in front of a line connecting the posterior corner of the eyes. Of the 24 males examined only about 8 showed one or two such spots. It may be noted that the abnormal male already referred to had no spots in this region.

The distinctive characters just described may be summarized for the sexes thus:

Male.—Jaws always dusky; plastron always distinctly concave in the median line toward anterior margin of femorals; mandibular stripe nearly or quite lacking (developed in one specimen); throat sparsely or rarely densely speckled with yellow, the specks never (except in one specimen) aggregated forward into a blotch; tail averaging 36.8 mm. long, its preanal length averaging 12.7 mm.; supra-auricular streak little developed (except in one specimen); anterior portion of crown usually immaculate (with one or two spots in one-third of the specimens).

Female.—Jaws always pale yellow; plastron never concave posteriorly along midline, sometimes somewhat depressed transversely in the region of the femorals; mandibular stripe always conspicuous; throat always streaked and spotted with yellow, this developed anteriorly into a blotch; tail averaging 29.6 mm. in length, its preanal length averaging 5 mm.; supra-auricular line usually well developed; anterior portion of crown with several yellow spots.

The single specimen in the series of 60 adult or subadult specimens examined which provides an exception to some of the more important characters listed is a male (Cat. No. 51785, U.S.N.M.), collected in Fairfax County, Virginia, June 29, 1914, and presented by Mrs. E. P. Miller. In this specimen the characters of plastron, tail, jaw color, and lack of spots on anterior portion of crown are normal for the male. The throat markings and mandibular and supra-auricular stripes, however, are those of the normal female. Dissection of the specimen showed nothing abnormal in the genital organs, and the cause of its peculiar coloration can only be assumed to be due to some abnormality in its embryonic history.

Another apparent exception to the constancy of the characters above described is furnished by the excellent colored plate [5] of this species published in Babcock's memoir on the turtles of New England. The colors of the carapace in this plate were taken from the shell of a Massachusetts specimen, while those of the soft parts, which agree with those described above as characteristic of the female, were copied by the artist, R. Deckert, from "a live male captured in New York City." Doctor Babcock writes me with regard to this illustration that he sent a fine shell in his possession to the artist "with instructions to draw the soft parts from a male as nearly the same size as possible. He evidently drew from a female . . ."

It is a curious fact that not one of the fairly conspicuous and constant sexual differences in coloration of *Clemmys guttata* has previously been recorded, although sexual differences in the shape of the plastron and position of the anal opening in this and other turtles have long been familiar to herpetologists. Indeed, beyond the slight

[5] Mem. Boston Soc. Nat. Hist., vol. 8, pl. 27, figs. 1, 2, 1919.

differences in two or three species mentioned in the first part of this paper, no difference in coloration between the sexes seems to have been recorded in any member of the Chelonia. This is undoubtedly due to the fact that practically all collections of turtles consist chiefly of alcoholic material. The examination of series of such specimens is much less convenient than that of skins; the specimens are often badly distorted or have the members drawn under the shell; and the colors are poorly preserved, although the distribution of the markings can usually be made out satisfactorily. It is somewhat remarkable that Agassiz, who had "thousands"[6] of living specimens of turtles of different species under observation in his yard, apparently failed to distinguish these differences, although he noted[7] sexual differences in the form of the shield, the length of the tail, and the scalation of the legs in the Kinosternidae.

In 1905, in a report of a meeting of the American Society of Zoologists, R. M. Yerkes[8] published the preliminary results of his study of the spotted turtle, in the following words:

1. The young of this species of tortoise usually have a single yellow spot on each plate of the carapace except the marginals. With age the number of spots increases; they appear on the marginal plates also, and their arrangement becomes irregular.

2. The epidermal layer is transparent immediately over the mass of yellow pigment n the outer bony layer, hence, window-like regions in the outer portion of the shell.

3. Although the females are slightly smaller than the males they usually have about 15 per cent more spots on the carapace. The average number for the males is 60, for the females 69. This would seem to indicate that the brightly colored spots serve as both sex and species marks. Probably they serve to render the females conspicuous.

4. Statistics indicate a greater number of spots on the left side of the carapace than on the right in both males and females. It is possible that this is to be correlated with right-handedness and right-eyedness.

Professor Yerkes informs me that these conclusions were based on the examination of several hundred specimens, and that several years ago all his data were turned over to Dr. C. B. Davenport for elaboration, but that nothing further has been published. (Doctor Davenport writes me that Professor Yerkes' manuscript has been mislaid.) In the absence of this detailed information it is impossible to assign much weight to the possible correlations suggested in his third and fourth paragraphs. His suggestion that the slightly greater average number of spots found on the females in his series serves as a sex-distinguishing character in nature is rendered very improbable when the great variability of the spotting in both sexes is considered.

Agassiz's description[9] of the newly hatched young of this species agrees with that of Yerkes: "When hatched, there is but a single dot

[6] Contr. Nat. Hist. U. S., vol. 1, p. 252, footnote, 1857.

[7] Idem, p. 419.

[8] Science, new ser., vol. 21, p. 386, 1905.

[9] Contr. Nat. Hist. U. S., vol. 1, p. 443, 1857.

upon each scale of the shield, and none upon the marginal scales; as it advances in age new dots appear, one by one, upon each scale, until they become very irregular, and extend to the margin of the shield. I have, however, seen old specimens that were entirely black, and others in which the dots remained few and regular."

There are in the National Museum seven very young specimens of this species, with a carapace varying from 28 to 33 mm. in length.[10] In only one individual are the marginals free from spots. The others have single spots on from 8 to 18 marginal scutes. The specimen (No. 23331, U.S.N.M.) with spots on 18 scutes is the youngest of all, the umbilical aperture not yet being closed by shell. It measures 28 mm. in length. The other specimen (No. 12701) of this length entirely lacks spots on the marginals. Despite Agassiz's statement that the newly hatched young are without spots on the marginals, the specimen which he figures [11] has spots on two marginal scutes on one side. Dr. H. L. Babcock, to whom I have recently written for information on this subject, informs me that of the two newly born young available to him for examination one has three spotted marginals on each side and the other four. From this it is evident that the statements of Agassiz and Yerkes with regard to the absence of spots on the marginal scutes in the newly hatched young are not true of all specimens. It is interesting to note that the color characters distinctive of the sexes can be clearly seen in these very young specimens, although the structural characters of tail and plastron are not discernible.

Babcock has recorded the fact that the males are less in evidence in late summer and fall than the females, which accords with my own observations. Most of my males were taken in March and none later than May. My earliest date of observation of the species is March 5, 1910, when a female was collected in North Easton, Massachusetts; my latest December 6, 1912, when I saw two, one of which, a female, was collected, in a pool in woods in Stoughton. I have the following notes on the development of eggs: A female collected on April 11, 1908, contained nine well-developed eggs in the yolk. One taken on June 19, 1908, contained three mature eggs, which are still in my collection, and eight in the yolk. One taken on March 29, 1909, held nine round eggs in the yolk. The specimen captured on March 5, 1910, contained three eggs in the yolk, about 14 mm. in diameter, and some smaller ones. The one taken on December 6, 1912, contained two eggs in the yolk, about 1 cm. in diameter, as well as smaller ones.

---

[10] Babcock (Mem. Boston Soc. Nat. Hist., vol. 8, p. 398, 1919) gives the length of the carapace in the newly hatched young as 26 mm., at the end of the first month 30 mm., and at the end of the second month 32 mm.

[11] Contr. Nat. Hist. U. S., vol. 2, pl. 1, fig. 7, 1857.

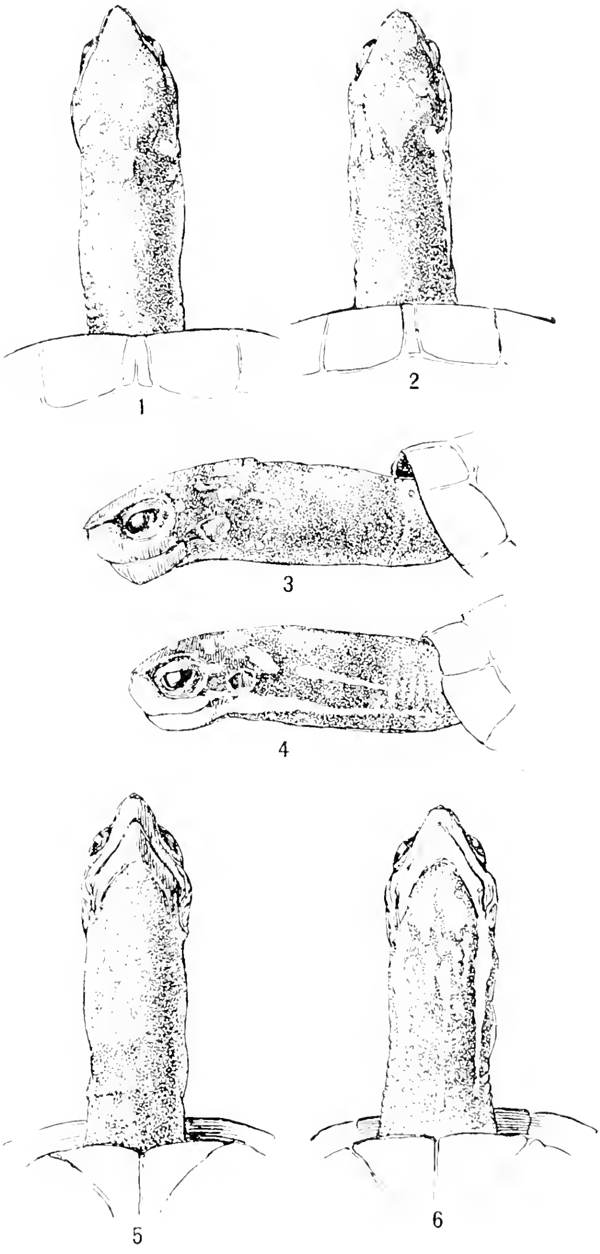
In eastern Massachusetts I have always found this species inhabiting different territory from that frequented by the painted turtle (*Chrysemys picta*). The latter is a species of ponds and rivers. *Clemmys guttata*, on the contrary, is found chiefly in wet woods, marshes, or shrubby ground traversed by brooks or ditches, and is much more easily captured than its shyer relative.

EXPLANATION OF PLATE 99.

Clemmys guttata, showing color pattern of head and neck, about natural size.

Fig. 1, 3, 5, male; U.S.N.M. No. 63409; Stoughton, Mass.; S. F. Blake, collector.

Fig. 2, 4, 6, female; U.S.N.M. No. 63407; Randolph, Mass.; S. F. Blake, collector.



COLOR PATTERN OF CLEMMYS GUTTATA.

FOR EXPLANATION OF PLATE SEE PAGE 469.

THE TROUP, TEXAS, METEORITE.

By J. A. Udden,

Of the University of Texas, Austin, Texas.

This meteor was secured soon after its fall by Mr. T. M. Coupland, of Troup, Texas, and by him donated to the University of Texas. It fell close to a negro boy, who was ploughing in a field about 3 miles north of Troup on the morning of April 26, 1917. The boy heard the meteor and "saw it smoking" after it hit the ground. He did not investigate the fall, but an older person, Forrest Lawson, went to the place indicated by the boy and found the meteor about 6 inches below the surface of the ground. It was later during the day brought to Mr. Coupland who first identified it as a meteor. In a letter of the same date to Prof. H. Y. Benedict, of the University of Texas, Mr. Coupland related the circumstances of the observation of the fall as given above and said that the meteor weighed 2 pounds and 4½ ounces; that it was "black on the outside, but about the color of lime rock after the surface was removed. It also appears to have some flakes of bright metal scattered through."

A few days after the fall Mr. Coupland addressed a circular letter to some people in Smith and adjacent counties. In this he inquired for observations on the fall of the meteorite and secured some information worth recording. At Nacogdoches, some 47 miles south-southeast from Troup, one man reported to have seen the fall and two persons reported having noted the sound it produced. The noise the meteor made was also heard at Big Sandy in Upshur County, about 30 miles north from Troup; at Arp, in Smith County, about 7 miles northwest from Troup; and at a pump station located about 17 miles southeast from the same point. At Troup Mr. Coupland states that many people heard an unusual and intense noise on the morning that the meteor fell. A weekly newspaper, the *Jacksonville Progress*, made mention of the fall, from which it has been inferred that the fall was also heard at this place, which lies about 15 miles southwest from Troup.

It was a fortunate circumstance that this meteorite chanced to come into the hands of a man whose education and whose interest in science enabled him to immediately identify the stone and prompted him to secure not only the stone but likewise all the above facts. These establish beyond any doubt the date and the place of the fall and also the physical phenomena associated therewith.

A part of the original stone, about 170 grams, has not been seen by the present writer. Some two or three grams have been used in making a chemical analysis. There are now extant one piece weighing about 840 grams (pl. 100), another weighing 124 grams (pl. 101), and a few smaller fragments of 2 or 3 grams.[1]

In form this meteorite belongs to the gnathoid or splinter-like type (fig. 1), evidently having originally measured somewhat more than 15 centimeters in length, quadrangular in cross section, thinning in one diameter toward one of its extremities and at the same time turning somewhat abruptly transversely to its longer axis, near its smaller end. At its thickest part it measures about 5 centimeters along one of its transverse diameters and about 4½ centimeters along the other. On one side of its heaviest end is a blunt point, perhaps

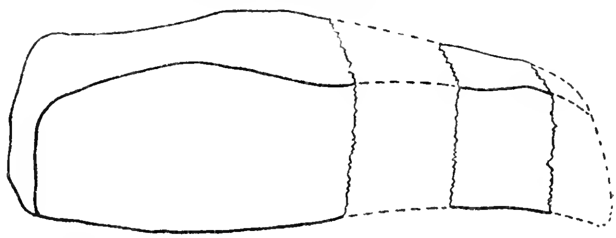


FIG. 1.—ORIGINAL FORM OF THE TROUP METEORITE (IN PART RESTORED). ABSENT PARTS ARE SHOWN IN DOTTED LINES. ABOUT ½ NATURAL SIZE.

due to fusion on the forward side of the stone as it passed through the atmosphere.

As already mentioned, the meteor is quadrangular in cross section, having four flat sides of about equal width. At its thickest end these planes are cut by the smooth surface of a wide cone, which has its apex turned sideways. This points approximately also to the side of one of the four angles of the wedge. It seems likely that this apex was the forward point of the meteor as it fell. If such was the case, the edge nearest this apex would cleave the air as the meteor advanced. All the four sides of the wedge are pitted, but the pitting on the two forward sides is somewhat different from the pitting on the posterior sides. Anteriorly the pits are larger and deeper than on the two posterior faces. Measurements on a number of pits selected at random were made, one measurement of the shortest and one measurement of the longest diameter of each pit. It can hardly be said that these slightly elongated pits have any distinct orientation in any particular direction (pl. 100). It is quite

[1] It is reported that another fragment from this fall has been found near the same place later.

clear that the impingement of the air currents producing the pits was not the same on the two posterior faces of the meteor as that on the anterior faces. Toward the narrow end the pitting appears on only two of the four flat sides of the stone and is markedly smaller than at the anterior end. The sizes of the pits on different parts of the stone are shown in averages in the following table:

Table showing diameters of pits in millimeters on different parts of the surface of the meteor.

	Shortest.	Longest.
On the two anterior sides	9	12
On the two posterior sides	4	7
Farthest back on the posterior sides	2	4

The stone is covered by a brownish black crust measuring from about 0.1 to 0.3 millimeters in thickness. Magnified under a good hand lens the surface of this crust is seen to have numerous small rugosities presenting quite sharp angles. At various points particles of metallic iron barely protrude through the crust. At some widely scattered places are some oval spots where the exterior of the crust is very smooth and almost shiny. These smooth areas resemble in form, size, and distribution some stony chondri that are seen to be scattered through the meteorite when a polished surface of its interior is examined. In some of the chondri the crystalline texture is laminated, and this texture evidently shows through the thin crust in some of the smooth areas seen.

A fracture, or vein, is seen following one of the four sides of the "wedge" at a distance of 3 to 5 millimeters from one of its faces. (See pl. 101.) The course of this vein is sinuous. The vein itself is mostly less than a tenth of a millimeter in thickness and apparently in this stone, as in others of its kind, consists of material like that of the outer fused crust. On the posterior side of the block showing in the photograph there appear three veins running in the same direction near the middle of the section. One of these is evidently the vein seen in the photograph. All three veins no doubt cross the stone obliquely.

The mineral composition and the petrographic characters of this stone must await the attention of the specialists.[2] Meanwhile a brief mention of its most obvious features may be recorded. Its color is gray when freshly laid bare. When exposed to moisture, this soon gives way to a gray speckled with rusty dots, which become especially conspicuous on a polished surface. Its texture is fine grained. It is chondritic, showing small light grains of an oval outline on a polished surface. These measure mostly less than a millimeter in

[2] See p. 477 following.

diameter. Among these are scattered many small particles of iron, small particles of pyrrhotite, and a few chondri of larger size, oval in outline in cross section, and showing eccentric radial structure in some cases. Eight of these larger chondri measure from 1 to 6 millimeters in their shortest diameters and from 1 to 8 millimeters in their longest diameters.

The particles of iron measure mostly from one-tenth to one millimeter in cross section on a polished surface. They are entirely isolated from each other and have, as it appears, a haphazard arrangement through the mass of the stone, except that they do not occur in the chondri and that in a few places on the ground surfaces examined they lie in irregular crescentic lines. On a polished surface the iron has a white, almost silvery, color.

In their shape the iron particles are very variable. Sections seen on a polished surface defy any general description except negatively. None of their sections are circular in outline and very few are limited

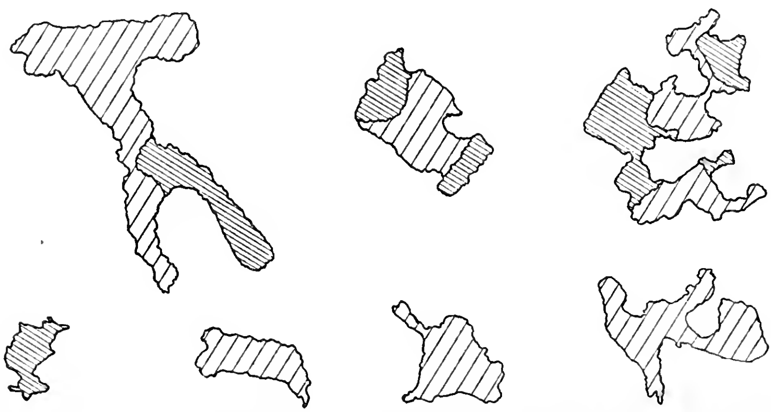


FIG. 2.—OUTLINES OF SECTIONS OF GRAINS OF IRON AND OF PYRRHOTITE FROM THE TROUP METEORITE, AS SEEN ON A POLISHED SURFACE OF THE STONE. THE CLOSELY SHADED AREAS REPRESENT PYRRHOTITE, WHILE THE LIGHT SHADED AREAS REPRESENT METALLIC IRON. MAGNIFIED ABOUT 25 TIMES.

by straight lines. Some of the outlines of such sections are shown in figure 2. Among some grains that were separated from the siliceous matrix three roughly outlined but distinctly square faces were observed under the microscope.

The pyrrhotite present occurs in grains apparently of quite as indefinable forms as the iron grains and in about the same abundance and distribution as these. On the whole, the pyrrhotite grains are slightly smaller in size. On a polished surface the pyrrhotite has a brownish metallic color. By immersing a polished surface of the stone in a solution of copper sulphate the pyrrhotite is soon covered with a bright coating of copper, and the grains of this mineral are thus readily identified. Many of the pyrrhotite grains are closely adherent to the iron grains, from which some come out as extensions or arms. The boundary between the two is in all such cases sharply defined.

The bulk of the siliceous material, which makes more than 90 per cent of the mass of this meteor, is finely granular, the finest grains measuring near one-sixth of a millimeter in diameter. This has a gray color. The larger chondri are very light gray. The mineral nature of this part of the meteorite has not yet been determined. It can to some extent be inferred from the chemical analysis given below.

The specific gravity of this meteorite, roughly determined, averages 3.6.

The chemical composition of the meteorite has been investigated by Dr. E. P. Schoch, of the University of Texas, assisted by Mr. J. E. Stullken. The following quantitative determinations were made:

	Per cent.		Per cent.
SiO_2	39.68	Na_2O	3.86
Al_2O_3	3.59	SO_3	8.23
Fe (metallic)	3.10	P_2O_5	.51
FeS	8.00	C (graphite)	.80
FeO	22.27	Hg_2O (loss drying at 110° C.)	1.10
CoO	.42	Ignition loss	.90
MnO	1.24		
CaO	2.03		100.03
MgO	4.30		

Doctor Schoch also makes the following observations:

The total sulphur was found to be 6.20 per cent. Treating the sample with nitric acid the free sulphur obtained was 2.91 per cent. This has been combined with iron in the form of ferrous sulphide, which is found to be 8 per cent. The rest of the sulphur (3.29 per cent) is in the form of sulphur trioxide, which amounts to 8.23 per cent.

The total iron is 25.53 per cent. Metallic iron was found to be 3.12 per cent. The iron in ferrous sulphide (8 per cent) equals 5.09 per cent. The remaining iron (17.32 per cent) is in the form of ferrous oxide, which amounts to 22.27 per cent.

The other determinations were made by the usual method and did not give any difficulty.

This piece of meteorite had a black surface. It is easily broken. The fresh surface thus exposed was brownish with many small black and gray specks.

After crushing pieces of this meteorite in a mortar some hard black particles, varying in size up to a small pin head, were easily removed by a magnet and proved to be metallic iron.

The presence of sulphides was easily suggested when dilute hydrochloric acid pro duced the odor of hydrogen disulphide.

The residue unattacked by hydrochloric, nitric, sulphuric, and hydrofluoric acids consisted of minute black particles, which proved to be carbon in the form of graphite.

It was found that this meteorite was not strictly of uniform composition; the results given represent somewhat of an average.

EXPLANATION OF PLATES.

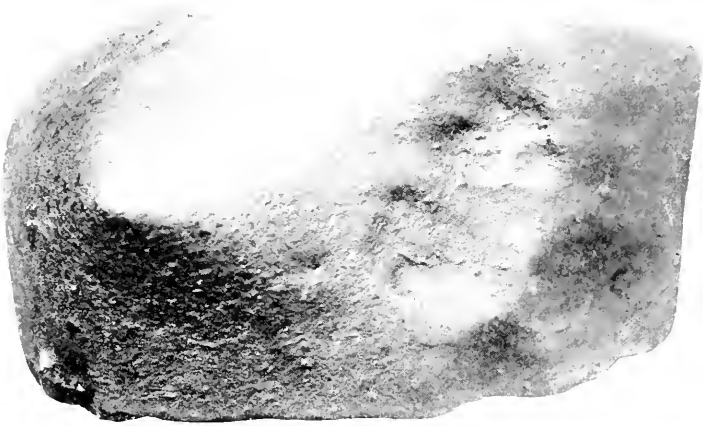
Plate 100.

Upper.—The anterior view of the larger fragment of the Troup meteorite. About three-fourths natural size.

Lower.—The posterior side of the larger fragment of the Troup meteorite. About three-fourths natural size.

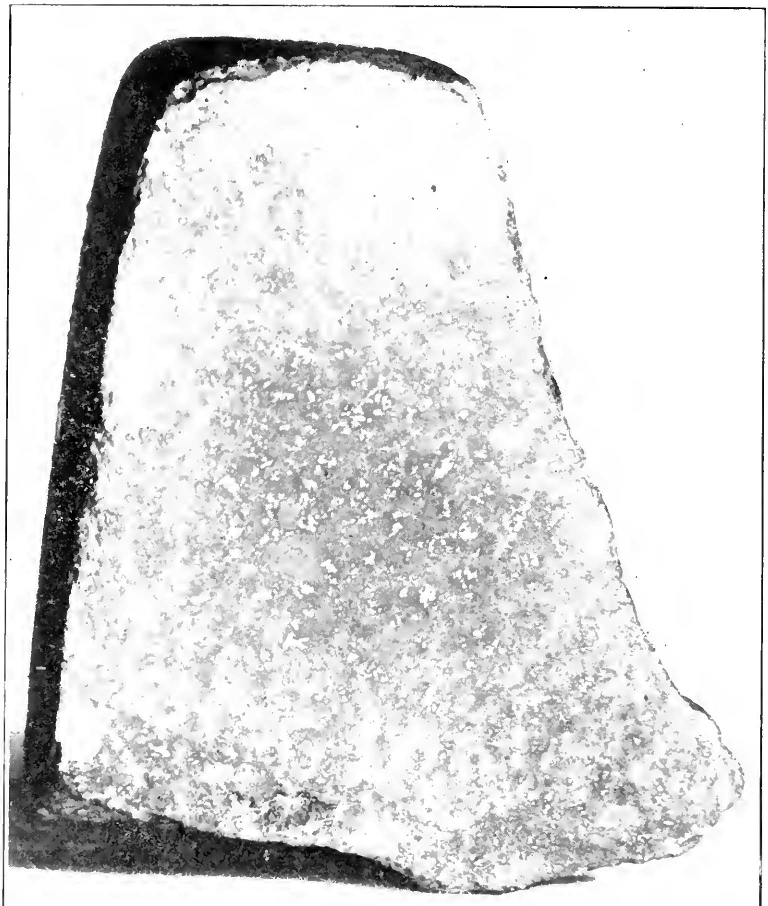
Plate 101.

Polished cross section of the Troup meteorite. The larger iron grains are the lightest spots. Several chondri appear, the largest near the left-hand corner. The dark blotches are due to oxidation of the iron immediately after polishing. A vein runs a sinuous course parallel to the lower margin. Magnified to twice the diameter of the stone.



THE TROUP, TEXAS, METEORITE.

FOR EXPLANATION OF PLATE SEE PAGE 476.



THE TROUP, TEXAS, METEORITE.

FOR EXPLANATION OF PLATE SEE PAGE 476.

MICROSTRUCTURE OF TROUP METEORITE. THE WHITE AREAS ARE MASKELYNITE.

FOR EXPLANATION OF PLATE SEE PAGE 477.

ON THE MINERAL COMPOSITION AND STRUCTURE OF THE TROUP METEORITE.

By George P. Merrill.

Head Curator of Geology, United States National Museum.

The general megascopic character of this stone has been sufficiently described in Prof. J. A. Udden's paper.[1] The chondritic structure is quite indistinct and might at first seem doubtful but for the occasional presence of larger forms (2 to 3 mm. in diameter) of a white and gray color. The texture is firm and the chondrules break with the matrix. The amount of metal (3.1 per cent) given in Doctor Schoch's analysis (p. 475) is much smaller than one would be led to suppose from the appearance of a polished surface (see pl. 101 of Professor Udden's paper), and the writer ventures to suggest that the small amount of material ("some 2 or 3 grams") utilized did not correctly represent the character of the stone as a whole. This has in the past been an altogether too frequent cause of error by those who have regarded meteorites as too precious for exhaustive study.

In thin sections under the microscope the stone presents an extremely variable, granular, and indistinctly chondritic structure, such as is characteristic of many of the intermediate chondrites, to which group this stone is assigned. So extremely variable is it as to almost baffle description (pl. 102). Areas of closely interlocking olivines and enstatites in crystalline granules of considerable size give way abruptly to those showing large irregular outlined fragmental material surrounded by narrow zones so finely granular as to give only aggregate polarization, and these again to imperfect chondroidal forms, sometimes porphyritic and sometimes of barred or radiate structure. Throughout the entire mass and within the chondrules themselves abundant irregular clear and transparent, almost completely isotropic areas of glass (maskelynite), with interstitial areas of colorless calcium phosphate (merrillite) are by no means rare. Indeed, so abundant are the last named that it

[1] Proc. U. S. Nat. Mus., vol. 59, 1921, pp. 471–476.

would seem their presence should have been made known by the analysis (p. 475).[2] This, together with an even greater abundance of the isotropic maskelynite, constitutes the most interesting feature of the stone. The pyroxenic constituent is almost completely colorless in the section and is evidently a normal enstatite. The metal, sulphide, and other opaque constituents require no special mention.

[2] Doctor Schoch's attention having been called to this discrepancy, he has, since the above was in type, made further investigations and reported 0.51 P_2O_5. See p. 475 of Udden's paper.

A CRYSTALLOGRAPHIC STUDY OF THE DATOLITE FROM WESTFIELD, MASSACHUSETTS.

By Earl V. Shannon,

Assistant Curator, Department of Geology, United States National Museum.

INTRODUCTION.

The locality of Westfield, Massachusetts, has within the past 18 years produced datolite crystals in such abundance and of such unusual size and perfection of form that the specimens have become well known and are now widely distributed in mineralogical collections. The datolite of this occurrence was first described by Whitlock,[1] whose work apparently was based on only a few crystals. Upon these 27 forms were found, four of which were new. Immediately following the publication of Whitlock's paper, Kraus and Cook [2] published a more extensive study of this datolite, their collection consisting of some 45 crystals, of which 10 were measured in detail. They added three new forms to the list and found a number of previously known forms not present on the crystals examined by Whitlock. Later Görgey and Goldschmidt,[3] in a general study of datolite, examined 11 crystals from Westfield, upon which they found eight new forms; and later still Ungemach [4] has reviewed all previous work on the mineral from this locality and measured eight crystals on which nine additional new forms were found. Thus 23 new forms had been found in the study of only approximately 70 crystals from a locality which had produced thousands of crystals of datolite—a fairly dependable indication that additional studies based upon the mineral from this locality might produce interesting results.

While a resident at Springfield, Massachusetts, between February, 1918, and April, 1919, the present writer had opportunity at frequent intervals to visit the quarries which yield the datolite. The modes of occurrence of the datolite and associated minerals were carefully observed with a view of describing the locality, and the crystallo-

[1] Bull. 98, N. Y. State Mus., pp. 19-22, 1905.
[2] Amer. Journ. Sci., vol. 22, p. 21, 1906.
[3] Zeitschr. Kryst., vol. 48, p. 652, 1910.
[4] Ungemach. Zeitschr. Kryst., vol. 49, p. 470, 1911.

graphic and other characters of the several minerals, with a discussion of their paragenesis and origin. Several shorter preliminary papers on various subjects relating to the locality have already been published. It was planned to make the present paper final and complete, but the crystallographic data on the datolite has assumed such proportions that it has been decided to reserve discussion of other subjects for another and final paper to be presented shortly. The following discussion of the crystallography of the Westfield datolite is based upon a very thorough acquaintance with the material. While at the quarries these specimens were selected with the view of securing as many variations in habit as might occur. Speci-

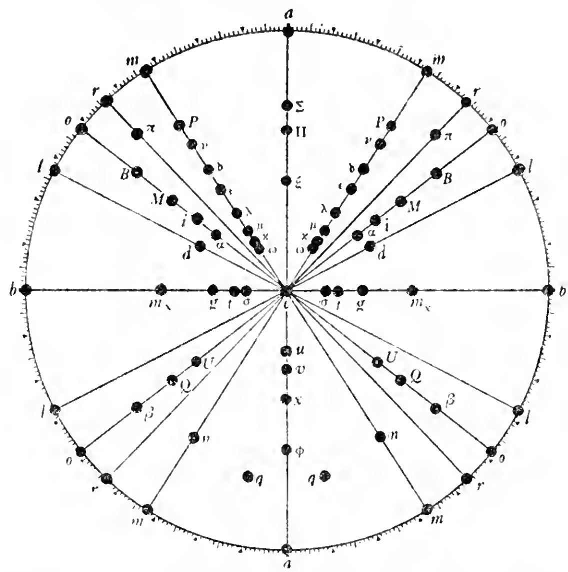


FIG. 1.—STEREOGRAPHIC PROJECTION SHOWING THE COMMON FORMS OCCURRING ON DATOLITE, PLOTTED IN THE DANA ORIENTATION. THE SYMMETRY IS EXPRESSED BY THE FALLING OF THE FORMS IN VERTICAL ZONES.

mens from unusual situations were especially sought, and all of the quarries were systematically sampled at various times while work was in progress. The United States National Museum had already acquired several excellent exhibition specimens of this datolite which were available for study, and in addition to these and the collection made by the writer a lot of some 35 specimens collected over a period of several years following the opening of the quarries was secured by exchange from Mr. William L. Fitts, of Springfield. The entire stock of this material held by Ward's Natural Science Establishment was also borrowed for study. From this large number of specimens about 200 crystals were selected for study, and after numerous preliminary measurements about two-thirds of this number were eliminated as duplicates. The series of about 50 crystals which was completely studied represents a concentration containing all the unusual forms and variations in habit occurring in upward of a thousand crystals. After much work had so familiarized the writer with the datolite and the peculiarities of outline and etching of the various forms that almost any given crystal could be oriented and its forms identified with a fair degree of accuracy by simple vision, the Westfield datolite specimens in the Brush collection of Yale University and in several private collections were examined without revealing any habits or any prominent forms not represented in the writer's final series of crystals.

METHODS.

The study of the datolite was begun and carried through the examination of some 30 crystals by zonal measurement with a Fuess 1-

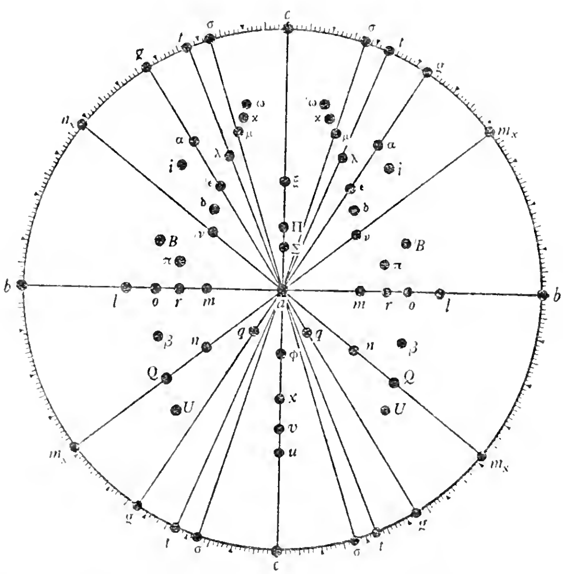
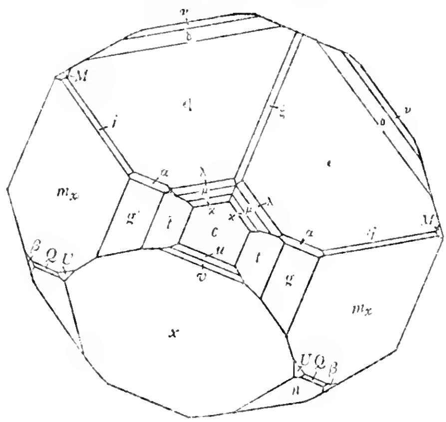
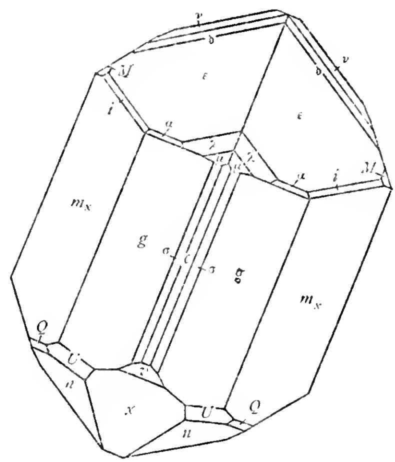


FIG. 2.—STEREOGRAPHIC PROJECTION SHOWING THE SAME FORMS AS FIGURE 1 BUT PLOTTED IN THE GOLDSCHMIDT ORIENTATION. THE POORER EXPRESSION OF THE SYMMETRY IS APPARENT.

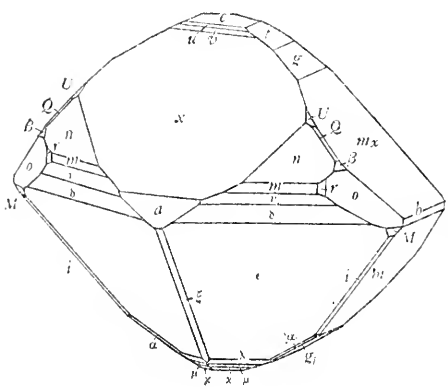
circle goniometer, the symmetry relations of the various forms being worked out in stereographic projection, many of the forms being identified graphically. Despite the pronounced zonal relations existing between the various forms on datolite this method was more or less unsatisfactory, and the attendant trigonometric calculations were so tedious and consumed so much time that the problem was finally laid aside for more than a year, since it was obvious that the work could be done much more easily and simply by using a Goldschmidt 2-circle goniometer and attendant methods. Recently such an instrument has become available and the work which had been so difficult by the older system became fairly easy. The measurements made by the 1-circle goniometer were all rejected and the crystals remeasured by the newer instrument. The numerous calculations of angles given in the tables were made by the use of Goldschmidt's formulas and the crystal drawings, which had been made by older methods using axial crosses, were redrawn, for the sake of the greater accuracy attainable, from the gnomonic projection. It was possible with the 2-circle goniometer to measure many faces which it was practically impossible to measure zonally. It may be appropriate to state that

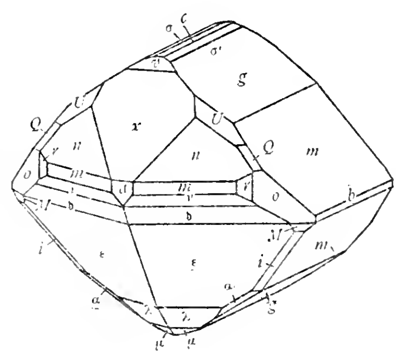


3



4

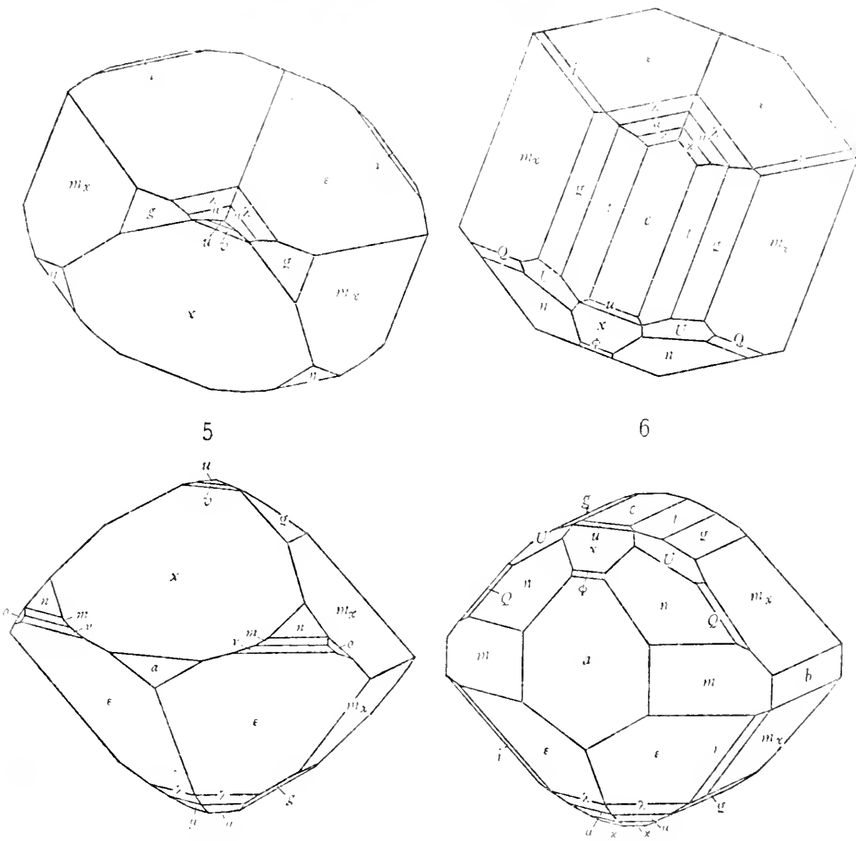




FIGS. 3-4.—3, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS SHOWING A CRYSTAL OF TYPE 1, THIS BEING THE DEVELOPMENT OF MOST FREQUENT OCCURRENCE AT WESTFIELD. 4, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS OF CRYSTAL 2, PRISMATIC BY ELONGATION ON THE *a* AXIS.

the writer, who up to this time had used only the 1-circle goniometer and attendant methods of plotting, projection, calculation, and drawing, is thoroughly convinced of the incomparable superiority of the 2-circle goniometer and the methods devised to accompany its use.

It is necessary in measuring these datolites to handle on the goniometer some large and decidedly awkward crystals, since many of the rarer forms are practically confined to the largest crystals. The average diameter of the crystals measured was approximately 1 cm., but crystals up to 3 cm. in diameter were measured at times. In these cases it is often necessary to shift the crystal backward and forward during measurement, thus slightly affecting the accuracy of the measurements, but the close agreement between the angles measured and the calculated angles indicates that in most cases the errors due to this cause are small. Many of the rarer forms which are present as small faces are characteristically etched and dull, and



FIGS. 5-6.—5, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS OF SYMMETRICALLY DEVELOPED DATOLITE CRYSTAL OF THE ACUTE HABIT DESIGNATED TYPE 2 BY KRAUS AND COOK. A COMMONLY OCCURRING HABIT AT WESTFIELD. 6, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS OF A SYMMETRICALLY DEVELOPED CRYSTAL OF THE PRISMATIC TYPE WITH LARGE DEVELOPMENT OF *a* (100), DESIGNATED TYPE 3 BY KRAUS AND COOK. SHOWS UNUSUAL FORM φ (101).

many faces which are clearly visible reflect no light at all. Many measurements are rendered inaccurate, even though the signal was clearly discernible, by the fact that the illumination was insufficient to render the cross hairs visible and the signal could only be brought to an approximation of the center of the field. In many cases small and partly etched faces which give only a faint signal are hard to accurately measure, because they fall so near other larger and highly polished faces that the brilliant signals in the field render it almost impossible for the eye to distinguish the fainter signals. In general no face was considered which did not yield an unmistakable signal, and, conversely, no signal was measured unless its face was readily visible under a lens. In many cases a single crystal will yield a measurable signal from a face representing a form which is represented on all other crystals only as dull etched faces yielding no reflection of light. Were more attention paid to working out the probable identity of dull faces by zonal relations and to measuring signals of doubtful authenticity which may represent minute faces or internal fractures, etc., the number of new forms listed might be more than doubled.

In the working out of the crystals by the Goldschmidt method the writer has been greatly assisted by the articles on this method which

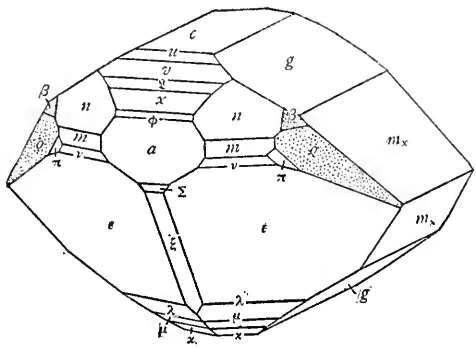


FIG. 7.—CLINOGRAPHIC PROJECTION OF A DATOLITE CRYSTAL OF TYPE 4 HABIT (CRYSTAL 36) SHOWING THE CHARACTERISTIC POSITIVE AND NEGATIVE ORTHODOME ZONE.

have appeared from time to time in recent numbers in the American Mineralogist. He has also to here express his obligation to Dr. Edgar T. Wherry and William F. Foshag for valuable advice and assistance.

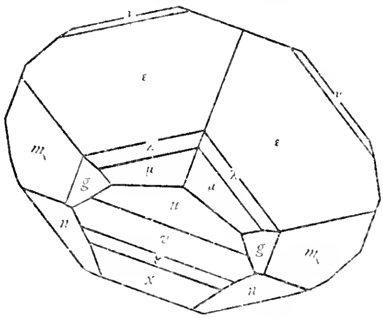
ORIENTATION.

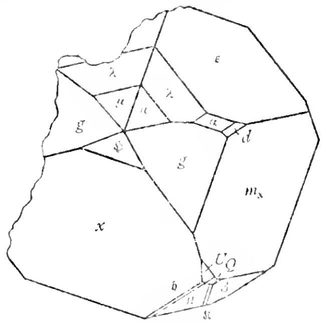
There are at present in use two prominent orientations for datolite—the Levy orientation, which was adopted by Dana and which will be referred to subsequently as the Dana orientation, and the orientation of Rammelsberg, which is followed by Goldschmidt and is best known as the Goldschmidt orientation. In the Goldschmidt orientation the form which in the Dana orientation is the dome *g*(012) becomes the unit prism *m* (110). The axes are thus interchanged, axis $\acute{a}$, Dana orientation, becoming axis $\grave{c}$, Goldschmidt orientation, and ½ axis $\grave{b}$, Dana orientation, becoming axis $\acute{a}$, Goldschmidt orientation. The axial ratios for the two orientations are then as follows:

$\acute{a} : \bar{b} : \grave{c} = 0.63446 : 1 : 1.26574$ Dana orientation.

$\acute{a} : \bar{b} : \grave{c} = 0.63287 : 1 : .63446$ Goldschmidt orientation.

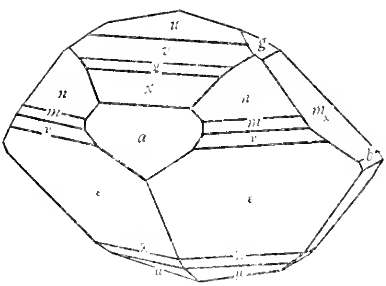
The Dana orientation has naturally been preferred by most American authors and also by Ungemach and other European authors who still use the 1-circle goniometer. The majority of German mineralogists and most others who use the 2-circle goniometer and Goldschmidt methods have used the Goldschmidt orientation. Various advocates of each of these two methods have endeavored to justify their preference by showing either that the orientation which they favored gave simpler indices or that it better illustrated the relationships existing between datolite and the other members of the group which includes homilite, gadolinite, and euclase.

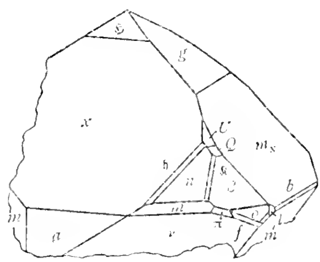




8

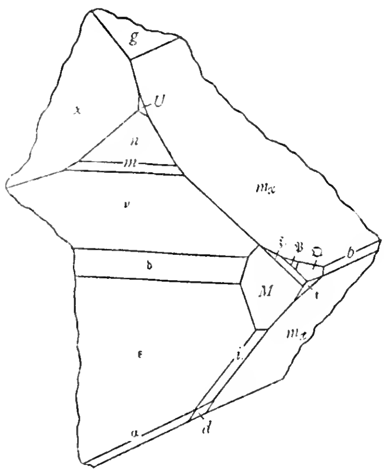
9



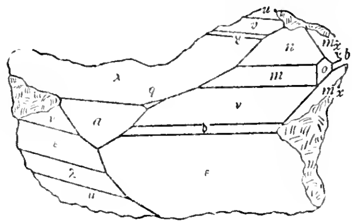


Figs. 8-9.—8, Orthographic and clinographic projections of crystal 28. An unusual habit with the steep pyramidal form of type 2 but with an orthodome series including 𝔏 (205) as in crystals of type 4. 9, Orthographic and clinographic projections of crystal B9 showing unusual pyramidal form with the forms 𝔥 (768), 𝔎 (451), f_1, ($\bar{3}61$), and m_1, ($\bar{1}\bar{2}.25.1$).

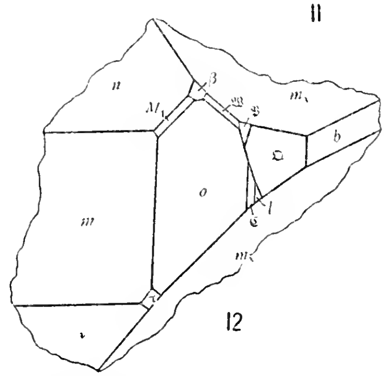
The difference in relative simplicity of indices is not greatly in favor of either orientation when all the known forms are considered, although it is possible to select groups of forms or zones which yield comparisons favoring either position. This is well illustrated by the method of adding the indices of the same forms for the two orientations. Thus, when the sums of the indices of the forms given in Table 1 are obtained the indices for the Dana orientation total 1,101, while the sum of the indices for the same forms in the Goldschmidt orientation is 1,113, the difference being too small to be of any importance. Similarly, the sum of the indices of the new forms given below is 811 for the Dana position and 927 for the Goldschmidt position the difference in each instance favoring the former orientation. In the majority of occurrences of crystallized datolite the crystals are so developed that the zone adopted as prismatic by Goldschmidt is much more prominent and recognizable than the zone taken as prismatic in the Dana orientation, this constituting the most practical argument in support of the Goldschmidt orientation, as it is consequently much easier to adjust crystals in polar position for measurement on the 2-circle goniometer in this orientation than in that of Dana. In the present work the Dana position is used, however, because it is more familiar to American mineralogists and because of priority of its use for datolite, homolite, and



10



11



12

FIGS. 10-12.—10, PORTION OF CRYSTAL B7. CLINOGRAPHIC PROJECTION SHOWING NEW FORMS $\mathfrak{z}$ ($\bar{2}63$), $\mathfrak{P}$ (192), $\mathfrak{Q}$ (1.10.2), AND T ($\bar{1}$.20.15). 11, CRYSTAL B8. CLINOGRAPHIC PROJECTION SHOWING DEVELOPMENT OF THE CRYSTAL AND THE NEW FORM $\mathfrak{L}$ (205). 12, CRYSTAL B8. CLINOGRAPHIC PROJECTION OF DETAIL SHOWING M_1 (231), $\mathfrak{W}$ (382), $\mathfrak{P}$ (192), $\mathfrak{Q}$ (1.10.2), $\mathfrak{C}$ (380).

gadolinite. The indices in general are not simpler in the Goldschmidt orientation, and the Dana orientation shows the crystallographic and optical relationships between the several members of the group equally well. Perhaps the most convincing support for this orientation is the symmetry relations existing between the common forms These relations are brought out by the stereographic projections, figures 1 and 2, which show the zonal relations existing between the commonly occurring forms for datolite in the two orientations.

The use of two orientations for datolite has been a source of considerable confusion since new forms have been described in either orientation according to the preference of the worker. The investigators using the 2-circle goniometer have been compelled to choose Goldschmidt's orientation or undertake the alternative of recalculating long tables of angles and of converting all forms to indices in terms of the Dana orientation. This has been done by the writer, and the tables, which represent a considerable expenditure of time and labor, are here reproduced for the benefit of future workers who may prefer the Dana position. Thus in table 1 is given a list of all known forms described for datolite, with the letters assigned them and the equivalent indices and symbols in the two orientations, together with references to the publication from which the writer obtained the data on the form. In table 2 the same list of forms is given with the angles calculated for all forms in the Dana position. For convenience in comparing measured angles this table is arranged by ascending φ and positive and negative forms are segregated. Also in table 4 is given a list of the new forms added by the present investigation, with equivalent indices and symbols, while in table 6, for the convenience of those preferring the Goldschmidt position, the new forms are listed with their calculated angles in the Goldschmidt orientation. For calculating angles in Dana's orientation the following mathematical constants were used:

$a = .63446$	$\lg.\ a = 9.80243$	$h = 1.0000$
$c = 1.26574$	$\lg.\ c = 10.10243$	$e = .0025$
$p_o = 1.995$	$\lg.\ p_o = 10.29994$	$\lg.\ \frac{p_o}{q_o} = 10.19762$
$q_o = 1.226$	$\lg.\ q_o = 10.10232$	
$\left.\begin{matrix}\mu = \\ 180° - \beta\end{matrix}\right\} = 89°\ 51'$	$\left.\begin{matrix}\lg.\ h = \\ \lg.\ \sin.\ \mu\end{matrix}\right\} = 0$	$\left.\begin{matrix}\lg.\ e = \\ \lg.\ \cos.\ \mu\end{matrix}\right\} = 7.41797$

Owing to the similarity in angles that exists between the two zones which are taken as prismatic in the two orientations, it is very easy to inadvertently interchange these. The very close similarity is shown by the following comparison of angles:

$$\begin{array}{llll}
m(110) \wedge m'''(1\bar{1}0) = 64°\ 47' & g(012) \wedge & g'(0\bar{1}2) = 64°\ 40'. \\
e(320) \wedge\ e'''(3\bar{2}0) = 45°\ 51' & t(013) \wedge & t'(0\bar{1}3) = 45°\ 45'. \\
\Delta(210) \wedge \Delta'''(2\bar{1}0) = 35°\ 12' & \sigma(014) \wedge & \sigma'(0\bar{1}4) = 35°\ 07'. \\
o(120) \wedge\ o'\ (\bar{1}20) = 76°\ 29' & m_x(011) \wedge & \overline{m}_x(01\bar{1}) = 76°\ 37'.
\end{array}$$

In addition to this common cause of confusion is the fact that the mineral approximates so very closely to orthorhombic symmetry ($\beta = 89°\ 51\frac{1}{2}'$) that the difference in angle between corresponding positive and negative forms is very small, and it is consequently possible to rotate crystals 180° from true position, especially if the angles measured are not very exact and the crystal is simple in combination. The danger of committing errors of orientation is naturally much greater with simple crystals than with highly modified crystals showing a large number of forms. In some rare instances it is possible to completely measure a crystal of this mineral without obtaining measurements which will show conclusively how it should be oriented, the difficulty then having to be settled by optical examination. The various characteristic etchings and irregularities which occur on the faces are of greatest value in orienting the crystals, and for this reason these peculiarities are described in considerable detail below. While every crystal measured by the writer has been carefully considered and the possibility of error in orientation carefully weighed, it is possible though improbable that one or more crystals were measured in a wrong position.

Table 1.—*Datolite.*

Giving a list of forms previously recorded for datolite with equivalent indices and symbols in the Dana (Levy) and Goldschmidt (Rammelsberg) orientations.

	Dana orientation.		Goldschmidt orientation.		Reference.
	Miller.	Goldschmidt.	Miller.	Goldschmidt.	
a	100	∞ 0	001	0	Goldschmidt Winkeltabellen.
b	010	0 ∞	010	0 ∞	Do.
c	001	0	100	∞ 0	Do.
m(*M*)	110	∞	011	0 1	Do.
o	120	∞ 2	021	0 2	Do.
l	130	∞ 3	031	0 3	Do.
Θ	140	∞ 4	041	0 4	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
Δ	210	2 ∞	012	0 $\frac{1}{2}$	Goldschmidt Winkeltabellen.
r	230	∞ $\frac{3}{2}$	032	0 $\frac{3}{2}$	Do.
N	340	∞ $\frac{4}{3}$	043	0 $\frac{4}{3}$	Hawkins, Amer. Journ. Sci., v. 39, p. 474, 1915.
η	410	4 ∞	014	0 $\frac{1}{4}$	Goldschmidt Winkeltabellen.
s	530	$\frac{5}{3}$ ∞	035	0 $\frac{3}{5}$	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
e	320	$\frac{3}{2}$ ∞	023	0 $\frac{2}{3}$	Goldschmidt Winkeltabellen.
$m_x(m)$	011	0 1	120	∞ 2	Do.
g	012	0 $\frac{1}{2}$	110	∞	Do.
t	013	0 $\frac{1}{3}$	320	$\frac{3}{2}$ ∞	Do.
σ	014	0 $\frac{1}{4}$	210	2 ∞	Do.
Ω	018	0 $\frac{1}{8}$	410	4 ∞	Do.
m_z	0-1-10	0 $\frac{1}{10}$	510	5 ∞	Kraus & Cook, Amer. Journ. Sci., v. 22, p. 21, 1906.
S	021	0 2	140	∞ 4	Goldschmidt Winkeltabellen.
h	023	0 $\frac{2}{3}$	340	∞ $\frac{4}{3}$	Do.
m_y	067	0 $\frac{6}{7}$	7-12-0	∞ $\frac{12}{7}$	Kraus & Cook, Amer. Journ. Sci., v. 22, p. 21, 1906.
ϕ	101	+ 1 0	102	+ $\frac{1}{2}$ 0	Goldschmidt Winkeltabellen.
x	102	+ $\frac{1}{2}$ 0	101	+ 1 0	Do.
v	103	+ $\frac{1}{3}$ 0	302	+ $\frac{3}{2}$ 0	Do.
u	104	+ $\frac{1}{4}$ 0	201	+ 2 0	Do.
p	106	+ $\frac{1}{6}$ 0	301	+ 3 0	Do.
q	1-0-14	+ $\frac{1}{14}$ 0	701	+ 7 0	Palache, Zeits. Kryst., v. 47, p. 583, 1910.
Ψ	201	+ 2 0	104	+ $\frac{1}{4}$ 0	Goldschmidt Winkeltabellen.
I	203	+ $\frac{2}{3}$ 0	304	+ $\frac{3}{4}$ 0	Palache, Zeits. Kryst., v. 47, p. 583, 1910.
s	302	+ $\frac{3}{2}$ 0	103	+ $\frac{1}{3}$ 0	Goldschmidt Winkeltabellen.
f	304	+ $\frac{3}{4}$ 0	203	+ $\frac{2}{3}$ 0	Do.
𝔖	308	+ $\frac{3}{8}$ 0	403	+ $\frac{4}{3}$ 0	Gorgey & Gdt., Zeits. Kryst., . 48, p. 652, 1910.

TABLE 1.—*Datolite*—Continued.

	Dana orientation.		Goldschmidt orientation.		Reference.
	Miller.	Goldschmidt.	Miller.	Goldschmidt.	
k:	3-0-10	+ $\frac{3}{10}$ 0	503	+ $\frac{5}{3}$ 0	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
j	502	+ $\frac{5}{2}$ 0	105	+ $\frac{1}{5}$ 0	Do.
y	601	+ 6 0	1-0-12	+ $\frac{1}{12}$ 0	Do.
H	$\bar{1}01$	— 10	$\bar{1}02$	— $\frac{1}{2}$ 0	Goldschmidt Winkeltabellen.
ξ	$\bar{1}02$	— $\frac{1}{2}$ 0	$\bar{1}01$	— 1 0	Do.
𝔞	$\bar{1}04$	— $\frac{1}{4}$ 0	$\bar{2}01$	— 2 0	Do.
z	$\bar{2}01$	— 20	$\bar{1}01$	— $\frac{1}{2}$ 0	Do.
Σ	$\bar{3}02$	— $\frac{3}{2}$ 0	$\bar{1}03$	— $\frac{1}{3}$ 0	Do.
𝔊	$\bar{3}04$	— $\frac{3}{4}$ 0	$\bar{2}03$	— $\frac{2}{3}$ 0	Do.
τ	$\bar{7}02$	— $\frac{7}{2}$ 0	$\bar{1}07$	— $\frac{1}{7}$ 0	Do.
	$\overline{11}$-0-2	— $\frac{11}{2}$ 0	1-0-11	— $\frac{2}{11}$ 0	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
n	111	+ 1	122	+ $\frac{1}{2}$ 1	Goldschmidt Winkeltabellen.
Λ	112	+ $\frac{1}{2}$	111	+ 1	Do.
L	113	+ $\frac{1}{3}$	322	+ $\frac{3}{2}$ 1	Do.
W	114	+ $\frac{1}{4}$	211	+ 2 1	Do.
ſ	115	+ $\frac{1}{5}$	522	+ $\frac{5}{2}$ 1	Do.
Z	116	+ $\frac{1}{6}$	311	+ 3 1	Do.
	1-1-18	+ $\frac{1}{18}$	911	+ 9 1	Eakle, Bull. Dept. Geol. U. Cal., v. 2, p. 318, 1900.
β	121	+ 1 2	142	+ $\frac{1}{2}$ 2	Goldschmidt Winkeltabellen.
Q	122	+ $\frac{1}{2}$ 1	121	+ 1 2	Do.
U	123	+ $\frac{1}{3}$ $\frac{2}{3}$	342	+ $\frac{3}{2}$ 2	Do.
γ	124	+ $\frac{1}{4}$ $\frac{1}{2}$	221	+ 2	Do.
𝔫 (*k*)	132	+ $\frac{1}{2}$ $\frac{3}{2}$	131	+ 1 3	Whitlock, Sch. Mines Quar., v. 31, p. 225, 1905.
D	133	+ $\frac{1}{3}$ 1	362	+ $\frac{3}{2}$ 3	Goldschmidt Winkeltabellen.
ſ	114	+ $\frac{1}{4}$ 1	241	+ 2 4	Do.
ρ	118	+ $\frac{1}{8}$ $\frac{1}{8}$	441	+ 4	Do.
𝔇	211	+ 2 1	124	+ $\frac{1}{4}$ $\frac{1}{2}$	Do.
ϑ	212	+ 1 $\frac{1}{2}$	112	+ $\frac{1}{2}$	Do.
𝔳	213	+ $\frac{2}{3}$ $\frac{1}{3}$	324	+ $\frac{3}{4}$ $\frac{1}{2}$	Do.
𝔴	215	+ $\frac{2}{5}$ $\frac{1}{5}$	524	+ $\frac{5}{4}$ $\frac{1}{2}$	Do.
A	216	+ $\frac{1}{3}$ $\frac{1}{6}$	312	+ $\frac{3}{2}$ $\frac{1}{2}$	Do.
δ	221	+ 2	144	+ $\frac{1}{4}$ 1	Do.
M_1	231	+ 2 3	164	+ $\frac{1}{4}$ $\frac{3}{2}$	Ungemach, Bull. Soc. Franc., v. 32, p. 397, 1909.
K	241	+ 2 4	181	+ $\frac{1}{4}$ 2	Goldschmidt Winkeltabellen.
Y	255	+ $\frac{2}{5}$ 1	5-10-4	+ $\frac{5}{4}$ $\frac{5}{2}$	Whitlock, Sch. Mines Quar., v. 31, p. 225, 1909.
g_0	2-15-28	+ $\frac{1}{14}$ $\frac{15}{28}$	14-15-2	+ 7 $\frac{15}{2}$	McClintock, Min. Mag., v. 15, p. 411, 1910.
J_1	311	+ 3 1	126	+ $\frac{1}{6}$ $\frac{1}{3}$	Ungemach, Bull. Soc. Franc., v. 32, p. 397, 1919.
q·	312	+ $\frac{3}{2}$ $\frac{1}{2}$	113	+ $\frac{1}{3}$	Goldschmidt Winkeltabellen.
𝔅·	313	+ 1 $\frac{1}{3}$	326	+ $\frac{1}{2}$ $\frac{1}{3}$	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652, 1910.
Γ	314	+ $\frac{3}{4}$ $\frac{1}{4}$	213	+ $\frac{2}{3}$ $\frac{1}{3}$	Goldschmidt Winkeltabellen.
N:	322	+ $\frac{3}{2}$ 1	123	+ $\frac{1}{3}$ $\frac{2}{3}$	Do.
u	324	+ $\frac{3}{4}$ $\frac{1}{2}$	223	+ $\frac{2}{3}$	Do.
𝔉	362	+ $\frac{3}{2}$ 3	163	+ $\frac{1}{3}$ 2	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652, 1910.
d·	364	+ $\frac{3}{4}$ $\frac{3}{2}$	263	+ $\frac{2}{3}$ 2	Palache, Zeits. Kryst., v. 47, p. 583, 1910.
I·	412	+ 2 $\frac{1}{2}$	111	+ $\frac{1}{4}$	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
Ψ	414	+ 1 $\frac{1}{4}$	214	+ $\frac{1}{2}$ $\frac{1}{4}$	Goldschmidt Winkeltabellen.
𝔚	421	+ 4 2	148	+ $\frac{1}{8}$ $\frac{1}{2}$	Do.
𝔎	454	+ 1 $\frac{5}{4}$	254	+ $\frac{1}{2}$ $\frac{5}{4}$	Görgey & Goldschmidt, idem.
X	534	+ $\frac{5}{4}$ $\frac{3}{4}$	235	+ $\frac{2}{5}$ $\frac{3}{5}$	Goldschmidt Winkeltabellen.
𝔖	548	+ $\frac{5}{8}$ $\frac{1}{2}$	445	+ $\frac{4}{5}$	Do.
k·	578	+ $\frac{5}{8}$ $\frac{7}{8}$	475	+ $\frac{4}{5}$ $\frac{7}{5}$	Palache, Zeits. Kryst., v. 47, p. 583, 1910.
λ_2	722	+ $\frac{7}{2}$ 1	127	+ $\frac{1}{7}$ $\frac{2}{7}$	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652, 1910.
𝔄	763	+ $\frac{7}{3}$ 2	3-12-14	+ $\frac{3}{14}$ $\frac{6}{7}$	Goldschmidt Winkeltabellen.
ν	$\bar{1}11$	— 1	$\bar{1}22$	— $\frac{1}{2}$ 1	Do.
ε	$\bar{1}12$	— $\frac{1}{2}$	$\bar{1}11$	— 1	Do.
λ	$\bar{1}13$	— $\frac{1}{3}$	$\bar{3}22$	— $\frac{3}{2}$ 1	Do.
μ	$\bar{1}14$	— $\frac{1}{4}$	$\bar{2}11$	— 2 1	Do.
κ	$\bar{1}15$	— $\frac{1}{5}$	$\bar{5}22$	— $\frac{5}{2}$ 1	Do.
ω	$\bar{1}16$	— $\frac{1}{6}$	$\bar{3}11$	— 3 1	Do.

TABLE 1.—*Datolite*—Continued.

	Dana orientation.		Goldschmidt orientation.		Reference.
	Miller.	Goldschmidt.	Miller.	Goldschmidt.	
b	$\bar{1}18$	$-\ \frac{1}{8}$	$\bar{4}11$	$-\ 4\ \ 1$	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652, 1910.
n_y	$\bar{1}$-1-10	$-\ \frac{1}{10}$	$\bar{5}11$	$-\ 5\ \ 1$	Kraus & Cook, Amer. Journ. Sci., v. 22, p. 21, 1906.
B	$\bar{1}21$	$-\ 1\ \ 2$	$\bar{1}42$	$-\ \frac{1}{2}\ \ 2$	Goldschmidt Winkeltabellen.
M (q)	$\bar{1}22$	$-\ \frac{1}{2}\ \ 1$	$\bar{1}21$	$-\ 1\ \ 2$	Whitlock, N. Y. State Mus. Bull., v. 98, p. 19, 1905.
i	$\bar{1}23$	$-\ \frac{1}{3}\ \ \frac{2}{3}$	$\bar{3}42$	$-\ \frac{3}{2}\ \ 2$	Goldschmidt Winkeltabellen.
α	$\bar{1}24$	$-\ \frac{1}{4}\ \ \frac{1}{2}$	$\bar{2}21$	$-\ \ 2$	Do.
C'	$\bar{1}25$	$-\ \frac{1}{5}\ \ \frac{2}{5}$	$\bar{5}42$	$-\ \frac{5}{2}\ \ 2$	Do.
ℜ	$\bar{1}26$	$-\ \frac{1}{6}\ \ \frac{1}{3}$	$\bar{3}21$	$-\ 3\ \ 2$	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652. 1910.
H	$\bar{1}31$	$-\ 1\ \ 3$	$\bar{1}62$	$-\ \frac{1}{2}\ \ 3$	Goldschmidt Winkeltabellen.
𝔯	$\bar{1}32$	$-\ \frac{1}{2}\ \ \frac{3}{2}$	$\bar{1}31$	$-\ 1\ \ 3$	Do.
Y_1	$\bar{1}34$	$-\ \frac{1}{4}\ \ \frac{3}{4}$	$\bar{2}31$	$-\ 2\ \ 3$	Ungemach, Bull. Soc. Franc., v. 32, p. 397, 1909.
d	$\bar{1}35$	$-\ \frac{1}{5}\ \ \frac{3}{5}$	$\bar{5}62$	$-\ \frac{5}{2}\ \ 3$	Do.
Ξ	$\bar{1}36$	$-\ \frac{1}{6}\ \ \frac{1}{2}$	$\bar{3}31$	$-\ \ 3$	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
E	$\bar{1}38$	$-\ \frac{1}{8}\ \ \frac{3}{8}$	$\bar{4}31$	$-\ 4\ \ 3$	Goldschmidt Winkeltabellen.
V	$\bar{1}41$	$-\ 1\ \ 4$	$\bar{1}82$	$-\ \frac{1}{2}\ \ 4$	Do.
ε'	$\bar{1}48$	$-\ \frac{1}{8}\ \ \frac{1}{2}$	$\bar{4}41$	$-\ \ 4$	Whitlock, Bull. N. Y. State Mus., v. 98, p. 19, 1919.
λ'	$\bar{1}49$	$-\ \frac{1}{9}\ \ \frac{4}{9}$	$\bar{9}82$	$-\ \frac{9}{2}\ \ 4$	Do.
μ'	$\bar{1}$-4-10	$-\ \frac{1}{10}\ \ \frac{2}{5}$	$\bar{5}41$	$-\ 5\ \ 4$	Do.
K	$\bar{1}58$	$-\ \frac{1}{8}\ \ \frac{5}{8}$	$\bar{4}51$	$-\ 4\ \ 5$	Goldschmidt Winkeltabellen.
X	$\bar{1}64$	$-\ \frac{1}{4}\ \ \frac{3}{2}$	$\bar{2}61$	$-\ 2\ \ 6$	Do.
G	$\bar{1}$-9-16	$-\ \frac{1}{16}\ \ \frac{9}{16}$	$\bar{8}91$	$-\ 8\ \ 9$	Do.
ι	$\bar{2}12$	$-\ 1\ \ \frac{1}{2}$	$\bar{1}12$	$-\ \ \frac{1}{2}$	Do.
T	$\bar{2}14$	$-\ \frac{1}{2}\ \ \frac{1}{4}$	$\bar{2}12$	$-\ 1\ \ \frac{1}{2}$	Do.
𝔡	$\bar{2}23$	$-\ \ \frac{2}{3}$	$\bar{3}44$	$-\ \frac{3}{4}\ \ 1$	Do.
μ_1	$\bar{2}27$	$-\ \ \frac{2}{7}$	$\bar{7}44$	$-\ \frac{7}{4}\ \ 1$	Slavík & Fišer, Centralbl. Min, 1903, p. 229.
π	$\bar{2}31$	$-\ 2\ \ 3$	$\bar{1}64$	$-\ \ \frac{1}{4}$	Goldschmidt Winkeltabellen.
J	$\bar{2}61$	$-\ 2\ \ 6$	$\bar{1}$-12-4	$-\ \frac{1}{4}\ \ 3$	Do.
O	$\bar{2}69$	$-\ \frac{2}{9}\ \ \frac{2}{3}$	$\bar{9}$-12-4	$-\ \frac{9}{4}\ \ 3$	Do.
Y·	$\bar{3}24$	$-\ \frac{3}{4}\ \ \frac{1}{2}$	$\bar{2}23$	$-\ \ \frac{2}{3}$	Do.
P	$\bar{3}32$	$-\ \ \frac{3}{2}$	$\bar{1}33$	$-\ \frac{1}{3}\ \ 1$	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652, 1910.
𝔢	$\bar{4}$-5-10	$-\ \frac{2}{5}\ \ \frac{1}{2}$	$\bar{5}54$	$-\ \ \frac{5}{4}$	Do.
k	$\bar{5}44$	$-\ \frac{5}{4}\ \ 1$	$\bar{2}45$	$-\ \frac{2}{5}\ \ \frac{4}{5}$	Palache, Zeits. Kryst., v. 47, p. 583, 1910.
Φ	$\bar{5}46$	$-\ \frac{5}{6}\ \ \frac{2}{3}$	$\bar{3}45$	$-\ \frac{3}{5}\ \ \frac{4}{5}$	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
F	$\bar{5}$-15-24	$-\ \frac{5}{24}\ \ \frac{5}{8}$	$\overline{12}$-15-5	$-\ \frac{12}{5}\ \ 3$	Goldschmidt Winkeltabellen.
ζ	$\bar{6}21$	$-\ 6\ \ 2$	$\bar{1}$-4-12	$-\ \frac{1}{12}\ \ \frac{1}{3}$	Do.
𝔊	$\bar{7}73$	$-\ \ \frac{7}{3}$	$\bar{3}$-14-14	$-\ \frac{3}{14}\ \ 1$	Do.
𝔶	$\bar{8}11$	$-\ 8\ \ 1$	$\bar{1}$-2-16	$-\ \frac{1}{16}\ \ \frac{1}{8}$	Ungemach, Zeits. Kryst., v. 49, p. 470, 1911.
𝔶	$\bar{9}11$	$-\ 9\ \ 1$	$\bar{1}$-2-18	$-\ \frac{1}{18}\ \ \frac{1}{9}$	Görgey & Gdt., Zeits. Kryst., v. 48, p. 652, 1910.

TABLE 2.—*Datolite.*

A table of calculated angles for all previously described forms for datolite in the Levy-Dana orientation.

Letter.	Miller.	Goldschmidt.	φ	ρ
			° ′	° ′
a	100	∞ 0	90 00	90 00
b	010	0 ∞	0 00	90 00
c	001	0	90 00	0 08
Θ	140	∞ 4	21 30	90 00
l	130	∞ 3	27 43	90 00
o	120	∞ 2	38 14	90 00

TABLE 2.—*Datolite*—Continued.

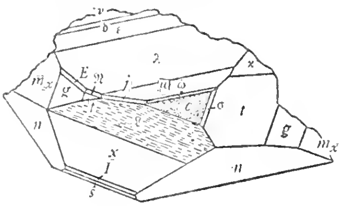
Letter.	Miller.	Goldschmidt.	ϕ °	ϕ ′	ρ °	ρ ′
r	230	$\infty\ \frac{3}{2}$	46	25	90	00
N	340	$\infty\ \frac{4}{3}$	49	16	90	00
m	110	∞	57	37	90	00
e	320	$\frac{3}{2}\ \infty$	67	05	90	00
s	530	$\frac{5}{3}\ \infty$	69	10	90	00
Δ	210	$2\ \infty$	72	21	90	00
η	410	$4\ \infty$	80	59	90	00
S	021	0 2	0	01	68	27
m_x (m)	011	0 1	0	07	51	41
m_y	067	$0\ \frac{6}{7}$	0	08	47	19
h	023	$0\ \frac{2}{3}$	0	10	40	10
g	012	$0\ \frac{1}{2}$	0	14	32	19
t	013	$0\ \frac{1}{3}$	0	20	22	52
s	014	$0\ \frac{1}{4}$	0	27	17	33
Ω	018	$0\ \frac{1}{8}$	0	54	8	59
m_z	0-1-10	$0\ \frac{1}{10}$	1	08	7	13
q	1-0-14	$+\frac{1}{14}\ 0$	90	00	8	15
p	106	$+\frac{1}{6}\ 0$	90	00	18	31
u	104	$+\frac{1}{4}\ 0$	90	00	26	37
k	3-0-10	$+\frac{3}{10}\ 0$	90	00	31	01
v	103	$+\frac{1}{3}\ 0$	90	00	33	43
𝔖	308	$+\frac{3}{8}\ 0$	90	00	36	54
x	102	$+\frac{1}{2}\ 0$	90	00	45	00
I	203	$+\frac{2}{3}\ 0$	90	00	53	07
f	304	$+\frac{3}{4}\ 0$	90	00	56	33
ϕ	101	$+1\ 0$	90	00	63	24
s	302	$+\frac{3}{2}\ 0$	90	00	71	18
ψ	201	$+2\ 0$	90	00	75	56
j	502	$+\frac{5}{2}\ 0$	90	00	78	40
y	601	$6\ 0$	90	00	85	14
a	$\bar{1}04$	$-\frac{1}{4}\ 0$	90	00	26	24
ξ	$\bar{1}02$	$-\frac{1}{2}\ 0$	90	00	44	51
𝔤	$\bar{3}04$	$-\frac{3}{4}\ 0$	90	00	56	12
Π	$\bar{1}01$	$-1\ 0$	90	00	63	21
Σ	$\bar{3}02$	$-\frac{3}{2}\ 0$	90	00	71	18
?	$\bar{2}01$	$-2\ 0$	90	00	75	55
τ	$\bar{7}02$	$-\frac{7}{2}\ 0$	90	00	81	51
	$\overline{11}$-0-2	$-\frac{11}{2}\ 0$	90	00	84	47
g_0	2-15-28	$+\frac{1}{14}\ \frac{15}{28}$	12	04	31	45
𝔣	144	$+\frac{1}{4}\ 1$	21	36	53	43
ρ	148	$+\frac{1}{8}\ \frac{1}{2}$	21	43	34	15
k (n)	132	$+\frac{1}{2}\ \frac{3}{2}$	27	46	65	01
D	133	$+\frac{1}{3}\ 1$	27	48	55	04
Y	255	$+\frac{2}{5}\ 1$	32	19	56	16
𝔉	362	$+\frac{3}{2}\ 3$	37	38	78	29
R	241	$+2\ 4$	38	14	81	11
β	121	$+1\ 2$	38	15	72	14
$d\cdot$	364	$+\frac{3}{4}\ \frac{3}{2}$	38	18	67	32
Q	122	$+\frac{1}{2}\ 1$	38	19	58	12
U	123	$+\frac{1}{3}\ \frac{2}{3}$	38	21	47	06
γ	124	$+\frac{1}{4}\ \frac{1}{2}$	38	23	38	55
M^1	231	$+2\ 3$	46	26	79	43
$k\cdot$	578	$+\frac{5}{8}\ \frac{7}{8}$	48	27	59	05
𝔎	454	$+1\ \frac{5}{4}$	51	36	68	34
δ	221	$+\ 2$	57	37	78	03
n	111	$+\ 1$	57	38	67	04
Λ	112	$+\ \frac{1}{2}$	57	40	49	48
L	113	$+\ \frac{1}{3}$	57	42	38	18
W	114	$+\ \frac{1}{4}$	57	44	30	40
𝔣	115	$+\ \frac{1}{5}$	57	46	25	24
Z	116	$+\ \frac{1}{6}$	57	48	21	36
	1-1-18	$+\ \frac{1}{18}$	58	11	7	36
𝔄	763	$+\frac{7}{3}\ 2$	61	29	79	19

TABLE 2.—*Datolite*—Continued.

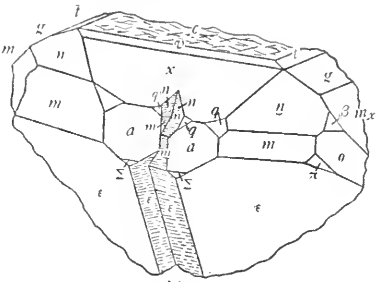
Letter.	Miller.	Goldschmidt.	φ	ρ
			° ′	° ′
$\mathfrak{E}$	518	$+\frac{5}{8}\ \frac{1}{2}$	63 08	54 28
N	322	$+\frac{3}{2}\ 1$	67 05	72 54
w	324	$+\frac{3}{4}\ \frac{1}{2}$	67 06	58 26
χ	534	$+\frac{5}{4}\ \frac{3}{4}$	69 11	69 28
$\mathfrak{D}$	211	$+2\ 1$	72 24	76 34
ϑ	212	$+1\ \frac{1}{2}$	72 25	64 29
$\mathfrak{B}$	421	$+4\ 2$	72 26	83 11
$\mathfrak{v}$	213	$+\frac{2}{3}\ \frac{1}{3}$	72 26	54 25
$\mathfrak{w}$	215	$+\frac{2}{5}\ \frac{1}{5}$	72 27	40 01
A	216	$+\frac{1}{3}\ \frac{1}{6}$	72 27	35 00
J_1	311	$+3\ 1$	78 04	80 43
q	312	$+\frac{3}{2}\ \frac{1}{2}$	78 04	71 55
$\mathfrak{B}^{\cdot}$	313	$+1\ \frac{1}{3}$	78 04	63 54
Γ	314	$+\frac{3}{4}\ \frac{1}{4}$	78 05	56 52
κ_2	722	$+\frac{7}{2}\ 1$	79 44	81 59
I	412	$+2\ \frac{1}{2}$	80 47	76 06
Ψ	414	$+1\ \frac{1}{4}$	81 00	63 40
G	$\bar{1}$-9-16	$-\frac{1}{16}\ \frac{9}{16}$	9 44	35 52
X	$\bar{1}64$	$-\frac{1}{4}\ \frac{3}{2}$	14 39	63 00
K	$\bar{1}58$	$-\frac{1}{8}\ \frac{5}{8}$	17 20	39 39
μ'	$\bar{1}$-4-10	$-\frac{1}{10}\ \frac{2}{5}$	21 16	28 30
λ'	$\bar{1}49$	$-\frac{1}{9}\ \frac{4}{9}$	21 18	31 07
ϵ'	$\bar{1}48$	$-\frac{1}{8}\ \frac{1}{2}$	21 19	34 11
V	$\bar{1}41$	$-1\ 4$	21 29	79 35
E	$\bar{1}38$	$-\frac{1}{8}\ \frac{3}{8}$	27 29	28 09
Ξ	$\bar{1}36$	$-\frac{1}{6}\ \frac{1}{2}$	27 32	35 31
d	$\bar{1}35$	$-\frac{1}{5}\ \frac{3}{5}$	27 34	40 35
F	$\bar{5}$-15-24	$-\frac{5}{24}\ \frac{5}{8}$	27 34	41 45
O	$\bar{2}69$	$-\frac{2}{9}\ \frac{2}{3}$	27 36	43 36
Y_1	$\bar{1}34$	$-\frac{1}{4}\ \frac{3}{4}$	27 36	46 58
$\mathfrak{r}$	$\bar{1}32$	$-\frac{1}{2}\ \frac{3}{2}$	27 40	64 59
H	$\bar{1}31$	$-1\ 3$	27 41	76 53
J	$\bar{2}61$	$-2\ 6$	27 42	83 21
$\mathfrak{R}$	$\bar{1}26$	$-\frac{1}{6}\ \frac{1}{3}$	38 02	28 19
C	$\bar{1}25$	$-\frac{1}{5}\ \frac{2}{5}$	38 04	32 45
α	$\bar{1}24$	$-\frac{1}{4}\ \frac{1}{2}$	38 06	38 49
i	$\bar{1}23$	$-\frac{1}{3}\ \frac{2}{3}$	38 08	47 00
M ($\mathfrak{q}$)	$\bar{1}22$	$-\frac{1}{2}\ 1$	38 10	58 09
B	$\bar{1}21$	$-1\ 2$	38 12	72 46
π	$\bar{2}31$	$-2\ 3$	46 24	79 42
$\mathfrak{e}$	$\bar{4}$-5-10	$-\frac{2}{5}\ \frac{1}{2}$	51 30	45 28
n_y	$\bar{1}$-1-10	$-\ \frac{1}{10}$	57 17	13 11
$\mathfrak{b}$	$\bar{1}18$	$-\ \frac{1}{8}$	57 21	16 58
ω	$\bar{1}16$	$-\ \frac{1}{6}$	57 24	21 23
κ	$\bar{1}15$	$-\ \frac{1}{5}$	57 27	25 12
μ	$\bar{1}14$	$-\ \frac{1}{4}$	57 29	30 29
μ_1	$\bar{2}27$	$-\ \frac{2}{7}$	57 30	33 56
λ	$\bar{1}13$	$-\ \frac{1}{3}$	57 31	38 09
ϵ	$\bar{1}12$	$-\ \frac{1}{2}$	57 33	49 42
$\mathfrak{d}$	$\bar{2}23$	$-\ \frac{2}{3}$	57 34	57 33
ν	$\bar{1}11$	$-\ 1$	57 34	67 03
P	$\bar{3}32$	$-\ \frac{3}{2}$	57 35	74 14
$\mathfrak{G}$	$\bar{7}73$	$-\ \frac{7}{3}$	57 36	79 43
Φ	$\bar{5}46$	$-\frac{5}{6}\ \frac{2}{3}$	63 04	61 46
k	$\bar{5}44$	$-\frac{5}{4}\ 1$	63 01	70 19
Y	$\bar{3}24$	$-\frac{3}{4}\ \frac{1}{2}$	67 03	57 49
T	$\bar{2}14$	$-\frac{1}{2}\ \frac{1}{4}$	72 22	46 14
ι	$\bar{2}12$	$-1\ \frac{1}{2}$	72 23	64 26
ζ	$\bar{6}21$	$-6\ 2$	78 04	52 20
$\mathfrak{y}$	$\bar{8}11$	$-8\ 1$	85 28	86 26
$\mathfrak{y}$	$\bar{9}11$	$-9\ 1$	85 58	86 49

GENERAL FEATURES.

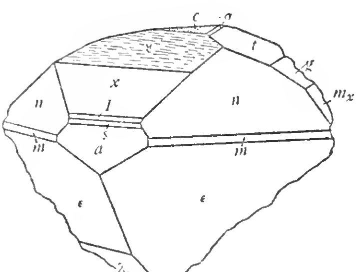
The datolite of the Westfield specimens occurs commonly as thick crusts of comparatively large crystals, lining open spaces in the basaltic rock, although rather dense veins and masses of granular datolite occur occasionally. There appears to be but one generation of the mineral and no other mineral is contemporaneous with it. The datolite in all parts of the area appears to have been deposited at the same period and under very similar conditions as regards temperature, pressure, and composition of solutions. The crystals vary from 1 millimeter to approximately 10 centimeters in diameter, the average diameter being around 1 centimeter. The crystals of

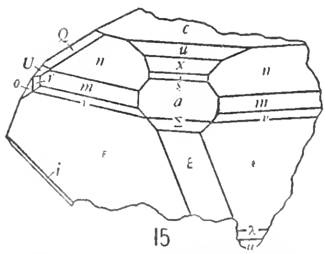


13



14

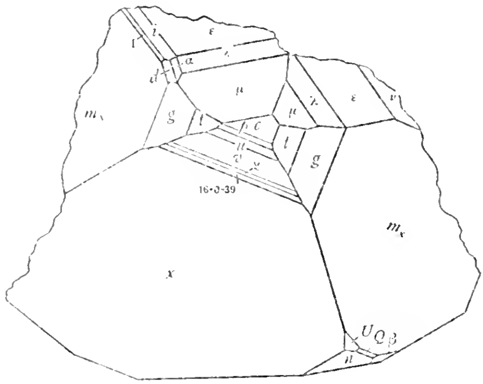




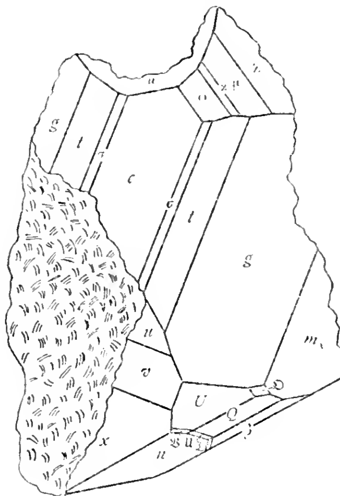
15

FIGS. 13-15.—13, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS OF CRYSTAL B5, SHOWING UNSYMMETRICAL DEVELOPMENT, ETCHING OF c(001), AND STRIATION OF ϱ (205); ALSO THE RARE AND NEW FORMS s (302), I (203), ω ($\bar{1}16$), N ($\bar{1}26$), E($\bar{1}38$), AND j_1 ($\bar{5}.6.30$). 14, CLINOGRAPHIC PROJECTION OF CRYSTAL B11, SHOWING PARALLEL GROWTH WITH REENTRANT ANGLE RESEMBLING TWINNING. ALSO SHOWS CHARACTERISTIC "RULING" OF THE BASAL PINACOID. 15, CLINOGRAPHIC PROJECTION OF CRYSTAL 39 SHOWING PROMINENT DEVELOPMENT OF Σ ($\bar{3}02$) AND ξ ($\bar{1}02$).

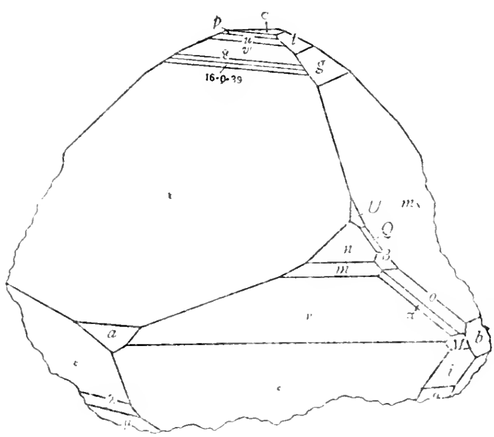
any given cavity or specimen, which are usually of approximately the same order of magnitude, appear to have grown simultaneously, very closely crowded together, and at about the same rate, and only rarely has an individual outstripped its neighbors and assumed a large size at their expense. The close crowding of the crystals has been almost universal, and they are consequently not nearly so well developed as would have been possible had they been more sparsely distributed over the base to which they are attached. Only the free surfaces projecting into the open portion of the cavity are bounded by crystal planes. In many ways the thicker crusts of datolite resemble the quartz combs of veins. They differ, however, in that each crystal repelled those adjoining it and preserved its individuality while growing upward, hemmed in on all sides, and instead of interlocking firmly in the crusts, the masses of crystals can often be separated with the fingers. Normally mutual interference

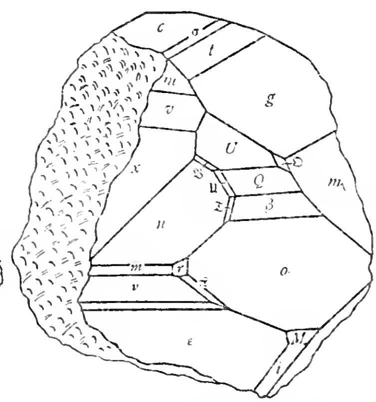


16



17

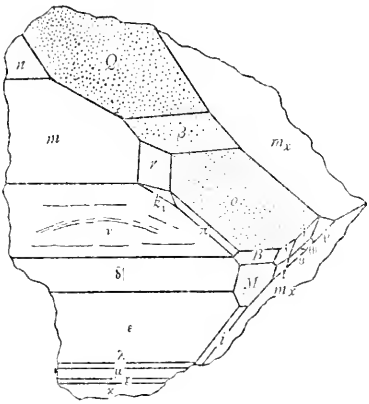




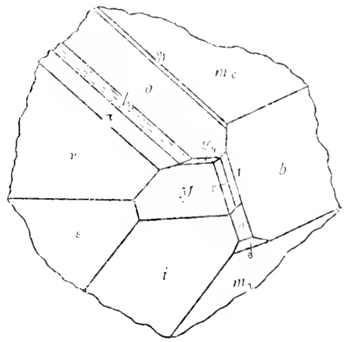
FIGS. 16-17.—16, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS OF CRYSTAL 10 SHOWING FORM AND DEVELOPMENT, ALSO THE FORMS 𝔍 ($\bar{1}67$) 𝔔 (205) AND THE VICINAL FORM (16.0.39). 17, ORTHOGRAPHIC AND CLINOGRAPHIC PROJECTIONS OF CRYSTAL 51 SHOWING THE NEW FORMS 𝔗 (343), 𝔘 (344), 𝔅 (345) AND 𝔇 (134).

seems to have resulted in pressure exerted nearly equally in all directions, so that many crystals are now more or less columnar, with the termination only bounded by crystal planes. The surfaces of contact with adjoining crystals show peculiar striations, doubtless resulting from oscillation exerted by growth pressure and following definite mathematical laws. Such striated contact surfaces are well shown in the photograph (pl. 104). In less frequent instances the growth tendency was exerted more strongly in one direction and resulted in sheaves of platy crystals, grown together in more or less parallel position, the plane of contact in many examples being approximately parallel to ξ ($\bar{1}02$).

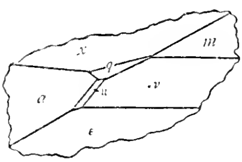
The crystals vary from transparent to almost opaque. The transparent crystals when first exposed to light are rather deep yellow green in color, but the color fades gradually on exposure to light



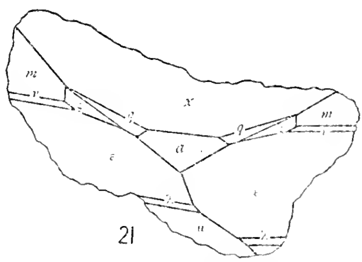
18



19



20



21

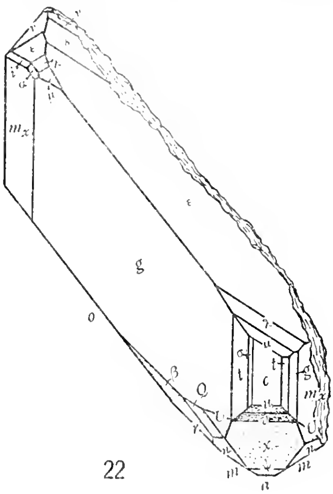
FIGS. 18-21.—18, CLINOGRAPHIC DETAIL OF CRYSTAL 41 SHOWING THE NEW FORMS k_1 ($\bar{7}94$), $\mathfrak{j}$ ($\bar{1}42$), $\mathfrak{f}$ ($\bar{1}43$), $\mathfrak{z}$ ($\bar{2}63$), $\mathfrak{g}$ ($\bar{2}96$), θ ($\bar{2}95$). $\mathfrak{p}$ ($\bar{2}.10.5$), AND $\mathfrak{r}$ ($\bar{2}29$). 19, CLINOGRAPHIC DETAIL OF CRYSTAL 10 SHOWING RARE AND NEW FORMS $\mathfrak{Y}$ (6.15.2), l_1 (9.16.2), g_1 ($\bar{2}62$), $\mathfrak{r}$ ($\bar{2}32$), $\mathfrak{j}$ ($\bar{2}42$), $\mathfrak{g}$ ($\bar{2}96$), AND $\mathfrak{s}$ ($\bar{2}.12.10$). 20, CLINOGRAPHIC DETAIL OF PORTION OF CRYSTAL 44 SHOWING NEW FORM $\mathfrak{u}$ ($\bar{2}11$). 21, CLINOGRAPHIC PROJECTION OF CRYSTAL 43 SHOWING UNUSUAL FORM $\mathfrak{s}$ (530).

until they become almost colorless. The opaque crystals are pure white in color and possess a peculiar porcellanous appearance.

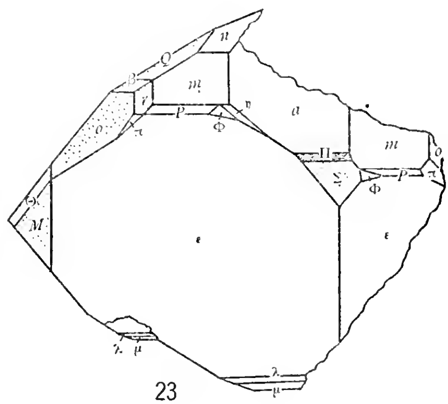
Cleavage was not observed, unless some faint rifts, which are parallel to the pinacoid a (100) and give iridescent reflections, indicate a very obscure cleavage parallel to this plane. Whitlock describes his crystals as showing distinct cleavage parallel to a (100) and parallel to c (001) somewhat less perfect. The present observations do not confirm these results. Several large transparent crystals were heated to various temperatures and chilled with water in an attempt to develop cleavage, but the crystals became filled with ramifying cracks, like those developed in glass, by the same treatment and show no indication of cleavage.

The crystals may be attached by any part, but from the development of those studied it appears that a majority of them are attached by the negative end of the *á* axis, the front of the crystal being completely developed, while the rear is bounded by fracture or interference surfaces. This frequently requires that the crystal be set up in two positions, top and bottom, on the 2-circle goniometer in order that all the forms may be measured in the Dana position. In some specimens all of the crystals are more or less parallel in arrangement, while in the majority of cases they may be inclined at every angle.

Twinning could not be distinctly proven to occur. Many crystals which at first seemed to be twinned proved, when studied, to be merely examples of parallel growth. Whitlock reports a large crystal



22



23

FIGS. 22-23.—22, ORTHOGRAPHIC PROJECTION ON *c* (001) OF CRYSTAL 65 SHOWING PECULIAR DISTORTION BY ELONGATION PARALLEL TO *o* (120). 23, ORTHOGRAPHIC PROJECTION ON *a* (100) OF CRYSTAL B10 SHOWING THE RARE FORMS Θ (140), Φ ($\bar{5}46$), AND $\mathfrak{y}$ ($\bar{8}11$).

from Westfield as a penetration twin parallel to *a* (100), having *c* for the twinning axis. This is the only reported occurrence of twinning in datolite.

Parallel growth is very common and characteristic, nearly every crystal being composite and made up of two or more individuals in parallel position. Although made up of more than one crystal these are united in a peculiar manner, some planes being common to both individuals, which merge without any trace of even a suture to show where they are joined, although sutures frequently occur. These parallel growths occur in great variety and are sometimes very striking in appearance and resemble twins. Figure 14 is drawn to show a very typical example, and the "step" growth is well shown in the photographs, plates 104 and 105, especially by the large crystal in the center of the specimen illustrated in the plate 105.

HABIT.

Whitlock apparently did not distinguish more than one type in the crystals examined by him. From his description and figures it is obvious that these were essentially like those of type 1 of Kraus and Cook described below.

Kraus and Cook distinguish four types differentiated by variation in habit, which are described below:

Type 1.—This type, which was observed on 34 crystals, is pyramidal in habit and shows the forms a, b, c, m, r, o, l, x, v, u, m_x, g, t, m_y*, m_z*, n, β, Q, ν, ƌ, ϵ, λ, μ, κ, n_z*, M, i, α, π, ϵ', μ'. a (100) is always present as a brilliant face, while b (010) occurs on about 50 per cent of the crystals of this type. When present it appears as a narrow edge, giving good reflections. c (001) is always present, sometimes as a wholly dull face, which is commonly not large. x (102) is the predominating form, the other orthodomes v (103) and u (104) occurring only rarely and as narrow faces. t (013), g (012), and m_x (011) are always present, m_x always being large. m_y (067) and m_z (0.1.10), which are new, occur on crystals of this type. The prisms r (230) and o (120) are usually present as somewhat dull faces. l (130) was observed once on 35 crystals. The pyramids n (111), β (121), ν ($\bar{1}11$), ϵ ($\bar{1}12$), λ ($\bar{1}13$), and μ ($\bar{1}14$) are usually all present, ν ($\bar{1}11$) commonly predominating. Q (122) is frequently present, often as a dull face giving no reflection. ƌ ($\bar{2}23$), sometimes large, is among the forms commonly observed. M ($\bar{1}22$), i ($\bar{1}23$), and α ($\bar{1}24$) are also frequently observed. ϵ' ($\bar{1}48$) and μ' ($\bar{1}$.4.10), first described by Whitlock, were seen on several crystals. μ' (1.4.10) gave very good readings but ϵ' ($\bar{1}48$) was identified by zonal relationships. n_z ($\bar{1}$-1-10) also occurs on crystals of this type.

Type 2.—This was observed on seven crystals, is also pyramidal, and similar to type 1, from which it is distinguished mainly by the absence of c (001) and b (010). The forms noted on crystals of this type are a, x, m_x, g, m, o, n, ƌ, ϵ, λ, μ, ν. a (100) occurs as a small triangular face giving good reflections. As in type 1, x (102) is the predominating form. The prisms m (110) and o (102) are always present, though generally small, o (120) beveling the edge between the faces ν ($\bar{1}11$) and m_x (011). Of the pyramids ϵ ($\bar{1}12$) and λ ($\bar{1}13$) present large uneven faces. ƌ ($\bar{2}23$) is usually dull. The other pyramids occur as very small faces.

Type 3.—This was observed on four crystals. It is characterized by a prismatic habit with a (100) prominent. All forms are well developed, the following being noted: a, b, c, x, ξ, m_x, g, t, m, n, ν, ϵ, λ, μ. All forms except ν ($\bar{1}11$) and ξ ($\bar{1}02$) are brilliant, giving good reflections. ν ($\bar{1}11$) occurs as a dull form and ξ ($\bar{1}02$), in addition to being dull, was so small that it could only be identified by zonal relationships.

Type 4.—This was observed on 2 crystals, is tabular in habit, the base c(001) being prominent. The forms noted on crystals of this type are a, b, c, m, m_x, g, t, x, v, n, ν, and ϵ. Of the clinodomes g (012) predominates, m_x (011) and g (013) being comparatively narrow faces. The orthodomes x (102) and v (103) are both dull forms.

Ungemach writes that there are, both on his crystals and on those examined by Görgey and Goldschmidt, two well-defined types distinguished according to the development of certain typical forms rather than upon habit which is subject to great variation:

Very characteristic for distinguishing between these are the forms of the orthodome zone. In the first type there are no steeper domes than x (102) and ξ ($\bar{1}02$). There occur here mostly v (103) with or without $\mathfrak{H}$ (308) and $k\colon$ (3.0.10), which may replace v (103). These three forms are always lacking in type 2 crystals, which often show the typical rounded form ψ (201) and the negative Π ($\bar{1}01$) and Σ ($\bar{3}02$). Another important feature is the etching on these forms. On type 1 all the negative domes are dull but give fairly good though faint signals on the goniometer, while on type 2 crystals v (103) and x (102) are completely lacking in reflection. The form ν ($\bar{1}11$) is a characteristic form of type 1, while on crystals of type 2 it is replaced by P ($\bar{3}32$) as brilliant faces. Finally, only on type 2 crystals occur q (312) and Γ (314) with the subordinate forms controlled by this interesting group, which includes $\mathfrak{y}$ ($\bar{8}11$) and Φ ($\bar{5}46$). The forms which are characteristic of the two types are as follows:

Type 1.	*Type 2.*
	ψ (201)
$k\colon$(3.0.10)	$y^{\cdot}$ (601)
v (103)	j (502)
$\mathfrak{H}$ (308)	Σ ($\bar{3}02$)
	Π ($\bar{1}01$)
ν ($\bar{1}11$)	P ($\bar{3}32$)
	q (312)
	$\mathfrak{B}^{\cdot}$ (313)
	Γ (314)
	N (322)
	χ (534)
	I (412)
	$\mathfrak{y}$ ($\bar{8}11$)
	Φ ($\bar{5}46$)

On crystals of both types individual forms may be lacking, but a mingling of forms characteristic of the two types never occurs.

According to Ungemach's definitions all of the crystals described by Whitlock and by Kraus and Cook fall in type 1. Of those studied by Görgey and Goldschmidt only two (Nos. 5 and 8) are of type 1, all others being of type 2. Of the eight crystals studied by Ungemach himself Nos. 1 and 2 belong to type 1 and the other six belong to type 2. So rigidly does he regard his definitions that he suggests that Görgey and Goldschmidt may be in error when they give the form P ($\bar{3}32$), characteristic of type 2, as occurring on their crystal No. 8, which otherwise agrees with type 1.

In minerals which are liable to great variation in habit, such as datolite, the development is commonly susceptible to variation with variation in the conditions attending deposition. Variation of composition, temperature, and pressure of solutions depositing the mineral are ordinarily shown by differences in the habit of the crystals. Where a single locality produces crystals of two or more distinct habits the difference can usually be found to be due to the fact that the crystals of different types belong to different generations. At the Westfield quarries, as previously mentioned, the datolite seems to have been deposited from a single set of solutions and the mineral in all veins and cavities over a large area seems to be practically contemporaneous in time of formation or deposition. Only one generation of datolite is represented, and no other mineral is exactly contemporaneous with the datolite. There was probably more or less variation in the temperature and composition of the solutions from cavity to cavity, but such variation was gradual and the total differences were small. This condition of affairs is represented in the crystals by very gradual variation. Those of any one cavity are identical in habit except for differences due to varying distortion caused by interference of adjacent crystals during growth. Although the crystals on different specimens commonly show distinct differences in habit, the variation is seen to be gradual when a large number of specimens are examined.

While the several types which have been described would be distinct and easily definable were only a few crystals, showing the extremes of development at hand, the examination of such a large number of crystals as has been accessible for the present investigation

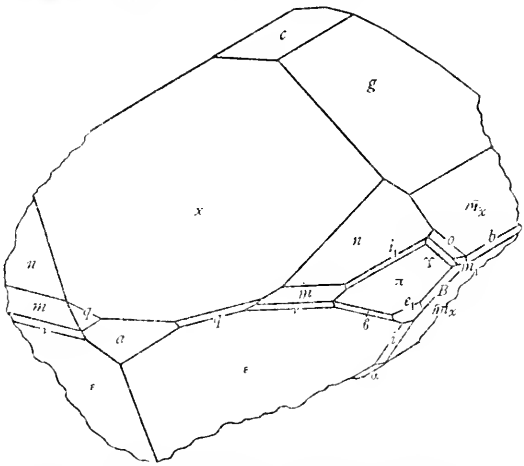


FIG. 24.—CLINOGRAPHIC PROJECTION OF CRYSTAL 33 SHOWING NEW FORMS i_1 ($\bar{4}61$), e_1 ($\bar{3}53$), m_1 ($\bar{1}\bar{2}.25.1$) Υ ($\bar{3}51$) AND ϭ ($\bar{3}43$).

reveals such a gradual transition from type to type through intermediate habits that the definition of types becomes futile. All of the habits described by Kraus and Cook can be illustrated by crystals selected from the series at hand. Their type 1 is by far the most abundant habit represented at the locality. The forms noted by them are all of common occurrence except the three forms which they gave as new, m_y, n_y, and n_z. Numerous other accessory forms were seen on crystals of this type, most of them being of infrequent occurrence, as noted under the discussions of forms. Figure 3 is given to show the general appearance of these crystals in orthographic and clinographic projection. Such crystals are well illustrated in the photographs (pls. 104–105). From this typical development the crystals vary in one direction by suppression of the basal pinacoid to acute pyramidal types similar to type 2 of Kraus and Cook, as illustrated in figure 5. These crystals are commonly smaller and less rich in forms than the typical or type 1 habit. The dominant forms are the positive orthodome x (102) and the negative hemipyramid ϵ ($\bar{1}12$). There is a gradation in the opposite direction toward a type more or less prismatic by elongation on the $\acute{a}$ axis, as shown in figure 4. Crystals as extreme in development as that here illustrated are relatively uncommon. The basal pinacoid, which on the type 1 crystals is represented by a small, nearly triangular face, is here an elongate rectangle. Crystals of this habit seldom show a very large development of the base. Certain other crystals which show a prominent development of the front pinacoid may be referred to type 3 of Kraus and Cook as illustrated in figure 6.

Ungemach's definitions are considered to possess an unjustified rigidity. Crystals of his type 2 are abundant in those studied by the writer. They all show a more or less prominent basal pinacoid, as does Kraus's type 4, and they will be referred to as type 4, although the crystals of this habit examined by Kraus and Cook chanced to be the most simple development of the type. The crystals of this type show some variation in habit, the large development of the basal pinacoid being the only constant criterion for their classification. As will be observed from a study of the table of combinations given, the forms regarded by Ungemach as characteristic and diagnostic of his two types frequently coexist on the same crystal. Some of the figures illustrate this, and some short descriptions will serve to point out examples of this, as shown below:

Crystal 65, illustrated in figure 22: A peculiarly distorted crystal elongated parallel to o (120) has the combination characteristic of type 1, having the forms ν ($\bar{1}11$), $\mathfrak{d}$ ($\bar{2}23$), u (104), and v (103), all diagnostic of type 1, according to the definition, together with the steep positive dome φ (101), as a well-defined though wholly dull face.

Crystal 39, illustrated in figure 15, is one of the characteristic crystals of what is here adopted as type 4. It shows q (312) and s (302) as small dull faces and Σ ($\bar{3}02$) as a well-defined face. These three type 2 forms are accompanied by the type 1 form ν ($\bar{1}11$), which is present as brilliant faces.

Crystal 43, showing development typical of type 1 and the diagnostic type 1 form ν ($\bar{1}11$), has the type 2 forms q (312) and $\mathfrak{s}$ (530) as well-developed faces.

Crystal 44, a part of which is shown in figure 20, is also a large crystal typically developed like type 1 and showing the type 1 form ν ($\bar{1}11$), together with the type 2 form q (312) and the new form $\mathfrak{u}$ ($\bar{2}11$).

Crystal 7, a somewhat broken crystal, has x (102) as the only prominent form in the orthodome zone. This crystal shows one face of q (312) and two small faces of $\mathfrak{y}$ ($\bar{8}11$) with one narrow but distinct face of ν ($\bar{1}11$).

Crystal 56 is distinctly tabular parallel to the base and otherwise resembles crystals referred to Ungemach's type 2, shows ν ($\bar{1}11$) and $\mathfrak{d}$ ($\bar{2}23$) with flat positive orthodomes $\mathfrak{L}$ (205), $\mathfrak{H}$ (308), v (103), and u (104), all type 1 forms, with the rare form w (324), characteristic of type 2.

Crystal B8, shown in figure 11, shows ν ($\bar{1}11$), with $\mathfrak{L}$ (205), v (103), and u (104), characteristic of type 1, with a well-developed face of q (312).

Crystal 36 shows q (312) as brilliant faces and also a steep dome $\mathfrak{M}$ (403), both characteristic of type 2, together with brilliant faces of ν ($\bar{1}11$) and of the flat domes $\mathfrak{H}$ (308), v (103), and u (104); characteristic forms of type 1.

Numerous other examples might be cited to show that the forms regarded as characteristic of the two separate types by Ungemach frequently intermingle, or at least that the orthodomes are subject to no laws regarding their distribution and that the forms q (312) and ν ($\bar{1}11$) are common to both types. In fact q (312) very frequently occurs on crystals of the type here designated as types 1 and 2 (following Kraus) as a narrow line beveling the edge x (102) $\wedge \epsilon$ ($\bar{1}12$).

Ungemach's rigid statements as to the degree of etching on the faces of the two types are not borne out by the crystals studied. The crystals showing the series of relatively equally developed orthodomes show q (312), together with other features characteristic of type 2 of Ungemach. These are all characterized chiefly by a relatively large development of the basal pinacoid. It is believed that type 4 of Kraus and Cook was essentially of this type, the crystals which they examined happening to lack the several unusual forms which are regarded as characteristic of the type by Ungemach. Many of the crystals of this type are more or less prismatic on the a axis, although others are nearly equidimensional. In the positive orthodome zone, instead of x (102) developed as the only prominent form, there often occurs a series of several narrow faces, which may include not only five or six well-defined forms but also several vicinal planes 1° or more from the established forms. This series of front domes, which during the study of the crystals was designated as "scintillating," is highly characteristic of crystals of this type, as shown in figures 7 and 15. It is not always present, however. Thus in crystal B11, shown in figure 14, the only forms in this zone are x (102) and v (103). The crystal B10, shown in orthographic projection on the front pinacoid in figure 23, contains a larger number of the forms listed by Ungemach as characteristic of his type 2 than any other crystal examined by the present writer, namely Σ ($\bar{3}02$), z ($\bar{2}01$), P ($\bar{3}32$), Φ ($\bar{5}46$), $\mathfrak{y}$ ($\bar{8}11$), and Θ (140). This crystal was taken from the small specimen shown in plate 106, all of the crystals of which are similar in development and agree closely with Ungemach's description of the type. As a matter of fact the form P ($\bar{3}32$) is a comparatively rare form, while ν ($\bar{1}11$) is much more common on this type of crystals. So far as seen the form $\mathfrak{d}$ ($\bar{2}23$), which is almost invariably present on the crystals of type 1 (Kraus), does not occur on those of type 4 (Ungemach's type 2). On the latter crystals ϵ ($\bar{1}12$) is often the steepest negative clinopyramid present.

DISTORTION.

Distortion, or unequal development of corresponding faces on opposite portions of the crystal, is the rule rather than the exception. Symmetrically developed crystals are rare, and various freakish developments are so common and so variable that they can not be described in detail. As typical examples of distortion, crystal 65 (fig. 22) and crystal B5 (fig. 13) may be cited. Crystal 65 is prismatic by elongation parallel to o (120) and is so unsymmetrical that were it not for the characteristic etchings of the various faces its orientation would have been almost impossible. Crystal B5 is unequally developed, so as to give the basal pinacoid the outline of a right triangle and to bring the new positive orthodome $\mathfrak{L}$ (205), which is present as a relatively large dull face, adjacent to the pyramid κ ($\bar{1}15$), this unusual angle being beveled by the new form j_1 ($\bar{5}$–6–30), which is dependent for its occurrence on this unusual development. The unequal development of crystals of type 1 is often expressed by the unsymmetrical outline of the basal pinacoid, which is right triangular in outline. Ideal development has been prevented in most crystals by mutual interference during growth, and more than one quadrant of a crystal is rarely developed, so that what form would have been assumed by the missing faces can not be surmised.

IRREGULARITIES OF THE CRYSTAL FACES.

Dana writes with regard to datolite: "Faces often wavy and rarely giving good measurements; x (102) commonly dull." The difficulties encountered in properly orienting crystals of datolite render certain peculiarities of several of the more prominent faces occurring on this mineral very important. Consequently the several forms, faces of which exhibit peculiarities of surface of sufficiently constant occurrence to be of value as orienting criteria, deserve special description. No two crystals are alike in the irregularities of surface shown by the planes, the surfaces, even when highly lustrous, showing an infinite variety of patterns and tracings, the detailed description of which might occupy many pages. Certain features are, however, comparatively constant and serve as a most convenient guide in orienting the crystals. The most useful of these are as follows:

c (001), the basal pinacoid, is seldom free from irregularities. These most frequently take the form of narrow depressed "ruled" lines in three directions, which are parallel to the unit prism *m* (110) and the orthopinacoid *a* (100). These sometimes are not etched, but are merely shallow depressions. They form, however, lines susceptible to attack by etching agents and are often greatly deepened by natural solution. The effect is to divide the face into triangular areas or to produce deep triangular pits or depressions. This plane has been one of the most easily attacked by corroding solutions. Sometimes this pinacoid is wholly dull. The characteristic three directional lines at times look like traces of cleavage, but no cleavage parallel to these directions could be proven to exist in the crystals. Such triangular rulings were artificially produced by the action of dilute hydrochloric acid on a crystal which did not originally show them.

x (102), which in the majority of the crystals is one of the most prominent faces, is most frequently dull, as in datolite from other localities. At times this dullness appears as a uniform etching over the whole face, giving the appearance of finely ground glass. More frequently the etching has taken the form of broad irregular lines, which divide the face into lozenge-shaped patches, separated by broad depressed channels. In other instances there appears a large irregular etched depression in the center of the face, from which crooked lines ramify in all directions. When the faces of this form are unetched they are horizontally striated by oscillatory lines, which increase in number and distinction toward the top of the face.

ϵ ($\bar{1}12$) and also λ ($\bar{1}13$) and to a less extent μ ($\bar{1}14$) are characteristically marked by an oscillatory horizontal striation. This is a most constant and diagnostic peculiarity of the important form ϵ ($\bar{1}12$), which is always lustrous and free from corrosion.

o (120) and the pyramids of the same vertical zone as U (123), Q (122), β (121), and M ($\bar{1}22$) are almost invariably dull by the presence of "ground glass" etched surfaces, which, while variable in degree, are almost never wholly absent. This etching renders these faces readily identifiable, thus greatly facilitating proper orientation.

ν ($\bar{1}11$) and 𝔡 ($\bar{2}23$) are often deeply etched to a uniform dull surface, which often reflects little if any light. Some of the etched faces have a peculiarly iridescent luster. The etching of these forms is very variable in degree and is frequently not present.

m (110) and *n* (111) are often ruled by parallel grooves due to oscillation between the two forms. These grooves are sharp reentrant angles and are not accompanied by any rounding, so that both faces give perfectly sharp signals. While not invariably present, these grooves serve immediately to identify these faces when they do occur-

In single crystals or those of a single specimen or cavity almost any form may be etched to complete dullness. The forms of the clinodome zone are almost invariably brilliant and free from etching of any sort, yet on one crystal measured the form g (012), present as a large face, was entirely dull. As before stated, various other irregularities occur, but not with sufficient regularity to be of value in form identification. Many of the other forms are characteristically etched, but these occur as faces too small to be of value in orienting the crystals.

FORMS.

Whitfield described the following 27 forms on datolite from Westfield:

a (100), b (010), c (001), m (110), r (230), o (120), x (102), v (103), m_x (011), g (012), Ω (018), t (013), n (111), ν ($\bar{1}11$), ϵ ($\bar{1}12$), λ ($\bar{1}13$), μ ($\bar{1}14$), κ ($\bar{1}15$), Q (122), β (121), M ($\bar{1}22$), i ($\bar{1}23$), α ($\bar{1}24$), ϵ' ($\bar{1}48$), λ' ($\bar{1}49$), μ' ($\bar{1}.4.10$).

Of these M ($\bar{1}22$), ϵ' ($\bar{1}48$), λ' ($\bar{1}49$), and μ' ($\bar{1}.4.10$) were new to the species.

Kraus and Cook confirmed all forms observed by Whitlock except λ' (149) and Ω (018) and added as forms new to the locality l (130), $\mathfrak{d}$ ($\bar{2}23$), π ($\bar{2}31$), u (104), ξ (102) and as forms new for the species m_y (067), m_z (0.1.10), n_y ($\bar{1}.1.10$).

Gorgey and Goldschmidt observed 45 forms, of which 11 were new to the locality, namely:

σ (014), Σ ($\bar{3}02$), Π ($\bar{1}01$), q (312), $\mathfrak{n}$ (132), T ($\bar{2}14$), U (123), B ($\bar{1}21$), N (322), Γ (314), χ (534), and 8 new to the species, namely:

$\mathfrak{H}$ (308), P ($\bar{3}32$), $\mathfrak{b}$ ($\bar{1}18$), H (131), $\mathfrak{N}$ ($\bar{1}26$), $\mathfrak{B}^{\cdot}$ (313), $\mathfrak{K}$ (454), $\mathfrak{y}$ ($\bar{9}11$).

Ungemach found 60 forms, of which the following 6 were new for the locality:

ψ (201), η (410), Δ (210), ω ($\bar{1}16$), Y_1 ($\bar{1}34$), d ($\bar{1}35$), and 9 which were new to the species, namely:

y (601), j (502), k: (3.0.10), $\mathfrak{s}$ (530), Θ (140), Ξ ($\bar{1}36$), $I^{\cdot}$ (412), φ ($\bar{5}46$), $\mathfrak{y}$ ($\bar{8}11$), ? ($\bar{1}\bar{1}.0.2$).

Thus at the beginning of the present investigation there had been reported on datolite from this locality 68 forms, of which 24 were new to the species. The present writer has recognized on the crystals studied during the present investigation 104 forms, of which 10 are new to the locality, as follows:

p (106), I (203), s (302), z ($\bar{2}01$), Λ (112), M_1 (231), $\mathfrak{K}$ (454), $\mathfrak{r}$ ($\bar{1}32$), E ($\bar{1}38$), μ_1 ($\bar{2}27$), and 46 forms which are new for the species, as follows:

$\mathfrak{C}$ (380), $\mathfrak{J}$ (043), $\mathfrak{L}$ (205), vic. (16.0.39), $\mathfrak{M}$ (403), (12.0.25), $\mathfrak{O}$ (134), $\mathfrak{P}$ (192), $\mathfrak{Q}$ (1.10.2), $\mathfrak{R}$ (1.12.2), $\mathfrak{S}$ (331), $\mathfrak{T}$ (343), $\mathfrak{U}$ (344),

$\mathfrak{V}$ (345), $\mathfrak{W}$ (382), $\mathfrak{X}$ (455), $\mathfrak{Y}$ (6.15.2), $\mathfrak{Z}$ (766), $\mathfrak{h}$ (768), $\mathfrak{i}$ (11.11.10), $\mathfrak{j}$ $(\bar{1}42)$, $\mathfrak{k}$ $(\bar{1}43)$, $\mathfrak{l}$ $(\bar{1}67)$, $\mathfrak{m}$ $(\bar{1}.6.12)$, $\mathfrak{o}$ $(\bar{1}.6.14)$, $\mathfrak{p}$ $(\bar{1}.10.30)$, $\mathfrak{s}$ $(\bar{1}.12.10)$, $\mathfrak{t}$ $(\bar{1}.20.15)$, $\mathfrak{u}$ $(\bar{2}11)$, $\mathfrak{x}$ $(\bar{2}29)$, $\mathfrak{z}$ $(\bar{2}63)$, θ $(\bar{2}95)$, ϑ $(\bar{2}96)$, $\dot{\rho}$ $(\bar{2}.10.5)$, x_1 $(\bar{3}42)$, σ $(\bar{3}43)$, Υ $(\bar{3}51)$, e_1 $(\bar{3}53)$, f_1 $(\bar{3}61)$, g_1 $(\bar{3}62)$, h_1 $(\bar{3}.10.20)$, $\boldsymbol{i}_1$ $(\bar{4}61)$, j_1 $(\bar{5}.6.30)$, k_1 $(\bar{7}94)$, l_1 $(\bar{9}.16.2)$, m_1 $(\bar{12}.25.1)$.

Of the latter, however, a considerable proportion were observed only once as very small faces giving faint signals, and they therefore require additional confirmation as emphasized below. Of the forms previously recorded from the locality the following 19 were not found:

Ω (018), m_z (0.1.10), n_y $(\bar{1}.1.10)$, $\mathfrak{n}$ (132), T $(\bar{2}14)$, $\mathfrak{b}$ (118), J_1 (311), $\mathfrak{B}^{\cdot}$ (313), Γ (314), χ (534), $\mathfrak{y}$ $(\bar{9}11)$, Y_1 (134), Δ (210), y (601), j (502), k: (3.0.10), Ξ (136), $I^{\cdot}$ (412), (11.0.2).

The combinations on the majority of the crystals are more or less similar. In general the number of forms present varies with the size of the crystal, many of the rarer forms being confined to the larger crystals, while small crystals are usually simple in combination. The rarer forms are erratically distributed. It might be possible to measure 100 crystals and find only relatively common forms, while one additional crystal might show 10 or more new or rare forms. Rare forms seldom occur singly, more frequently occurring as small nests of several unusual faces. Although the present examination covered a relatively large number of crystals, it is entirely probable that the examination of additional crystals from this locality will reveal additional rare and new forms. The different forms observed are described in detail below.

COMMON FORMS.

a (100) is practically never absent except where it has been destroyed by breaking of the crystal or by confinement during growth. The faces of this form vary from small triangles, sometimes minute, on crystals of types 1 and 2, shown in figures 3, 4, and 5, to large polygons on crystals of types 3 and 4. The largest development of this form is shown by type 3, illustrated in figure 6, where the front pinacoid is one of the most prominent faces. The faces of this form are invariably brilliant and never show any characteristic etching or irregularity.

b (010), the clinopinacoid, is usually though not invariably present. It is commonly a linear face, varying from a fairly broad to a very narrow line. It is almost invariably bright and yields good signals even when very narrow.

c (001), the basal pinacoid, is usually present, although it occasionally fails, as in crystals of type 2 shown in figure 5, and also occasionally on crystals referable to other types, as shown, for example, by crystal 28, figure 8, and crystal B9, figure 9. The faces of this form vary from minute to large. They are usually not brilliant, being characteristically marked by triangular pits or ruled depressed lines, as further discussed under another head. Occasionally the face is wholly dull, reflecting no light at all, but usually it gives a distinct although somewhat furred signal. On crystals of type 1 the base is usually more or less triangular in outline, as shown in figures 3 and 16. It may also be represented by a narrow line, as shown in figure 4. On crystals of type 4 (type 2 of Ungemach) the base is the most conspicuous form, many of the crystals of this type being distinctly tabular parallel to this face.

m (110), the unit prism is not absent from any crystal examined, although it varies from the thinnest line on some crystals of types 1 and 2, figures 3 and 5, to a large and predominant face on crystals of types 3 and 4, as shown in figure 6. It is usually a plane and brilliant face, yielding excellent signals. The only characteristic irregularity present is a grooving by reentrant angles, produced by oscillatory alternation between *m* (110) and *n* (111), as described above.

o (120) occurs on somewhat more than half of the crystals examined. It varies from a very small to a fairly large face, being exceedingly variable in outline. On crystals of types 1 and 2 it is oftenest shown as a relatively narrow faces truncating the angle ν ($\bar{1}11$) $\wedge m_x$ (011), as shown in figures 5 and 16. Other characteristic outlines are shown also in figures 4, 7, and 23. The most prominent type of development of this form is shown by crystal 51, illustrated in figure 17. The luster of the face is almost never perfect, the etching varying from a faint satiny sheen to complete lack of luster. Usually the faces of this prism, like others in the same vertical zone, yield clear and sharp though faint signals, which are sometimes blood red in color and appear as though viewed through a haze.

r (230) occurs on about one-fourth of the crystals examined, usually as a small face, as well illustrated by crystal 51, shown in figure 17, and crystal B10, shown in figure 23. The face lies between *m* (110) and *o* (120) and usually yields a fair signal. It is frequently etched lightly but is not so characteristically so as is *o* (120).

m_x (011) is invariably present, usually as one of the most prominent and brilliant faces. While sometimes slightly wavy, it is always brilliant and yields excellent signals.

g (012) is practically always present as a prominent and brilliant face, yielding good measurements.

t (013) is present on about half of the crystals studied, occurring as a narrow face, giving good signals. It is much less prominent than the two steeper clinodomes m_x (011) and *g* (012).

σ (014) occurs on about one-third of the crystals as a narrow face, which is often reduced to a mere line, sometimes so narrow as to yield a very faint signal. This is the flattest clinodome observed during the present work.

x (102) is the only orthodome which is invariably present, and on many crystals it is the most prominent form. It is nearly always etched to a greater or less extent and in various manner, as described elsewhere. The form commonly yields a good signal. On crystals of types 1 and 2 it may be very large, as shown in figures 3, 5, and 16, while on crystals of type 4 it may not be more conspicuous than the other forms in this zone, as shown in figures 7, 8, and 15.

v (103) occurs on about one in each three crystals, usually as a narrow and relatively inconspicuous face. It varies from bright through various degrees of etching to wholly dull, reflecting no light at all. Quite frequently the form can be measured only by the expedient of moistening the face with alcohol, and some of the less completely etched forms give red signals.

u (104) occurs much as does v (103), the two forms often occurring together and being similar in size, outline, and degree of etching.

n (111), the only common positive pyramid in this vertical zone, is always present. It varies from a small triangular face, as in the crystals of type 2, figure 5, to a prominent form. The faces of this form are always brilliant and yield a sharp signal. The only characteristic irregularity of the surface of the faces is the presence of the reentrant angles formed by oscillation between n (111) and m (110).

β (121) occurs on about one-fourth of the crystals measured as a small face, which is often more or less etched. Characteristic occurrences of this form are shown by crystal 10 (fig. 16), 36 (fig. 7), 51 (fig. 17), B9 (fig. 9), B10 (fig. 23), and B11 (fig. 14).

Q (122) occurs frequently with β (121) and, like it, is usually etched. It falls between n (111) and m_x (011). It varies from a relatively prominent face, as shown in figure 17, crystal 51, to a narrow line, as shown by figure 16 of crystal 10.

U (123) is about as frequent in occurrence as β (121) and Q(122), and like them is often etched lightly. It falls between n(111) and g(012) and can easily be identified by its position. Typical outlines and positions of this form are shown by figures 4, 6, and 23.

ν ($\bar{1}$11) is a common form, being present on over half of the crystals examined. This form is considered characteristic of his type 1 crystals by Ungemach, but was frequently observed during the present examination in combination with q(312) and other forms characteristic of Ungemach's type 2. This is shown by the figured crystal B8 shown in figure 11, etc. This form is usually represented by a narrow face, often a mere line, but may be more prominent, as shown, for example, by crystals 10 (fig. 16) and B7 (fig. 10). On type 4 crystals it is usually narrow and brilliant, yielding excellent measurements, while on other types of crystals the form is usually larger and more or less dull and etched.

𝔡 ($\bar{2}23$) is a characteristic form on Westfield datolite occurring on one-third of the crystals measured. Unlike ν ($\bar{1}11$) it is practically confined to crystals classed as type 1 by Ungemach, and occurs almost invariably on crystals of type 1, as defined here, as a moderately narrow to relatively broad face between ν ($\bar{1}11$) and ϵ ($\bar{1}12$). It is often more or less etched. Typical occurrences are shown in figures 10, 11, and 17.

ϵ ($\bar{1}12$) is a universally present form, and ordinarily it is the most prominent pyramid. It determines the form of crystals of type 2, shown in figure 5, and of the similar type shown in figure 8. The faces are horizontally striated and are often more or less irregular yielding multiple signals.

λ ($\bar{1}13$) is invariably present where not destroyed by interference. It is commonly a narrow face which is bright and gives a good signal.

μ ($\bar{1}14$), like λ ($\bar{1}13$), is commonly present as narrow bright faces, giving good signals.

κ ($\bar{1}15$) is of relatively infrequent occurrence, being found on about 1 in every 10 crystals. It is narrower than μ($\bar{1}14$), but yields good signals.

i ($\bar{1}23$) is a common form, occurring on half of the crystals studied. It forms a narrow but brilliant face, beveling the angle between ϵ ($\bar{1}12$) and m_x ($0\bar{1}\bar{1}$). Its characteristic form and position are well shown by figures 4 and 6.

α ($\bar{1}24$) occurs on about 1 in every 4 crystals studied, being similar to i ($\bar{1}23$) in form and occurrence. It forms a narrow but bright face beveling the edge between g($01\bar{2}$) and ϵ ($\bar{1}12$), as shown by figures 4 and 10 (crystal B7). Occasionally it is present as a broader face, as shown in figure 16 (crystal 10).

π ($\bar{2}31$), elsewhere a rare form for datolite, is a characteristic form at Westfield, occurring on every second crystal. It occurs commonly as a narrow face, beveling the angle between o(120) and ν ($\bar{1}11$), as shown by figures 17 (crystal 51) and 16 (crystal 10). Where ν ($\bar{1}11$) is absent this form occurs as a larger triangular face, as shown, for example, in figures 23 (crystal B10) and 14 (crystal B11). The most conspicuous development of this form is shown in figure 24 (crystal 33), where it forms the center of a small group of rare and new forms. Commonly the faces of π ($\bar{2}31$) are more or less delicately etched, so as to give them a silky sheen, although the form usually yields clear and brilliant signals.

LESS COMMON AND RARE FORMS.

l (130) may be considered one of the rarer forms, as it occurs on only about one-tenth of the crystals studied. It is usually present as a very small and more or less dull face. Its typical occurrences are illustrated by figures 12 (crystal B8) and 9 (crystal B9).

Θ (140) a prism, first described by Ungemach as a new form occurring on datolite from this locality, was seen once as a narrow and dull face on crystal B10 between *M* ($\bar{1}22$) and m_x (011), as shown in figure 23. The signal from the face was very faint, due to etching, although the face was moderately conspicuous. The angle measured does not compare very well with the calculated values as shown below:

(140)	Measured	$\varphi = 20° 55'$	$\rho = 90° 00'$
	Calculated	$\varphi = 21° 30'$	$\rho = 90° 00'$
		$\Delta = 0° 35'$	$\Delta = 0° 00'$

ς (530), another prism described as new from Westfield by Ungemach, was observed on one crystal, No. 43, as bright faces, as shown in figure 21. The angles measured compare as follows:

(530)	Measured	$\varphi = 69° 31'$	$\rho = 90° 00'$
	Calculated	$\varphi = 69° 10'$	$\rho = 90° 00'$
		$\Delta = 0° 21'$	$\Delta = 0° 00'$

The form is thus confirmed.

m_y (067) was doubtfully identified once, on crystal B5, as a small face giving a poor signal. Some doubt attaches to the identification, however, as the face may have been m_x (011) of a crystal not quite in parallel position. The corresponding face on the opposite side of the crystal was m_x (011). The angles measured are as follows:

(067)	Measured	$\varphi = 0° 41'$	$\rho = 48° 20'$
	Calculated	$\varphi = 0° 08'$	$\rho = 47° 19'$
		$\Delta = 0° 33'$	$\Delta = 1° 01'$

ϕ (101) was recorded as occurring on Westfield datolite by Görgey and Goldschmidt. Ungemach takes exception to their identification as follows: "ψ (201), which is here given as new was apparently observed by Görgey and Goldschmidt, but owing to the curvature of its faces it was only tentatively identified by them and then as ϕ (101). The authors say that the signals from the curved face yield a train of light in the center of which the position of (101) lies. In my crystals there is no trace of ϕ (101), while the train of light begins quite sharply at the position of ψ (201) and extends through the short arc to the position of *a* (100)." In the present examination the phenomenon described by Görgey and Goldschmidt—that is, a train of signals centering at the position of ϕ (101)—was observed on crystal 58 (fig. 6). This form was also identified with moderate certainty on crystal 65 (fig. 22) as a well-defined face. This was wholly without reflection but was approximately measured by moistening with alcohol yielding the following angles:

(101)	Measured	$\varphi=90° 00'$	$\rho=59° 34'$
	Calculated	$\varphi=90° 00'$	$\rho=53° 24'$
		$\Delta=0° 00'$	$\Delta=3° 50'$

In several other instances narrow and wholly dull faces were seen which were thought to be this form, but owing to their failure to reflect any light they could not be measured.

p (106) was tentatively identified as a narrow line yielding a very dim and not accurately measureable signal on crystal 10, as shown in figure 16. The angles obtained are as follows:

(106)	Measured	$\varphi=90° 00'$	$\rho=21° 00'$
	Calculated	$\varphi=90° 00'$	$\rho=18° 31'$
		$\Delta=0° 00'$	$\Delta=2° 29'$

I (203) was observed twice, once on crystal 7 as a small face, somewhat etched and giving a faint signal, which yielded angles compared as follows:

(203)	Calculated	$\varphi=90° 00'$	$\rho=53° 07'$
	Measured	$\varphi=90° 55'$	$\rho=54° 51'$
		$\Delta=0° 55'$	$\Delta=1° 44'$

This form also occurred as a well-defined though narrow face on crystal B5, shown in figure 13, which gave the angles:

Measured	$\varphi=89° 41'$	$\rho=53° 25'$
	$\Delta=0° 19'$	$\Delta=0° 08'$

s (302) was found as very narrow faces, yielding poor signals, on crystals B5 (fig. 13) and 39 (fig. 15). The angles are as follows:

(302)	Calculated	$\varphi=90° 00'$	$\rho=71° 18'$
	Crystal B5, measured	$\varphi=89° 48'$	$\rho=69° 02'$
		$\Delta=0° 12'$	$\Delta=2° 16'$
	Crystal 39, measured	$\varphi=90° 04'$	$\rho=70° 00'$
		$\Delta=0° 04'$	$\Delta=1° 18'$

$\mathfrak{H}$ (308), described as new on Westfield datolite by Görgey and Goldschmidt, was found on six crystals. It is usually present as a small or narrow face, which is sometimes bright, but is more frequently etched or "matte," yielding a dim or a red signal. It occurs as a small triangular face, which is somewhat dull on crystal B9, which is illustrated in figure 9. The angles for this form are as follows:

(308)	Calculated	$\varphi=90° 00'$	$\rho=36° 54'$
	Measured, maximum	$\varphi=91° 28'$	$\rho=37° 48'$
	Measured, minimum	$\varphi=89° 28'$	$\rho=36° 49'$
	Measured, average	$\varphi=90° 26'$	$\rho=37° 14'$
		$\Delta=0° 26'$	$\Delta=0° 20'$

ξ ($\bar{1}02$) was seen several times on crystals of types 1 and 4. On type 1 crystals it occurs usually as a very narrow line, beveling the edge between ϵ ($\bar{1}1\bar{2}$) and ϵ' ($\bar{1}\bar{1}2$). On crystals of type 4 it may be present as a relatively broad face, yielding measurements agreeing closely with the calculated angles for the form. It is shown in typical development on crystals 36 (fig. 7) and 39 (fig. 15).

Σ ($\bar{3}02$) occurs occasionally as a relatively small face, which, though slightly etched and having a satiny sheen, yields sharp signals. It is shown in typical development on crystal 39 (fig. 15), crystal 27 (fig. 7), and crystal B10 (fig. 23).

Π ($\bar{1}01$) occurs occasionally with Σ ($\bar{3}02$) as a narrow face, which is sometimes dull and etched.

Λ (112) is a rare form on datolite from Westfield. Only one crystal (B4) showed measurable faces of this form, which gave the angles

(112)	Calculated	$\varphi=57° 40'$	$\rho=49° 48'$
	Measured	$\varphi=57° 40'$	$\rho=49° 50'$
		$\Delta=0° 00'$	$\Delta=0° 02'$

The form was seen on two or three other crystals as very small and dull faces.

$M_{\prime}$ (231), a form previously described by Ungemach on datolite from Sainte Marie, was doubtfully identified on crystal B8 as a narrow line face beveling the angle o (120) $\wedge n$ (111), as shown in figure 12. The signal from the narrow face was so faint that it could be measured only approximately, owing to lack of visibility of the cross hairs. The angles are:

(231)	Calculated	$\varphi=46° 26'$	$\rho=79° 43'$
	Measured	$\varphi=44° 48'$	$\rho=81° 34'$
		$\Delta=1° 38'$	$\Delta=1° 51'$

q (312) should perhaps be included with the common forms, as it occurred on approximately one-third of all the crystals examined. On type 1 crystals it frequently forms a narrow line, beveling the edge x (102) $\wedge$ ($\bar{1}11$). On type 4 crystals it is almost invariably present as small triangular faces at the upper corners of the front pinacoid. Although normally clear and brilliant, yielding excellent signals, the faces of this form are occasionally somewhat etched.

ω (324) was observed on crystal 56 and on several similar crystals from the same specimen as a very narrow line beveling the angle between *m* (110) and *x* (102). The angles are:

(324)	Measured	$\varphi = 68° 26'$	$\rho = 60° 47'$
	Calculated	$\varphi = 67° 06'$	$\rho = 58° 26'$
		$\Delta = 1° 20'$	$\Delta = 2° 21'$

𝔎 (454) occurred on crystal B9 as a very narrow face beveling the angle between *n* (111) and β (121), as shown in figure 9. The signal was so faint as to not be accurately measurable in the presence of adjacent brilliant forms. The angles are:

(454)	Measured	$\varphi = 53° 29'$	$\rho = 67° 28'$
	Calculated	$\varphi = 51° 36'$	$\rho = 68° 34'$
		$\Delta = 1° 53'$	$\Delta = 1° 06'$

ω ($\bar{1}16$) was found on but two of the crystals studied. On crystal B5 it forms a very narrow line, giving a poor signal, as shown in figure 13, while on crystal 51 it is present as a somewhat broader face, as shown in figure 17. The angles are:

(116)	Measured	Xl. 51	$\varphi = 57° 35'$	$\rho = 20° 25'$
		B5	$\varphi = 57° 56'$	$\rho = 21° 40'$
	Average		$\varphi = 57° 45'$	$\rho = 21° 03'$
	Calculated		$\varphi = 57° 24'$	$\rho = 21° 23'$
			$\Delta = 0° 21'$	$\Delta = 0° 20'$

B ($\bar{1}21$) was found as a distinct line, giving a poor signal on crystal 33, as shown in figure 24. On crystal 41, shown in figure 18, this form occurred as a bright face, giving a very good signal. The angles are:

($\bar{1}21$)	Measured	Xl. 33	$\varphi = 39° 43'$	$\rho = 73° 39'$
		41	$\varphi = 38° 07'$	$\rho = 72° 43'$
	Average		$\varphi = 38° 55'$	$\rho = 73° 11'$
	Calculated		$\varphi = 38° 12'$	$\rho = 72° 46'$
			$\Delta = 0° 43'$	$\Delta = 0° 25'$

M ($\bar{1}22$), which was first reported by Whitlock on Westfield datolite, occurs rather frequently, especially on crystals of type 1, usually as a small face, which is frequently lightly etched. Characteristic outlines are shown in figures 4, 7, 18, and 23. The faces frequently give perfect signals. The angles are:

(122)	Measured, maximum	$\varphi = 37° 16'$	$\rho = 58° 19'$
	Measured, minimum	$\varphi = 38° 13'$	$\rho = 57° 50'$
	Measured, average	$\varphi = 37° 57'$	$\rho = 58° 09'$
	Calculated	$\varphi = 38° 10'$	$\rho = 58° 09'$
		$\Delta = 0° 13'$	$\Delta = 0° 00'$

$\mathfrak{N}$ $(\bar{1}26)$. A form near $(\bar{1}26)$ was found on crystal B5 as a very narrow face beveling the angle between *g* (012) and λ $(\bar{1}13)$. The signal was distinct although too faint to illumine the crosshairs. The angles are as follows:

$(\bar{1}26)$	Measured	$\varphi=36°\ 27'$	$\rho=26°\ 58'$
	Calculated	$\varphi=38°\ 02'$	$\rho=28°\ 10'$
		$\Delta=\ 1°\ 35'$	$\Delta=\ 1°\ 12'$

r $(\bar{1}32)$ occurred as a very narrow line face, with (142) on crystal 10 between *M* $(\bar{1}22)$ and *b* (010), as shown in figure 19. The signal was very faint and could not be accurately centered. The angles are:

$(\bar{1}32)$	Measured	$\varphi=25°\ 49'$	$\rho=66°\ 31'$
	Calculated	$\varphi=27°\ 40'$	$\rho=67°\ 59'$
		$\Delta=\ 1°\ 51'$	$\Delta=\ 1°\ 28'$

d $(\bar{1}35)$, which was described as new from this locality by Ungemach, occurred on six of the crystals examined. It forms a small face between *α* $(\bar{1}24)$ and m_x (011), as shown in figures 9, 10, 16, etc. The faces are usually slightly etched, but give good signals. Angles:

$(\bar{1}35)$	Measured, maximum	$\varphi=27°\ 44'$	$\rho=40°\ 53'$
	Measured, minimum	$\varphi=26°\ 49'$	$\rho=40°\ 08'$
	Measured, average	$\varphi=27°\ 16'$	$\rho=40°\ 30'$
	Calculated	$\varphi=27°\ 34'$	$\rho=40°\ 35'$
		$\Delta=\ 0°\ 18'$	$\Delta=\ 0°\ 05'$

E $(\bar{1}38)$ was doubtfully identified as a very narrow and partly etched face between *g* (012) and λ $(\bar{1}13)$ on crystal B5, as shown in figure 13. The signal was too faint for accurate measurement. The angles are:

(138)	Measured	$\varphi=29°\ 44'$	$\rho=30°\ 32'$
	Calculated	$\varphi=27°\ 31'$	$\rho=31°\ 27'$
		$\Delta=\ 2°\ 13'$	$\Delta=\ 0°\ 55'$

ϵ' $(\bar{1}48)$ was described as new by Whitlock, together with λ' $(\bar{1}49)$ and μ' $(\bar{1}.4.10)$. All three of these forms occur occasionally as very narrow faces, which are either too narrow to yield distinct signals or are on such very large crystals that their measurement is almost impossible.

μ_1 $(\bar{2}27)$ was observed once as a very narrow line on crystal B2. Angles:

$(\bar{2}27)$	Measured	$\varphi=57°\ 56'$	$\rho=33°\ 33'$
	Calculated	$\varphi=57°\ 30'$	$\rho=33°\ 56'$
		$\Delta=\ 0°\ 26'$	$\Delta=\ 0°\ 23'$

P ($\bar{3}32$) was seen several times as a brilliant though narrow face. Its best development was on crystal B10, which is illustrated in figure 23. The angles are:

($\bar{3}32$)	Measured	$\varphi = 57° 27'$	$\rho = 73° 22'$
	Calculated	$\varphi = 57° 35'$	$\rho = 74° 14'$
		$\Delta = 0° 08'$	$\Delta = 0° 52'$

This form was described as new from Westfield by Görgey and Goldschmidt.

Φ ($\bar{5}46$), described as new on Westfield datolite by Ungemach, was observed as two rounded faces on crystal B10, shown in figure 23. It was also seen as two small and dull faces on crystal 7. The signals from the faces were very poor. Angles:

($\bar{5}46$)	Measured, maximum	$\varphi = 61° 18'$	$\rho = 60° 09'$
	Measured, minimum	$\varphi = 60° 57'$	$\rho = 59° 30'$
	Measured, average	$\varphi = 61° 07'$	$\rho = 59° 49'$
	Calculated	$\varphi = 63° 04'$	$\rho = 61° 46'$
		$\Delta = 1° 57'$	$\Delta = 1° 57'$

𝔶 ($\bar{8}11$). The form 𝔶 ($\bar{9}11$) was described as new on datolite from Westfield by Görgey and Goldschmidt. Ungemach described 𝔶 ($\bar{8}11$) as occurring on the crystals examined by him and suggested that the form ($\bar{9}11$) of Goldschmidt and Görgey was the same. The form was seen on crystal B10, illustrated in figure 23, and also as small dull faces on crystal 7. The angles are:

	Measured	$\varphi = 85° 00'$	$\rho = 86° 05'$
($\bar{8}11$)	Calculated	$\varphi = 85° 28'$	$\rho = 86° 26'$
($\bar{9}11$)	Calculated	$\varphi = 85° 58'$	$\rho = 86° 49'$

The measured angles would seem to indicate the form ($\bar{8}11$), although both forms probably occur.

RELATIVE IMPORTANCE OF FORMS.

The forms found on the Westfield datolite may be grouped according to their relative importance as follows:

1. Forms practically always present as large and important faces: *a* (100), m_x (011), *g* (012), *x* (102), ε ($\bar{1}12$).

2. Forms practically always present as smaller faces but sometimes large: *b* (010), *c* (001), *m* (110), *n* (111), μ ($\bar{1}14$), λ ($\bar{1}13$).

3. Forms frequently present as small faces: *t* (013), *v* (103), *u* (104), *o* (120), *r* (230), σ (014), β (121), *Q* (122), *U* (123), ν ($\bar{1}11$), 𝔡 ($\bar{2}23$), *i* ($\bar{1}23$), α ($\bar{1}24$), π ($\bar{2}31$).

4. Forms occasionally or rarely present, including all other forms listed:

TABLE 3.—*Datolite.*

Comparison of average measured angles with calculated angles for previously described forms observed on datolite from Westfield during the present examination. Dana orientation.

Letter.	Miller.	No.*	Quality.	Measured. φ	Measured. ρ	Calculated. φ	Calculated. ρ
				° ′	° ′	° ′	° ′
a	100	......	Very good........	90 00	90 00	90 00	90 00
b	010	......	.....do..........	0 00	90 00	0 00	90 00
c	001	......	Good............	90 00	0 11	90 00	0 09
m	110	39	Very good........	57 42	90 00	57 37	90 00
o	120	23	.....do..........	38 14	90 00	38 14	90 00
l	130	3	Medium..........	27 42	90 00	27 43	90 00
Θ	140	1	Poor............	20 55	90 00	21 30	90 00
r	230	10	Good............	46 28	90 00	46 25	90 00
s	530	2	Fair.............	69 31	90 00	69 10	90 00
m_x	011	27	Very good........	0 19	51 35	0 07	51 41
g	012	30	.....do..........	0 32	32 15	0 14	32 19
t	013	15	.....do..........	0 58	22 34	0 20	22 52
σ	014	9	Good............	0 36	17 23	0 27	17 33
m_y	067?	1	Medium..........	2 41	48 20	0 08	47 19
φ	101	1	Poor............	90 00	59 31	90 00	63 24
x	102	22	Very good........	90 00	44 57	90 00	45 00
v	103	9	Good............	90 10	34 20	90 00	33 43
u	104	10	.....do..........	89 57	26 51	90 00	26 37
p	106?	1	Very poor........	90 00	21 00	90 00	18 31
J	203	2	Good............	90 18	54 08	90 00	53 07
s	302	2	Poor............	89 56	69 31	90 00	71 18
$\mathfrak{S}$	308	6	Good............	90 26	37 14	90 00	36 54
Π	$\bar{1}01$	2	.....do..........	90 00	63 10	90 00	63 21
ξ	$\bar{1}02$	1	Very good........	89 55	44 46	90 00	44 51
z	$\bar{2}01$	1	Dull............	....	....	90 00	75 55
Σ	$\bar{3}02$	2	Very good........	90 01	71 27	90 00	71 18
n	111	21	.....do..........	57 47	67 37	57 38	67 04
Λ	112	1	.....do..........	57 40	49 50	57 40	49 48
β	121	7	.....do..........	38 23	72 48	38 15	72 14
Q	122	7	.....do..........	38 26	58 15	38 19	58 12
U	123	8	.....do..........	38 29	47 07	38 21	47 06
M_1	231	1	Poor............	44 48	81 34	46 26	79 34
q	312	13	Very good........	78 05	71 56	78 01	71 55
w	324	1	Poor............	68 26	60 47	67 06	58 26
$\mathfrak{K}$	454	1	Very poor........	53 29	69 01	51 36	68 34
ν	$\bar{1}11$	17	Very good........	57 33	66 57	57 34	67 03
ε	$\bar{1}12$	30	.....do..........	57 28	49 38	57 33	49 42
λ	$\bar{1}13$	21	.....do..........	57 27	38 12	57 31	38 09
μ	$\bar{1}14$	19	.....do..........	57 05	30 36	57 29	30 29
κ	$\bar{1}15$	4	Good............	57 35	25 12	57 27	25 12
ω	$\bar{1}16$	2	.....do..........	57 45	21 02	57 24	21 23
B	$\bar{1}21$	2	.....do..........	38 55	73 11	38 12	72 46
M	$\bar{1}22$	6	Very good........	37 57	58 09	38 10	58 09
i	$\bar{1}23$	12	Good............	37 56	46 51	38 08	47 00
α	$\bar{1}24$	9	Very good........	37 57	38 45	38 06	38 49
$\mathfrak{N}$	$\bar{1}26$?	1	Good............	36 27	26 58	38 02	28 19
$\mathfrak{r}$	$\bar{1}32$?	1	Fair.............	25 49	66 31	27 40	64 59
d	$\bar{1}35$	6	Very good........	27 16	40 30	27 31	40 35
E	$\bar{1}38$?	1	Fair.............	29 44	30 32	27 29	28 09
ε′	$\bar{1}48$	1	Very poor........	23 08	31 00	21 19	31 11
μ′	$\bar{1}.4.10$	1	....	23 08	28 26	21 16	28 30
$\mathfrak{b}$	$\bar{2}23$	8	Fair.............	57 41	57 00	57 34	57 33
μ_1	$\bar{2}27$	1	Poor............	57 56	33 33	57 30	33 56
π	$\bar{2}31$	11	Very good........	46 28	79 35	46 24	79 42
P	$\bar{3}32$	1	Good............	57 27	73 22	57 35	71 14
Φ	$\bar{5}46$	2	Very poor........	61 07	59 49	63 04	61 46
$\mathfrak{y}$	$\bar{8}11$	1	Fair.............	85 00	86 05	85 28	86 26

* Number of measurements included in the average.

NEW FORMS.

Forty-six forms are listed below as new to the species datolite. Some of these, it is true, are open to criticism, inasmuch as the indices are high and seem somewhat irrational, while the greater number of the forms were observed but once or twice each. Two are certainly vicinal and are listed only because they occur as prominent faces repeatedly. Other vicinal forms occur frequently in certain zones, but those which were present as narrow faces less than a degree from established forms were ignored. As has been emphasized above, no form is here listed as new unless there was present on the crystal a distinct and unmistakable face which could not be referred to any established form for this species. Especial precautions were taken to exclude from consideration "wild" signals, which were frequently found to be reflected from contact surfaces where adjacent crystals had prevented growth, and also to avoid mistakes regarding faces of small attached crystals, which frequently complicate the study of the crystals. Wherever a new form is listed one such doubtless occurs, although it is entirely possible that wrong indices have been derived for some forms, especially those with high indices. The discrepancy which in some cases is apparent between the measured and the calculated angles for new forms may, in some cases, be due to wrong indices having been derived for the form, but in the majority of cases it is due to the difficulty of measuring large crystals requiring much shifting during measurement, and to the failure of the signal to yield sufficient light to illuminate the cross hairs. The dim signals were due to the natural etching, which is so common on the rarer forms. The new forms are described below:

$\mathfrak{C}$ (380) was observed only once as a minute face between *o* (120) and *l* (130) on crystal B8, as shown in figure 12. Although small the face was unetched and gave a sharp and brilliant signal. The angles are:

(380)	Measured	$\varphi = 30° \ 08'$	$\rho = 89° \ 27'$
	Calculated	$\varphi = 30° \ 35'$	$\rho = 90° \ 00'$
		$\Delta = 0° \ 27'$	$\Delta = 0° \ 33'$

$\mathfrak{J}$ (043). A narrow line face in the side dome zone of crystal 55 gave angles nearer (043) than any other simple form. The face was clearly discernible, but was etched so as to give only a very faint signal, which could not be accurately centered. The angles are:

(043)	Measured	$\varphi = 0° \ 00'$	$\rho = 62° \ 00'$
	Calculated	$\varphi = 0° \ 05'$	$\rho = 59° \ 21'$
		$\Delta = 0° \ 05'$	$\Delta = 2° \ 39'$

𝔏 (205) was observed on five crystals as well-defined faces yielding good measurements. It is among the best established of the forms added here. The form is shown typically in crystals 10 (fig. 16), B8 (fig. 11), and 28 (fig. 8). The angles are as follows:

(205)	Measured, maximum	$\varphi=90° 13'$	$\rho=39° 20'$
	Measured, minimum	$\varphi=89° 28'$	$\rho=37° 54'$
	Average (of five)	$\varphi=89° 55'$	$\rho=38° 25'$
	Calculated	$\varphi=90° 00'$	$\rho=38° 41'$
		$\Delta=0° 05'$	$\Delta=0° 16'$

Vicinal (16.0.39). Although vicinal forms occur frequently on the datolite crystals, those of the orthodome zone deserve especial mention. On crystals of type 4 this zone contains certain vicinal forms as prominent faces. The present form was measured on three crystals, on which it was present as a prominent face, and was seen as a narrower line on several other crystals of type 4. The angles are:

Vicinal (16.0.39)	Measured	$\varphi=89° 49'$	$\rho=39° 22'$	Crystal B4.
		$\varphi=90° 00'$	$\rho=39° 05'$	Crystal B5.
		$\varphi=90° 00'$	$\rho=39° 50'$	Crystal 10.
		$\varphi=89° 56'$	$\rho=39° 26'$	Average.
	Calculated	$\varphi=90° 00'$	$\rho=39° 22'$	
		$\Delta=0° 04'$	$\Delta=0° 04'$	

𝔐 (403) was observed once as a very narrow and etched line face on crystal 36. The angles are:

(403)	Measured	$\varphi=90° 00'$	$\rho=68° 55'$
	Calculated	$\varphi=90° 00'$	$\rho=69° 25'$
		$\Delta=0° 00'$	$\Delta=0° 30'$

Vicinal (12.0.25) is another characteristic vicinal form, which occurs very frequently in the orthodome zone of crystals of type 4. This face occurs with x (102), the two forms, which are only about 1° apart, being represented by faces of equal size and brilliancy. The angles are:

Vicinal (12.0.25)	Measured	$\varphi=90° 26'$	$\rho=44° 09'$
	Calculated	$\varphi=90° 00'$	$\rho=43° 50'$
		$\Delta=0° 26'$	$\Delta=0° 19'$

𝔒 (134) is a new form which occurred on crystal 51, as shown in figure 17, as a narrow face between U (123) and m_x (011). The face is somewhat dull from etching and is correspondingly difficult to accurately measure. The angles are:

(134)	Measured	$\varphi=28° 51'$	$\rho=46° 48'$
	Calculated	$\varphi=27° 50'$	$\rho=47° 02'$
		$\Delta=1° 01'$	$\Delta=0° 14'$

$\mathfrak{P}$ (192) is considered to be one of the best established of the forms here listed as new. It occurs as sharp and brilliant, though small, faces and yields excellent signals. The habit and position of the form are shown on crystal B7 (fig. 10) and crystal B8 (fig. 12). The angles are:

(192)	Measured, minimum	$\varphi = 9° 57'$	$\rho = 80° 11'$
	Measured, maximum	$\varphi = 10° 01'$	$\rho = 80° 17'$
	Measured, average	$\varphi = 9° 58'$	$\rho = 80° 13'$
	Calculated	$\varphi = 9° 57'$	$\rho = 80° 12'$
		$\Delta = 0° 01'$	$\Delta = 0° 01'$

$\mathfrak{Q}$ (1.10.2), like (192), which it always accompanies, is a well-substantiated form observed as bright faces yielding sharp signals on several crystals. The angles are:

(1.10.2)	Measured, maximum	$\varphi = 9° 10'$	$\rho = 81° 06'$
	Measured, minimum	$\varphi = 9° 08'$	$\rho = 81° 04'$
	Measured, average	$\varphi = 9° 09'$	$\rho = 81° 05'$
	Calculated	$\varphi = 9° 08'$	$\rho = 81° 01'$
		$\Delta = 0° 01'$	$\Delta = 0° 04'$

The two forms (192) and (1.10.2) occur together, and the differences in their angles are so small that the signals overlap slightly.

$\mathfrak{R}$ (1.12.2) occurred as two fairly large, though etched, faces on crystal 14. The angles are:

(1.12.2)	Measured	$\varphi = 7° 35'$	$\rho = 83° 18'$	(average of 2).
	Calculated	$\varphi = 7° 30'$	$\rho = 82° 34'$	
		$\Delta = 0° 05'$	$\Delta = 0° 44'$	

$\mathfrak{S}$ (331), new, is one of the few positive pyramids occurring in the zone (001):(110). It occurs as a narrow line face, with i (11.11.10) between (110) and (111), on crystal B6, and as a similar narrow, though distinct, face yielding a poor signal on crystal 55. The angles are:

(331)	Measured	$\varphi = 57° 34'$	$\rho = 81° 58'$	Crystal B6.
	Calculated	$\varphi = 57° 37'$	$\rho = 81° 42'$	
		$\Delta = 0° 17'$	$\Delta = 0° 16'$	
	Measured	$\varphi = 57° 29'$	$\rho = 80° 37'$	Crystal 55.
		$\Delta = 0° 08'$	$\Delta = 1° 05'$	

$\mathfrak{T}$ (343) was found as a very narrow but bright face, beveling the angle between β (121) and n (111) on crystal 51, as shown in figure 17. Here it occurs with the other forms of the same vertical zone—namely, (344) and (345). The angles are:

(343)	Measured	$\varphi = 48° 30'$	$\rho = 69° 13'$
	Calculated	$\varphi = 49° 49'$	$\rho = 69° 04'$
		$\Delta = 1° 19'$	$\Delta = 0° 09'$

$\mathfrak{U}$ (344) occurred on crystal 51 as a very narrow face, beveling the edge between n (111) and Q (122), as shown in figure 17. The face was bright but very narrow and gave a faint signal. The angles are:

(344) Measured	$\varphi=49° 24'$	$\rho=63° 18'$
Calculated	$\varphi=49° 49'$	$\rho=63° 00'$
	$\Delta=0° 25'$	$\Delta=0° 18'$

The same form was noted on two other crystals, but the faces were entirely dull, yielding no signals. These were identified by their zonal relations.

$\mathfrak{V}$ (345). A narrow line face, occurring with (343) and (344) on crystal 51, gave a distinct signal, which, however, was so faint that it could not be accurately measured. The form indicated by the angles measured is (10.12.15). The position of the form, however, shows the true indices to be (345), the discrepancy in the angles being due to inexact measurement. The angles are given as follows:

(345) Measured	$\varphi=52° 49'$	$\rho=59° 01'$
(345) Calculated	$\varphi=49° 50'$	$\rho=57° 30'$
	$\Delta=2° 59'$	$\Delta=1° 31'$
(10.12.15) Calculated	$\varphi=52° 46'$	$\rho=59° 08'$
	$\Delta=0° 03'$	$\Delta=0° 07'$

The true indices of this form are thus somewhat in doubt.

$\mathfrak{W}$ (382) occurred once as a very narrow and somewhat etched face, beveling the angle between o (120) and m_x (011) on crystal B8, as shown in figure 12. The dim signal could not be accurately centered, thus giving very inaccurate measurements, as shown below:

(382) Measured	$\varphi=30° 38'$	$\rho=82° 36'$
Calculated	$\varphi=30° 37'$	$\rho=80° 21'$
	$\Delta=0° 01'$	$\Delta=2° 15'$

$\mathfrak{X}$ (455) occurred on crystal 14 as a narrow and somewhat etched face between n (111) and m_x (011). The angles are:

(455) Measured	$\varphi=52° 27'$	$\rho=64° 13'$
Calculated	$\varphi=51° 38'$	$\rho=63° 52'$
	$\Delta=0° 49'$	$\Delta=0° 21'$

$\mathfrak{Y}$ (6.15.2) is one of the forms which is of more or less doubtful validity. It occurred on crystal 10 as a somewhat curved and etched face between m_x (011) and o (120), as shown in figure 19. The angles are:

(6.15.2) Measured	$\varphi=33° 55'$	$\rho=84° 51'$
Calculated	$\varphi=32° 14'$	$\rho=84° 54'$
	$\Delta=1° 41'$	$\Delta=0° 03'$

$\mathfrak{z}$ (766) occurred as a small face yielding a sharp signal on crystal B 6. The angles are:

(766)	Measured	$\varphi=61°\ 45'$	$\rho=69°\ 12'$
	Calculated	$\varphi=61°\ 29'$	$\rho=69°\ 20'$
		$\Delta=\ 0°\ 16'$	$\Delta=\ 0°\ 08'$

The form, although it occurred only once as a measurable face, is believed well established.

$\mathfrak{h}$ (768) occurred once only as a small and somewhat etched face on crystal B 9. Its angles are:

(768)	Measured	$\varphi=61°\ 24'$	$\rho=62°\ 44'$
	Calculated	$\varphi=61°\ 30'$	$\rho=63°\ 19'$
		$\Delta=\ 0°\ 06'$	$\Delta=\ 0°\ 35'$

The order of agreement between the measured and calculated angles is satisfactory, although the form needs confirmation.

$\mathfrak{i}$ (11.11.10) occurred as a narrow line face with 331 between *m* (110) and *n* (111) n crystal B 6. While this might be considered a form vicinal to *n* (111), the signals from the two faces are separated by almost 2°, as shown below:

(11.11.10)	Measured	$\varphi=57°\ 44'$	$\rho=69°\ 01'$
	Calculated	$\varphi=57°\ 38'$	$\rho=68°\ 58'$
		$\Delta=\ 0°\ 06'$	$\Delta=\ 0°\ 03'$
(111)	Calculated	$\varphi=57°\ 38'$	$\rho=67°\ 04'$
		$\Delta=\ 0°\ 06'$	$\Delta=\ 1°\ 57'$

$\mathfrak{f}$ $(\bar{1}42)$ occurs as a well-defined face on crystal 41, as shown in figure 18. Although small, this face gave an excellent signal, yielding the angles:

$(\bar{1}42)$	Measured	$\varphi=21°\ 22'$	$\rho=69°\ 38'$	Crystal 41
	Calculated	$\varphi=21°\ 25'$	$\rho=69°\ 51'$	
		$\Delta=\ 0°\ 03'$	$\Delta=\ 0°\ 13'$	

The same form occurred also on crystal 10 as a narrow face with $(\bar{1}32)$ between *b* (010) and *M* $(\bar{1}22)$, as shown in figure 19. The signal from this face, which was very narrow and etched, was too dim to be accurately measured. The angles it gave are:

$(\bar{1}42)$	Measured	$\varphi=23°\ 25'$	$\rho=68°\ 20'$	Crystal 10
		$\Delta=\ 2°\ 00'$	$\Delta=\ 1°\ 31'$	

$\mathfrak{f}$ $(\bar{1}43)$ occurred as a single face on crystal 41, as shown in figure 18. Although small, this face was bright and gave a good signal. The angles are:

$(\bar{1}43)$	Measured	$\varphi=21°\ 51'$	$\rho=61°\ 25'$
	Calculated	$\varphi=21°\ 26'$	$\rho=61°\ 07'$
		$\Delta=\ 0°\ 25'$	$\Delta=\ 0°\ 18'$

The agreement is good, and although observed only once, this is considered a well-grounded form.

𝔩 ($\bar{1}67$) occurs on crystal 10 as a narrow face between i ($\bar{1}23$) and m_x (011), as shown in figure 16. The face is partly dulled by etching and yields a dim signal giving the following angles:

($\bar{1}67$)	Measured	$\varphi = 15°\ 22'$	$\rho = 48°\ 18'$
	Calculated	$\varphi = 14°\ 36'$	$\rho = 48°\ 16'$
		$\Delta = 0°\ 46'$	$\Delta = 0°\ 02'$

Although the values for Δ are small, the form was not confirmed by measurement of any other crystals, and, since it does not fit in a normal series as shown in the following discussion of zones, it must be considered to be doubtful.

𝔪 ($\bar{1}.6.12$) occurred as a narrow line face, beveling the angle between g (012) and μ ($\bar{1}14$) on crystal 55. The face, although fairly conspicuous, was etched and rounded so as to yield only a poor signal, which, owing to its dimness, could not be accurately measured. The angles are:

($\bar{1}.6.12$)	Measured	$\varphi = 15°\ 14'$	$\rho = 30°\ 06'$
	Calculated	$\varphi = 14°\ 30'$	$\rho = 33°\ 11'$
		$\Delta = 0°\ 44'$	$\Delta = 3°\ 05'$

There is a marked probability that the indices have been incorrectly determined.

𝔬 ($\bar{1}.6.14$) occurred with the last as a distinct but rounded face, beveling the angle between g (012) and κ (115) on crystal 55. The signal was dim and somewhat blurred. The angles are:

($\bar{1}.6.14$)	Measured	$\varphi = 15°\ 05'$	$\rho = 27°\ 49'$
	Calculated	$\varphi = 14°\ 28'$	$\rho = 29°\ 16'$
		$\Delta = 0°\ 37'$	$\Delta = 1°\ 27'$

This form also must be regarded as requiring further confirmation.

𝔭 ($\bar{1}.10.30$) occurred as a dim face, beveling the angle between t (013) and κ ($\bar{1}15$) adjacent to μ ($\bar{1}.6.12$) and 𝔭 ($\bar{1}.6.14$) on crystal 55. Like these forms the face, though a relatively broad and prominent line, is somewhat etched and rounded, although this is the best established of the three forms, as shown by its angles, which are as follows:

($\bar{1}.10.30$)	Measured	$\varphi = 8°\ 06'$	$\rho = 22°\ 42'$
	Calculated	$\varphi = 8°\ 38'$	$\rho = 23°\ 05'$
		$\Delta = 0°\ 32'$	$\Delta = 0°\ 23'$

$\mathfrak{s}$ ($\bar{1}$.12.10) occurred on crystal 10 as a small though bright face, as shown in figure 19. The angles are:

($\bar{1}$.12.10)	Measured	$\varphi = 7° 25'$	$\rho = 56° 15'$
	Calculated	$\varphi = 7° 23'$	$\rho = 56° 53'$
		$\Delta = 0° 02'$	$\Delta = 0° 38'$

The order of agreement is good, and this is regarded as a well-established form.

$\mathfrak{t}$ ($\bar{1}$.20.15) occurs on crystal B7, as shown in figure 10, as a small triangular face. The angles are:

($\bar{1}$.20.15)	Measured	$\varphi = 4° 51'$	$\rho = 58° 50'$
	Calculated	$\varphi = 4° 25'$	$\rho = 59° 27'$
		$\Delta = 0° 26'$	$\Delta = 0° 37'$

$\mathfrak{u}$ ($\bar{2}$11) occurs on several crystals as a narrow face between ν ($\bar{1}$11) and *a* (100). In most instances, however, the face is entirely dull and can not be measured. The best face of this form which occurred on crystal 44, shown in part in figure 20, gave the following angles:

($\bar{2}$11)	Measured	$\varphi = 71° 41'$	$\rho = 76° 03'$
	Calculated	$\varphi = 72° 25'$	$\rho = 76° 34'$
		$\Delta = 0° 44'$	$\Delta = 0° 31'$

Although the agreement between the calculated and measured angles is not as close as might be expected, this is due to the faintness of the signal from the etched face. The form may be regarded as well grounded.

$\mathfrak{x}$ ($\bar{2}$29) was noted first upon crystal 41, shown in figure 18, as a narrow line face between μ ($\bar{1}$14) and κ ($\bar{1}$15). The angles are as follows:

($\bar{2}$29)	Measured	$\varphi = 58° 04'$	$\rho = 27° 33'$
	Calculated	$\varphi = 57° 28'$	$\rho = 27° 36'$
		$\Delta = 0° 36'$	$\Delta = 0° 03'$

The same form was also noted on crystal 55 as an etched face which gave very poor signals, not accurately measurable because of their faintness. These gave the angles:

($\bar{2}$29)	Measured	$\varphi = 55° 40'$	$\rho = 25° 08'$
		$\Delta = 1° 48'$	$\Delta = 2° 28'$

Since the form does not agree with the normal series as shown in the discussion of zone 4 below, it must be regarded as a disturbed form.

ʒ ($\bar{2}63$) occurred on crystal 41 as a somewhat rounded face yielding a close group of signals. The face is shown in figure 18. It gave the angles:

($\bar{2}63$)	Measured	$\varphi=28°\ 55'$	$\rho=70°\ 15'$
	Calculated	$\varphi=27°\ 37'$	$\rho=70°\ 45'$
		$\Delta=\ 1°\ 18'$	$\Delta=\ 0°\ 30'$

This form fits normally in the zone as shown below, and since it is an entirely probable form it may be considered established. The same form occurred on crystal B 7 as a narrow face between $\mathfrak{Q}$ (1.10.2) and M ($\bar{1}22$). This occurrence of the form yielded a somewhat better signal, giving the angles:

($\bar{2}63$)	Measured	$\varphi=27°\ 57'$	$\rho=70°\ 44'$
		$\Delta=\ 0°\ 20'$	$\Delta=\ 0°\ 01'$

θ ($\bar{2}95$) occurred as one of a small group of rare forms on crystal 41 as shown in figure 18. The face of $\bar{2}95$, though small, gave a sharp though faint signal, furnishing the angles:

($\bar{2}95$)	Measured	$\varphi=18°\ 54'$	$\rho=67°\ 00'$
	Calculated	$\varphi=19°\ 15'$	$\rho=67°\ 29'$
		$\Delta=\ 0°\ 21'$	$\Delta=\ 0°\ 29'$

ɣ ($\bar{2}96$) occurred on crystal 41 as a small face, as shown in figure 18, which gave a distinct signal, although, owing to the minuteness of the face, the signal was too faint to illuminate the cross hairs. The angles on this crystal were:

($\bar{2}96$)	Measured	$\varphi=19°\ 39'$	$\rho=65°\ 32'$
	Calculated	$\varphi=19°\ 14'$	$\rho=63°\ 34'$
		$\Delta=\ 0°\ 25'$	$\Delta=\ 1°\ 58'$

The same form occurred on crystal 10 as a narrow face between i ($\bar{1}23$) and b (010), as shown in figure 19. This gave a somewhat brighter and more accurately measurable signal than the last, yielding the following angles:

($\bar{2}96$)	Measured	$\varphi=18°\ 50'$	$\rho=63°\ 54'$
		$\Delta=\ 0°\ 24'$	$\Delta=\ 0°\ 20'$

The measurements of the two crystals are averaged in Table 5.

$\dot{p}$ ($\bar{2}$.10.5) occurred on crystal 41, as shown in figure 18, as a minute face giving a signal too dim to be accurately centered. The angles are:

$$(\bar{2}.10.5)\quad \begin{array}{lll} \text{Measured} & \varphi=18^\circ\ 41' & \rho=69^\circ\ 41' \\ \text{Calculated} & \varphi=17^\circ\ 24' & \rho=69^\circ\ 24' \\ & \Delta=\ 1^\circ\ 17' & \Delta=\ 0^\circ\ 17' \end{array}$$

This form therefore is poorly established by the data obtained.

x_1 ($\bar{3}42$) occurred on crystal 27 as a small brilliant face yielding an excellent signal. The angles are:

$$(\bar{3}42)\quad \begin{array}{lll} \text{Measured} & \varphi=49^\circ\ 04' & \rho=75^\circ\ 41' \\ \text{Calculated} & \phi=49^\circ\ 45' & \rho=75^\circ\ 41' \\ & \Delta=\ 0^\circ\ 41' & \Delta=\ 0^\circ\ 00' \end{array}$$

Although observed only once, the form is considered to be well established.

σ ($\bar{3}43$) occurs on crystal 33 as a distinct though narrow line face between π ($\bar{2}31$) and ϵ ($\bar{1}12$), as shown in figure 24. The signal, owing to the narrowness of the face, was too faint for precise measurement. The angles measured are:

$$(\bar{3}43)\quad \begin{array}{lll} \text{Measured} & \varphi=49^\circ\ 36' & \rho=70^\circ\ 29' \\ \text{Calculated} & \varphi=49^\circ\ 45' & \rho=69^\circ\ 03' \\ & \Delta=\ 0^\circ\ 09' & \Delta=\ 1^\circ\ 26' \end{array}$$

The form is normal in zone No. 12, as shown below, and is considered as established, the indices being confirmed by zonal relations.

Υ ($\bar{3}51$) occurred on crystal 33, as shown in figure 24, as a distinct line face between π ($\bar{2}31$) and o (120). The very faint signal from the partially etched face gave as angles:

$$(\bar{3}51)\quad \begin{array}{lll} \text{Measured} & \varphi=42^\circ\ 32' & \rho=83^\circ\ 45' \\ \text{Calculated} & \varphi=43^\circ\ 17' & \rho=83^\circ\ 26' \\ & \Delta=\ 0^\circ\ 45' & \Delta=\ 0^\circ\ 19' \end{array}$$

e_1 ($\bar{3}53$) occurred on crystal 33, as shown in figure 24, as a small and very much etched face. The signal was very faint, and the measurements are only approximate. The angles are:

$$(\bar{3}53)\quad \begin{array}{lll} \text{Measured} & \varphi=44^\circ\ 20' & \rho=68^\circ\ 58' \\ \text{Calculated} & \varphi=43^\circ\ 23' & \rho=73^\circ\ 58' \\ & \Delta=\ 0^\circ\ 57' & \Delta=\ 5^\circ\ 00' \end{array}$$

The large discrepancy, $\Delta=5^\circ\ 00'$, is attributed to the difficulty of measuring so badly etched a face. The indices are confirmed by the zonal relations.

f_1 $(\bar{3}61)$ occurred as a narrow line, giving a faint though distinct signal on crystal B2 between $o(120)$ and $M(\bar{1}22)$. The angles measured are:

$(\bar{3}61)$	Measured	$\varphi=38°\ 06'$	$\rho=83°\ 28'$
	Calculated	$\varphi=38°\ 15'$	$\rho=84°\ 06'$
		$\Delta=\ 0°\ 09'$	$\Delta=\ 0°\ 38'$

The form is considered to be well established.

g_1 $(\bar{3}62)$ occurred as a line face yielding a fair signal on crystal 10, as shown in figure 19. The angles are:

$(\bar{3}62)$	Measured	$\varphi=37°\ 55'$	$\rho=78°\ 35'$
	Calculated	$\varphi=38°\ 13'$	$\rho=78°\ 19'$
		$\Delta=\ 0°\ 18'$	$\Delta=\ 0°\ 16'$

This form also is normal in the zone (001): (120) and is considered to be well grounded.

h_1 $(\bar{3}.10.20)$ occurred on crystal B2 as a bright line yielding a fair signal between α $(\bar{1}24)$ and $g(012)$. The angles are:

$(\bar{3}.10.20)$	Measured	$\varphi=25°\ 03'$	$\rho=34°\ 54'$
	Calculated	$\varphi=25°\ 30'$	$\rho=35°\ 02'$
		$\Delta=\ 0°\ 27'$	$\Delta=\ 0°\ 08'$
$(\bar{1}36)$	Calculated	$\varphi=27°\ 32'$	$\rho=35°\ 31'$
		$\Delta=\ 2°\ 29'$	$\Delta=\ 0°\ 37'$

The form is near $(\bar{1}36)$, as shown above, but not sufficiently near, the quality of the signal considered, to be assigned to that form As shown by its high indices and its zonal position, the form is "disturbed" and somewhat uncertainly established.

i_1 $(\bar{4}61)$ occurs as a distinct line face, giving a dim signal between π $(\bar{2}31)$ and n (111), as shown in figure 24. The angles are:

$(\bar{4}61)$	Measured	$\varphi=48°\ 06'$	$\rho=84°\ 55'$
	Calculated	$\varphi=46°\ 26'$	$\rho=84°\ 49'$
		$\Delta=\ 1°\ 40'$	$\Delta=\ 0°\ 06'$

j_1 $(\bar{5}.6.30)$ occurs on crystal B5 as a very narrow line face truncating the angle between μ $(\bar{1}14)$ and $\mathfrak{Q}$ (205), as shown in figure 13. The angles are:

$(\bar{5}.6.30)$	Measured	$\varphi=51°\ 47'$	$\rho=22°\ 22'$
	Calculated	$\varphi=52°\ 31'$	$\rho=22°\ 35'$
		$\Delta=\ 0°\ 44'$	$\Delta=\ 0°\ 13'$

The indices are improbable and are not confirmed by the zonal relations or by the position of the form in the normal series, as shown below. This must consequently be considered a disturbed and abnormal form.

k_1 ($\bar{7}94$) occurs as a small face on crystal 41, as shown in figure 18. The face, in addition to being small, was somewhat etched. The angles are:

($\bar{7}94$)	Measured	$\varphi = 50° 11'$	$\rho = 77° 12'$
	Calculated	$\varphi = 50° 46'$	$\rho = 77° 29'$
		$\Delta = 0° 35'$	$\Delta = 0° 17'$

This form also fails to fit in the normal series for its zone and is therefore a disturbed and abnormal form.

l_1 ($\bar{9}.16.2$) occurred on crystal 10 as a narrow rounded face between *o* (120) and π ($\bar{2}31$), as shown in figure 19. The angles measured are:

($\bar{9}.16.2$)	Measured	$\varphi = 41° 25'$	$\rho = 85° 47'$
	Calculated	$\varphi = 41° 33'$	$\rho = 85° 46'$
		$\Delta = 0° 08'$	$\Delta = 0° 01'$

The rounded face gave a band of signals. The measurement was made on a brighter and more pronounced signal in the center of the band. The form is poorly confirmed and is somewhat doubtful.

m_1 ($\bar{1}\bar{2}.25.1$), a form with such high indices that it may almost be considered vicinal to *o* (120) was observed as 7 distinct faces on 5 of the crystals examined. It is consequently believed to be a well-substantiated form. Of the crystals measured, Nos. 33 and B9 yielded the following angles:

(12.25.1)	Measured, XI. 33	$\varphi = 37° 11'$	$\rho = 88° 33'$
	Measured, B9	$\varphi = 36° 40'$	$\rho = 88° 14'$
	Measured, B9	$\varphi = 36° 44'$	$\rho = 88° 18'$
	Measured, average	$\varphi = 36° 52'$	$\rho = 88° 22'$
	Calculated	$\varphi = 37° 07'$	$\rho = 88° 27'$
		$\Delta = 0° 15'$	$\Delta = 0° 05'$

This form occurs as a narrow line sometimes completely etched, beveling the edge between *o* (120) and m_x (011).

TABLE 4.—*Datolite.*

List of new forms observed on datolite from Westfield during the present study with equivalent symbols and indices in the Dana and Goldschmidt orientations.

Letter.	Dana orientation.		Goldschmidt orientation.	
	Miller.	Symbol.	Miller.	Symbol.
$\mathfrak{C}$	380	$\infty\ \frac{8}{3}$	083	$0\ \frac{8}{3}$
$\mathfrak{J}$	043	$0\ \frac{4}{3}$	380	$\infty\ \frac{8}{3}$
$\mathfrak{L}$	205	$\frac{2}{5}\ 0$	504	$+\frac{5}{4}\ 0$
Vic.	16.0.39	$+\frac{16}{39}\ 0$	39.0.32	$+\frac{39}{32}\ 0$
$\mathfrak{M}$	403	$+\frac{4}{3}\ 0$	302	$+\frac{3}{2}\ 0$
Vic.	12.0.25	$+\frac{12}{25}\ 0$	25.0.24	$+\frac{25}{24}\ 0$
$\mathfrak{O}$	134	$+\frac{1}{4}\ \frac{3}{4}$	231	$+2\ 3$
$\mathfrak{P}$	192	$+\frac{1}{2}\ \frac{9}{2}$	191	$+1\ 9$
$\mathfrak{Q}$	1.10.2	$+\frac{1}{2}\ 5$	1.10.1	$+1\ 10$
$\mathfrak{R}$	1.12.2	$+\frac{1}{2}\ 6$	1.12.1	$+1\ 12$
$\mathfrak{S}$	331	$+\ \ 3$	166	$+\frac{1}{6}\ 1$
$\mathfrak{T}$	343	$+1\ \frac{4}{3}$	386	$+\frac{1}{2}\ \frac{4}{3}$
$\mathfrak{U}$	344	$+\frac{3}{4}\ 1$	243	$+\frac{2}{3}\ \frac{4}{3}$
$\mathfrak{V}$	345	$+\frac{3}{5}\ \frac{4}{5}$	586	$+\frac{5}{6}\ \frac{4}{3}$
$\mathfrak{W}$	382	$+\frac{3}{2}\ 4$	183	$+\frac{1}{3}\ \frac{8}{3}$
$\mathfrak{X}$	455	$+\frac{4}{5}\ 1$	5.10.8	$+\frac{5}{8}\ \frac{5}{4}$
$\mathfrak{Y}$	6.15.2	$+3\ \frac{15}{2}$	1.15.6	$+\frac{1}{6}\ \frac{5}{2}$
$\mathfrak{Z}$	766	$+\frac{7}{6}\ 1$	367	$+\frac{3}{7}\ \frac{6}{7}$
$\mathfrak{h}$	768	$+\frac{7}{8}\ \frac{3}{4}$	467	$+\frac{4}{7}\ \frac{6}{7}$
$\mathfrak{i}$	11.11.10	$+\ \ \frac{11}{10}$	5.11.11	$+\frac{5}{11}\ 1$
$\mathfrak{j}$	$\bar{1}42$	$-\frac{1}{2}\ 2$	$\bar{1}41$	$-1\ 4$
$\mathfrak{k}$	$\bar{1}43$	$-\frac{1}{3}\ \frac{4}{3}$	$\bar{3}82$	$-\frac{3}{2}\ 4$
$\mathfrak{l}$	$\bar{1}67$	$-\frac{1}{7}\ \frac{6}{7}$	$\bar{7}.12.2$	$-\frac{7}{2}\ 6$
$\mathfrak{m}$	$\bar{1}.6.12$	$-\frac{1}{12}\ \frac{1}{2}$	$\bar{6}61$	$-\ \ 6$
$\mathfrak{o}$	$\bar{1}.6.14$	$-\frac{1}{14}\ \frac{3}{7}$	$\bar{7}61$	$-7\ 6$
$\mathfrak{p}$	$\bar{1}.10.30$	$-\frac{1}{30}\ \frac{1}{3}$	$\bar{15}.10.1$	$-15\ 10$
$\mathfrak{s}$	$\bar{1}.12.10$	$-\frac{1}{10}\ \frac{6}{5}$	$\bar{5}.12.1$	$-5\ 12$
$\mathfrak{t}$	$\bar{1}.20.15$	$-\frac{1}{15}\ \frac{4}{3}$	$\bar{15}.40.2$	$-\frac{15}{2}\ 20$
$\mathfrak{u}$	$\bar{2}11$	$-2\ 1$	$\bar{1}24$	$-\frac{1}{4}\ \frac{1}{2}$
$\mathfrak{x}$	$\bar{2}29$	$-\ \ \frac{2}{9}$	$\bar{9}44$	$-\frac{9}{4}\ 1$
$\mathfrak{z}$	$\bar{2}63$	$-\frac{2}{3}\ 2$	$\bar{3}.12.4$	$-\frac{3}{4}\ 3$
θ	$\bar{2}95$	$-\frac{2}{5}\ \frac{9}{5}$	$\bar{5}.18.4$	$-\frac{5}{4}\ \frac{9}{2}$
♉	$\bar{2}96$	$-\frac{1}{3}\ \frac{3}{2}$	$\bar{3}92$	$-\frac{3}{2}\ \frac{9}{2}$
ρ	$\bar{2}.10.5$	$-\frac{2}{5}\ 2$	$\bar{5}.20.4$	$-\frac{5}{4}\ 5$
x_1	$\bar{3}42$	$-\frac{3}{2}\ 2$	$\bar{1}43$	$-\frac{1}{3}\ \frac{4}{3}$
σ	$\bar{3}43$	$-1\ \frac{4}{3}$	$\bar{3}86$	$-\frac{1}{2}\ \frac{4}{3}$
Υ	$\bar{3}51$	$-3\ 5$	$\bar{1}.10.6$	$-\frac{1}{6}\ \frac{5}{3}$
e_1	$\bar{3}53$	$-1\ \frac{5}{3}$	$\bar{3}.10.9$	$-\frac{1}{3}\ \frac{10}{9}$
f_1	$\bar{3}61$	$-3\ 6$	$\bar{1}.12.6$	$-\frac{1}{6}\ \frac{1}{2}$
g_1	$\bar{3}62$	$-\frac{3}{2}\ 3$	$\bar{1}63$	$-\frac{1}{3}\ 2$
h_1	$\bar{3}.10.20$	$-\frac{3}{20}\ \frac{1}{2}$	$\bar{10}.10.3$	$-\ \ \frac{10}{3}$
i_1	$\bar{4}61$	$-4\ 6$	$\bar{1}.12.8$	$-\frac{1}{8}\ \frac{3}{2}$
j_1	$\bar{5}.6.30$	$-\frac{1}{6}\ \frac{1}{5}$	$\bar{15}.6.5$	$-3\ \frac{6}{5}$
k_1	$\bar{7}94$	$-\frac{7}{4}\ \frac{9}{4}$	$\bar{2}97$	$-\frac{2}{7}\ \frac{9}{7}$
l_1	$\bar{9}.16.2$	$-\frac{9}{2}\ 8$	$\bar{1}.16.9$	$-\frac{1}{9}\ \frac{16}{9}$
m_1	$\bar{12}.25.1$	$-12\ 25$	$\bar{1}.50.24$	$-\frac{1}{24}\ \frac{25}{12}$

TABLE 5.—*Datolite.*

Comparison of measured angles with calculated angles for new forms observed on datolite from Westfield, Massachusetts. Dana orientation.

Letter.	Miller.	Quality.	Measured.		Calculated.	
			φ	ρ	φ	ρ
			° ′	° ′	° ′	° ′
𝔈	380	Very good.......	30 08	89 27	30 35	90 00
𝔍	013	Poor............	0 00	62 00	0 05	59 21
𝔏	205	Very good.......	89 55	38 25	90 00	38 41
Vic.	16.0.39	Good............	89 56	39 26	90 00	39 22
𝔐	403	Poor............	90 00	68 55	90 00	69 25
Vic.	12.0.25	Very good.......	90 00	44 09	90 00	43 50
𝔒	134	Fair............	28 51	46 48	27 50	47 02
𝔓	192	Very good.......	9 58	80 13	9 57	80 12
𝔔	1.10.2	.....do..........	9 08	81 04	9 06	81 01
ℜ	1.12.2	Good............	7 35	83 18	7 30	82 34
𝔖	331	.....do..........	57 25	81 09	57 37	81 58
𝔗	313	Very poor.......	48 30	69 13	49 49	69 04
𝔘	344	Good............	49 24	63 18	49 49	63 00
𝔙	345	Poor............	52 49	59 01	49 50	57 30
𝔚	382	.....do..........	30 38	82 36	30 37	80 21
𝔛	455	.....do..........	52 27	64 13	51 38	63 52
𝔜	6.15.2	.....do..........	33 55	84 51	32 14	84 54
ℨ	766	Good............	61 45	69 12	61 29	69 20
𝔥	768	Poor............	61 24	62 44	61 30	63 19
𝔦	11.11.10	Fair............	57 44	69 01	57 38	68 58
𝔧	$\bar{1}42$	Very good.......	22 23	68 59	21 25	69 51
𝔨	$\bar{1}43$	Good............	21 51	61 25	21 26	61 07
𝔩	$\bar{1}67$	Poor............	15 22	48 18	14 36	48 16
𝔪	$\bar{1}.6.12$	.....do..........	15 14	30 06	14 30	33 11
𝔬	$\bar{1}.6.14$	.....do..........	15 05	27 49	14 28	29 16
𝔭	$\bar{1}.10.30$	.....do..........	8 06	22 42	8 38	23 05
𝔰	$\bar{1}.12.10$	.....do..........	7 25	56 15	7 23	56 53
𝔱	$\bar{1}.20.15$	.....do..........	4 51	58 50	4 25	59 27
𝔲	$\bar{2}11$	.....do..........	71 41	76 03	72 25	76 34
𝔵	$\bar{2}29$	.....do..........	56 52	26 20	57 28	27 36
𝔷	$\bar{2}63$	.....do..........	28 26	70 35	27 37	70 45
θ	$\bar{2}95$	Good............	18 54	67 00	19 15	67 29
8	$\bar{2}96$	.....do..........	19 14	64 43	19 14	63 34
ρ	$\bar{2}.10.5$	Very poor.......	18 41	69 41	17 24	69 24
x_1	$\bar{3}42$	Very good.......	49 01	75 41	49 45	75 41
σ	$\bar{3}43$	Poor............	49 36	70 29	49 45	69 03
Υ	$\bar{3}51$	.....do..........	42 32	83 45	43 17	83 26
e'	$\bar{3}53$	.....do..........	44 20	68 59	43 23	73 58
f_1	$\bar{3}61$	Very poor.......	39 25	83 48	38 15	81 06
g_1	$\bar{3}62$	Fair............	37 55	78 35	38 13	78 19
h_1	$\bar{3}.10.20$	.....do..........	25 03	34 54	25 30	35 02
i_1	$\bar{4}61$	Very poor.......	48 06	84 55	46 26	84 49
j_1	$\bar{5}.6.30$	Poor............	51 47	22 23	52 31	22 35
k_1	$\bar{7}94$	Very poor.......	50 11	77 12	50 46	77 29
l_1	$\bar{9}.16.2$	Poor............	41 25	85 47	41 33	85 46
m_1	$\overline{12}.25.1$	Good............	36 52	88 22	37 07	88 27

TABLE 6.—*Datolite.*

A table giving the new forms observed on datolite from Westfield, Mass., during the present investigation, together with the calculated angles for these forms in the Goldschmidt orientation.

Letter.	Miller.	Symbol.	ϕ	ρ
			° ′	° ′
𝔈	083	$0\ \frac{8}{3}$	0 05	59 25
𝔍	380	$\infty\ \frac{8}{3}$	58 42	90 00
𝔏	504	$+\frac{5}{4}\ 0$	90 00	51 28
Vic.	39.0.32	$+\frac{39}{32}\ 0$	90 00	50 45
𝔐	302	$+\frac{3}{2}\ 0$	90 00	56 25
Vic.	25.0.24	$+\frac{25}{24}\ 0$	90 00	46 11
𝔒	231	$+2\ 3$	46 31	70 08
𝔓	191	$+1\ 9$	9 59	80 13
𝔔	1.10.1	$+1\ 10$	9 00	81 09
ℜ	1.12.1	$+1\ 12$	7 31	82 35
𝔖	166	$+\frac{1}{6}\ 1$	14 58	75 36
𝔗	386	$+\frac{1}{2}\ \frac{4}{3}$	30 47	41 33
𝔘	243	$+\frac{2}{3}\ \frac{4}{3}$	38 26	47 12
𝔙	586	$+\frac{5}{6}\ \frac{4}{3}$	44 44	49 59
𝔚	183	$+\frac{1}{3}\ \frac{8}{3}$	11 15	59 55
𝔛	5.10.8	$+\frac{5}{8}\ \frac{5}{4}$	38 26	45 21
𝔜	1.15.6	$+\frac{1}{6}\ \frac{5}{2}$	6 07	57 53
ℨ	367	$+\frac{3}{7}\ \frac{6}{7}$	38 29	34 47
𝔥	467	$+\frac{4}{7}\ \frac{6}{7}$	46 37	38 22
𝔦	5.11.11	$+\frac{5}{11}\ 1$	35 50	38 03
𝔧	$\bar{1}41$	$-1\ 4$	21 30	69 52
𝔨	$\bar{3}82$	$-\frac{3}{2}\ 4$	30 36	71 16
𝔩	$\bar{7}.12.2$	$-\frac{7}{2}\ 6$	42 39	79 01
𝔪	$\bar{6}61$	-6	57 39	82 00
𝔬	$\bar{7}61$	$-7\ 6$	61 31	82 52
𝔳	$\bar{15}.10.1$	$-15\ 10$	67 01	86 30
𝔰	$\bar{5}.12.1$	$-5\ 12$	33 21	83 44
𝔱	$\bar{15}.40.2$	$-\frac{15}{2}\ 20$	80 25	82 31
𝔲	$\bar{1}24$	$-\frac{1}{4}\ \frac{1}{2}$	38 01	21 56
𝔵	$\bar{9}44$	$-\frac{9}{4}\ 1$	74 17	66 53
𝔷	$\bar{3}.12.4$	$-\frac{3}{4}\ 3$	21 29	63 57
θ	$\bar{5}.18.4$	$-\frac{5}{4}\ \frac{9}{2}$	23 39	72 13
ϑ	$\bar{3}92$	$-\frac{3}{2}\ \frac{9}{2}$	27 44	72 17
δ	$\bar{5}.20.4$	$-\frac{5}{4}\ 5$	21 31	73 39
x_1	$\bar{1}43$	$-\frac{1}{3}\ \frac{4}{3}$	21 25	42 15
σ	$\bar{3}86$	$-\frac{1}{2}\ \frac{4}{3}$	30 32	44 28
Υ	$\bar{1}.10.6$	$-\frac{1}{6}\ \frac{5}{3}$	8 50	46 58
e_1	$\bar{3}.10.9$	$-\frac{1}{3}\ \frac{10}{9}$	25 12	37 55
f_1	$\bar{1}.12.6$	$-\frac{1}{6}\ \frac{1}{2}$	7 23	52 00
g_1	$\bar{1}63$	$-\frac{1}{3}\ 2$	14 39	37 55
h_1	$\bar{10}.10.3$	$-\frac{10}{3}$	57 39	75 48
i_1	$\bar{1}.12.8$	$-\frac{1}{8}\ \frac{3}{2}$	7 21	43 48
j_1	$\bar{15}.6.5$	$-3\ \frac{6}{5}$	75 59	72 21
k_1	$\bar{2}97$	$-\frac{2}{7}\ \frac{9}{7}$	19 11	40 49
l_1	$\bar{1}.16.9$	$-\frac{1}{9}\ \frac{16}{9}$	5 31	6 28
m_1	$\bar{1}.50.24$	$-\frac{1}{24}\ \frac{25}{12}$	1 12	7 30

COMBINATIONS.

Below are listed the combinations recorded for 55 of the crystals measured, including all of those which showed new or rare forms. The greatest number of forms recorded for any crystal is 35, while the least number given below is 5. The latter crystal was, however, very incompletely developed, and many of the others which showed fewest forms would have shown others had the crystal not been badly broken or much crowded during growth. Some of the crystals listed below were incompletely measured.

Combinations observed on datolite from Westfield.

No.	Crystal.	Forms.
1	B3	$b\ m\ M\ i\ \alpha$
2	B1	$b\ m_x\ g\ \epsilon\ d$
3	43	$a\ m\ s\ x\ q$
4	44	$a\ m\ g\ \nu\ \epsilon\ \mathfrak{u}$
5	27	$a\ m\ o\ \Pi\ \Sigma\ q\ x_1$
6	B6	$a\ m\ o\ x\ u\ \mathfrak{S}\ \mathfrak{i}\ n\ \mathfrak{Z}$
7	13	$a\ m\ m_x\ g\ \nu\ \epsilon\ i\ \mathfrak{d}$
8	61	$a\ m\ o\ r\ m_x\ g\ n\ \beta$
9	8	$a\ m\ m_x\ g\ x\ n\ q\ \epsilon\ \lambda$
10	28	$a\ m\ m_x\ g\ x\ v\ u\ n\ \lambda\ \mu$
11	31	$c\ m\ o\ m_x\ g\ t\ n\ \beta\ \epsilon\ \lambda\ \mu\ \kappa\ \alpha$
12	32	$c\ m\ o\ r\ m_x\ g\ t\ \sigma\ x\ n\ Q\ U\ \pi$
13	B7	$b\ m\ \nu\ \epsilon\ M\ i\ \alpha\ \mathfrak{d}\ d\ \mathfrak{t}\ \mathfrak{p}\ \mathfrak{Q}\ \mathfrak{z}$
14	9	$a\ m\ o\ m_x\ g\ x\ n\ \beta\ Q\ \nu\ \epsilon\ M\ i\ \alpha\ \pi$
15	22	$c\ m\ o\ m_x\ g\ t\ n\ \beta\ Q\ U\ \nu\ \epsilon\ i$
16	23	$a\ b\ m\ o\ m_x\ g\ \Pi\ \Sigma\ n\ Q\ \epsilon\ \lambda$
17	7	$a\ m\ m_x\ g\ x\ I\ \mathfrak{H}\ n\ q\ \nu\ \epsilon\ \lambda\ \mu\ \mathfrak{y}$
18	18	$a\ m\ o\ m_x\ g\ x\ n\ \beta\ U\ \nu\ \epsilon\ M\ i\ \alpha\ d\ \pi$
19	B18	$a\ m\ o\ m_x\ g\ x\ n\ \beta\ Q\ U\ \nu\ \epsilon\ i\ \mathfrak{d}$
20	63	$c\ m\ o\ m_x\ g\ t\ n\ Q\ \nu\ \epsilon\ \lambda\ \mu\ \kappa\ \alpha$
21	59	$c\ m\ o\ m_x\ g\ t\ n\ \nu\ \epsilon\ \lambda\ \mu\ \kappa\ M\ \pi$
22	56	$c\ m\ o\ r\ m_x\ g\ t\ \sigma\ x\ v\ u\ \mathfrak{H}\ n\ w\ \mathfrak{L}$
23	5	$a\ c\ m\ o\ l\ x\ v\ u\ n\ Q\ U\ \nu\ \epsilon\ \lambda\ \mu$
24	52	$a\ m\ o\ r\ m_x\ g\ t\ x\ \mathfrak{H}\ n\ \beta\ Q\ U\ q\ \nu\ \epsilon$
25	17	$a\ b\ c\ m\ o\ r\ m_x\ g\ t\ x\ \Sigma\ n\ \beta\ q\ \epsilon\ i$
26	B11	$a\ c\ m\ o\ m_x\ g\ t\ x\ v\ \Sigma\ n\ \beta\ q\ \epsilon\ \lambda\ \mu\ \pi$
27	B8	$a\ b\ m\ o\ l\ x\ v\ u\ Q\ q\ \pi\ \mathfrak{S}\ \mathfrak{M}\ M_1\ \mathfrak{P}\ \mathfrak{Q}\ \mathfrak{L}$
28	64	$a\ c\ m\ o\ m_x\ g\ t\ \psi\ n\ \beta\ \epsilon\ \lambda\ \mu\ \kappa\ \alpha\ \pi$
29	4	$a\ b\ m\ o\ r\ m_x\ g\ x\ u\ \mathfrak{H}\ n\ \beta\ q\ u\ \epsilon\ \lambda\ \mu$
30	12	$a\ b\ m\ o\ m_x\ g\ x\ u\ n\ \beta\ Q\ \nu\ \epsilon\ \lambda\ i\ \alpha\ \pi$
31	16	$b\ m\ o\ m_x\ g\ t\ n\ \beta\ Q\ U\ \nu\ \epsilon\ \lambda\ \mu\ i\ \alpha\ d$
32	14	$a\ b\ m\ m_x\ g\ x\ \mathfrak{H}\ \beta\ n\ U\ \epsilon\ \lambda\ \mu\ i\ d\ \mathfrak{R}\ \mathfrak{X}$
33	15	$m\ o\ r\ m_x\ g\ x\ n\ \beta\ q\ \nu\ \epsilon\ \lambda\ \mu\ M\ \alpha\ \mathfrak{d}\ \pi$
34	53	$a\ c\ m\ o\ m_x\ g\ t\ x\ v\ n\ \nu\ \epsilon\ \lambda\ \mu\ \kappa\ M\ i\ \alpha\ d$
35	B10	$a\ c\ m\ o\ \Theta\ r\ m_x\ g\ t\ \Pi\ \epsilon\ \lambda\ \mu\ M\ \pi\ P\ \Phi\ \mathfrak{y}$
36	B4	$a\ c\ m\ o\ m_x\ g\ t\ \sigma\ x\ v\ u\ n\ \beta\ q\ \epsilon\ \Lambda\ \mathfrak{L}$ (16.0.39)
37	1	$a\ c\ m\ o\ r\ m_x\ g\ t\ x\ v\ u\ \xi\ n\ Q\ U\ \epsilon\ \lambda\ \mu$
38	2	$a\ c\ m\ o\ r\ m_x\ g\ o\ x\ v\ \nu\ \epsilon\ \lambda\ \mu\ M\ i\ \alpha\ \mathfrak{d}$
39	20	$a\ c\ m\ o\ m_x\ g\ t\ x\ \Pi\ \Sigma\ n\ \beta\ q\ \epsilon\ \lambda\ \mu\ \kappa\ \alpha\ d$
40	39	$a\ b\ c\ m\ o\ r\ x\ u\ s\ \Pi\ \Sigma\ n\ Q\ U\ \nu\ \epsilon\ \lambda\ \mu\ i$
41	50	$a\ c\ m\ o\ m_x\ g\ t\ \sigma\ \phi\ x\ v\ u\ n\ \epsilon\ \lambda\ \mu\ \alpha\ \mathfrak{d}\ \mathfrak{L}$
42	21	$a\ b\ m\ o\ r\ m_x\ g\ x\ v\ u\ n\ \beta\ Q\ U\ \nu\ \lambda\ M\ i\ \mathfrak{d}$
43	B5	$a\ c\ m\ m_x\ g\ t\ \sigma\ x\ I\ s\ n\ \epsilon\ \lambda\ \mu\ \omega\ m_y\ \mathfrak{R}\ E\ j_1$ (16.0.39) $\mathfrak{L}$
44	25	$a\ b\ c\ m\ o\ r\ m_x\ g\ t\ x\ n\ \beta\ q\ \epsilon\ \mu\ \kappa\ \alpha\ d\ M\ U\ Q$
45	3	$a\ m\ o\ l\ m_x\ g\ t\ x\ v\ u\ \xi\ n\ \beta\ Q\ \nu\ \epsilon\ \lambda\ \mu\ i\ \alpha\ \mathfrak{d}$
46	B2	$m\ o\ r\ m_x\ g\ t\ \nu\ \epsilon\ \lambda\ \mu\ M\ i\ \alpha\ d\ \mathfrak{d}\ \pi\ \epsilon'\ \mu'\ \mu_1\ h_1\ f_1$
47	41	$m\ o\ r\ \nu\ \epsilon\ \lambda\ \mu\ \kappa\ B\ M\ i\ \mathfrak{d}\ \pi\ \mathfrak{j}\ \mathfrak{z}\ \delta\ \theta\ \dot{\rho}\ \mathfrak{f}\ \mathfrak{x}$
48	55	$a\ b\ m\ o\ m_x\ g\ t\ x\ u\ \beta\ q\ \epsilon\ \lambda\ \mu\ \kappa\ \mathfrak{S}\ \mathfrak{p}\ \mathfrak{o}\ \mathfrak{m}\ \mathfrak{x}\ \mathfrak{T}$
49	65	$a\ c\ m\ o\ l\ r\ m_x\ g\ t\ \sigma\ \phi\ x\ u\ n\ \beta\ Q\ U\ \nu\ \epsilon\ \lambda\ \mu\ i\ \alpha\ \mathfrak{d}$
50	B9	$a\ b\ m\ o\ l\ m_x\ g\ x\ \mathfrak{H}\ n\ \beta\ Q\ U\ \epsilon\ \lambda\ \mu\ \alpha\ d\ \pi\ m_1\ \mathfrak{h}\ \mathfrak{K}\ f_1$
51	33	$a\ b\ c\ m\ o\ m_x\ g\ x\ n\ q\ \nu\ \epsilon\ \lambda\ \mu\ B\ i\ \alpha\ \pi\ m_1\ e_1\ 6\ \mathfrak{T}\ i_1$
52	36	$a\ c\ m\ o\ m_x\ g\ x\ v\ u\ \mathfrak{H}\ \xi\ \Sigma\ n\ \beta\ q\ \nu\ \epsilon\ \lambda\ \mu\ \kappa\ \pi\ \mathfrak{M}$ (12.0.25)
53	51	$a\ c\ m\ o\ r\ m_x\ g\ t\ \sigma\ x\ v\ u\ \beta\ Q\ U\ \lambda\ \mu\ \kappa\ \omega\ \pi\ \mathfrak{T}\ \mathfrak{U}\ \mathfrak{B}\ \mathfrak{O}$
54	57	$b\ c\ m\ o\ r\ m_x\ g\ t\ \sigma\ x\ v\ u\ n\ \beta\ Q\ \nu\ \epsilon\ \lambda\ \mu\ M\ i\ \alpha\ \mathfrak{d}\ \pi$
55	10	$a\ b\ c\ m\ o\ m_x\ g\ t\ x\ v\ u\ n\ \beta\ Q\ U\ \nu\ \epsilon\ \lambda\ \mu\ M\ i\ \alpha\ d\ \pi\ \mathfrak{s}\ \delta\ \mathfrak{j}\ \mathfrak{r}\ g_1\ \mathfrak{Y}\ l_1\ p\ \mathfrak{L}\ \mathfrak{l}$ (16.0.39)

ZONES.

The several prominent zones present on datolite have been discussed by Görgey and Goldschmidt, using the Goldschmidt orientation. It is of interest here to compare some of the more prominent zones in the Dana orientation with the normal series according to the law of complication of Goldschmidt with the especial purpose of criticising the new forms here described for this mineral. The method is useful indeed in checking up the indices assigned to new forms. This is illustrated by the fact that, although preceding portions of this paper had been completed previous to the analysis of the zones, the indices of at least two forms listed as new were shown by this method to be incorrect. These two have been corrected. The zones discussed are those shown on the gnomonic projection, plate 1 of this paper. The excellent work of Schaller [5] has been a most useful guide in this interpretation.

Zone No. 1.—Prism zone.

Symbol $\frac{h}{k}$.

Form	*b* 010	*θ* 140	*l* 130	ℭ 380	*o* 120	*r* 230	*N* [340][a]	*m* 110	*e* [320]	*s* 530	Δ [210]	*η* [410]	*a* 100
Symbol	0	1/4	1/3	3/8	1/2	2/3	3/4	1	3/2	5/3	2	4	∞
N_4	0	1/4	1/3	2/5	1/2 3/5	2/3	3/4	1	3/2	5/3	2 5/2	3 4	∞

[a] Forms bracketed are known for the species but were not observed during the present study and are not shown on the gnomonic projection.

This zone is normal with one form extra and four missing. The extra form is the one here listed as new, 380. In place of this the normal series requires the form 2/5, or 250. The form 380 is considered to be well founded, however, by its clean-cut face and sharp signal. That this is not 250 is shown by the following comparison of angles:

$$\left.\begin{array}{l} 250\ \varphi = 32^\circ\ 13' \\ 380\ \varphi = 30^\circ\ 35' \end{array}\right\} \text{Measured } \varphi = 30^\circ\ 05'.$$

Zone No. 2.—Clinodome zone.

Symbol $\frac{k}{l}$.

Form	*c* 001	m_z [0.1.10]	Ω [018]	*σ* 014	*t* 013	*g* 012	*h* 023	m_y 067	m_x 011	ℑ 043	*S* [021]	*b* 010
Symbol	0	1/10	1/8	1/4	1/3	1/2	2/3	6/7	1	4/3	2	∞
N4	0	....	....	1/4	1/3 2/5	1/2 3/5	2/3	3/4	1	4/3 3/2 5/3	2 5/3 3 4	∞

This zone is normal, with eight forms missing and three extra. Of the extra forms (1/10) and (1/8) were not observed by the writer, although 018 is reported from this locality by Whitlock. (067)

[5] Schaller, W. T., Mercury Minerals of Terlingua, Texas. U. S. Geol. Survey Bull. 405, 1909.

described by Kraus and Cook was doubtfully confirmed by one face measured on a single crystal. The only form listed here as new in this zone is 4/3, or 043, which fits in the normal series.

Zone No. 3.—Positive orthodome zone.

(001) : (100). Symbol $\frac{h}{l}$.

Form	c 001	p 106	u 104	v 103	𝔖 308	𝔏 205	vic. 12.0.25	x 102	I 203	f 304	φ 101	𝔐 403	s 302	a 100
Symbol	0	1/6	1/4	1/3	3/8	2/5	12/25	1/2	2/3	3/4	1	4/3	3/2	∞
N_4	0	.....	1/4	1/3	.....	2/5	....	1/2 3/5	2/3	3/4	1	4/3	3/2 5/3 2 5/2 3 4	∞

This zone is then normal, with three forms extra and six forms missing. Of the extra forms (106), listed in Goldschmidt's Winkeltabellen, was observed as one narrow and etched face. The form 308, first described by Görgey and Goldschmidt from this locality, was many times confirmed and is well established. (12.0.25), admittedly vicinal, may be ignored. The new form (403) in this zone is normal, and being entirely probable may be regarded as established, although it was seen as only a single narrow face.

Zone No. 3b.—Negative orthodome zone.

(001) : (1̄00) Symbol $\frac{-h}{l}$.

Form	c 001	a [1̄01]	ξ 1̄02	g [3̄04]	u 1̄01	Σ 3̄02	z [2̄01]	z [7̄02]	[1̄1̄.0.2]	a 1̄00
Symbol	0	1/4	1/2	3/4	1	3/2	2	7/2	11/2	∞
N_4	0	1/4 1/3 2/5	1/2	3/4	1 4/3	3/2 5/3	2 5/2	3 4	....	∞

The zone is normal, with nine forms missing and two extra. Of the extra forms neither was found by the writer nor were any new forms listed by the writer in this zone.

Zone No. 4a.—Positive pyramid zone.

(001) : (110) Symbol $\frac{h}{l}$.

Form	c 001	[1.1.18]	Z [116]	𝔣 [115]	W [114]	L [113]	Λ 112	n 111	i 11.11.10	δ [221]	𝔖 331	m 110
Symbol	0	(1/18)	(1/6)	(1/5)	1/4	1/3	1/2	1	11/10	2	3	∞
N_4	0	....	....	......	1/4	1/3 2/5	1/2	3/5 2/3 3/4 1 4/3	3/2 5/3	2 5/2	3 4	∞

The zone is normal, with four forms extra and nine missing. Of the extra forms 11/10 is here listed as new. It is obviously a disturbed or vicinal form. None of the other extra forms were encountered.

Zone No. 4b.—Negative pyramid zone.

$(001):(\bar{1}10)$ Symbol $\frac{-h}{l}$.

Form	c	ω	π	$\mathfrak{G}$	μ	μ_1	λ	ϵ	$\mathfrak{d}$	ν	P	m
	001	$\bar{1}16$	$\bar{1}15$	$\bar{2}29$	$\bar{1}14$	$\bar{2}27$	$\bar{1}13$	$\bar{1}12$	$\bar{2}23$	$\bar{1}11$	$\bar{3}32$	$\bar{1}10$
Symbol	0	1/6	1/5	2/9	1/4	2/7	1/3	1/2	2/3	1	3/2	∞
2v	0	1/3	2/5	4/9	1/2	4/7	2/3	1	4/3	2	3	∞
N_4	$0_{\frac{1}{4}}$	1/3	2/5	....	1/2	....	2/3	$1_{\frac{3}{4}}$	$4/3_{\frac{3}{2}}$	${}_{\frac{5}{3}}\,2_{\frac{5}{2}}$	3_4	∞

The zone is normal, with six forms missing and two extra. Of the extra forms $(\bar{2}27)$, previously reported, was confirmed by one narrow and poor face while $(\bar{2}29)$, here listed as new was found on two crystals. Both are probably established though disturbed forms.

Zone No. 5a.—Positive pyramid zone.

$(011):(100)$. Symbol $\frac{h}{l}\cdot\ \frac{k}{l}=1$.

Form	m_x	Q	$\mathfrak{u}$	$\mathfrak{X}$	n	$\mathfrak{Z}$	$\mathfrak{D}$	a
	011	122	344	455	111	766	[211]	100
Symbol	0	1/2	3/4	4/5	1	7/6	2	∞
N_4	$0_{\frac{1}{4}\,\frac{1}{3}\,\frac{2}{5}}$	$1/2_{\frac{3}{5}\,\frac{2}{3}}$	3/4	....	$1_{4\,3}$	${}_{\frac{5}{2}\,\frac{5}{3}}$	$2_{\frac{5}{2}\,3\,4}$	∞

The zone is normal, though very incomplete. Two forms are extra, both of which are new. These are regarded as well founded through disturbed forms.

Zone No. 5b.—Negative pyramid zone.

$(011):(\bar{1}00)$. Symbol $\frac{-h}{l}\cdot\ \frac{k}{l}=1$.

Form	m_x	M	ν	$\mathfrak{u}$	$\mathfrak{y}$	a
	011	$\bar{1}22$	$\bar{1}11$	$\bar{2}11$	$\bar{8}11$	$\bar{1}00$
Symbol	0	1/2	1	2	8	∞
N_2	0	1/2	1	2	....	∞

The zone is normal, with no forms lacking and only one extra. The extra form $(\bar{8}11)$ observed independently by Gorgey and Goldschmidt, Ungemach, and the present writer, can be regarded as established.

Zone No. 6.—Negative pyramid zone.

$(013):(\bar{1}00)$. Symbol $\frac{h}{l}\cdot\ \frac{l}{k}=3$.

Form	t	$\mathfrak{p}$	$\mathfrak{R}$	λ	a
	$\bar{0}13$	$\bar{1}.10.30$	$\bar{1}26$	$\bar{1}13$	$\bar{1}00$
Symbol	0	1/30	1/6	1/3	∞
$3v$	0	1/10	1/2	1	∞
N_2	0	....	1/2	1_2	∞

The zone is normal, having the form $(\bar{1}.10.30)$, here listed as new an extra form.

Zone No. 7.—Pyramid zone.

(100) : (012) : ($\bar{1}$00). Symbol $\frac{h}{l} \cdot \frac{l}{k} = 2$.

Form	*a* 100	*q* 312	*w* 324	Λ 112	*g* 012	m $\bar{1}$.6.12	ϵ' $\bar{1}$48	h_1 $\bar{3}$.10.20	α $\bar{1}$24	ϵ $\bar{1}$12	*a* $\bar{1}$00
Symbol		3/2	3/4	1/2	0	1/12	1/8	3/20	1/4	1/2	∞

Dividing at 0 and reversing the first part gives:

Symbol	0		1/2		3/4	3/2		∞
N_3	0	1/3	1/2	2/3		3/2	2 3	∞

The first or positive portion of the zone is thus normal, with four forms missing but none extra. The second portion gives:

Symbol	0	1/12	1/8	3/20	1/4	1/2	∞
4v	0	1/3	1/2	3/5	1	2	∞

Dividing at 1:

Symbol	0		1/3		1/2	3/5		1
$\frac{v}{1-v}$	0		1/2		1	3/2		∞
N_3	0	1/3	1/2	2/3	1	3/2	2 3	∞

The zone is then normal with no extra forms. This is especially gratifying, since new forms with high indices, such as $\bar{1}$–6–12 and $\bar{3}$.10.20, fit in very well.

Zone No. 8.—Pyramid zone.

(100) : (023) : ($\bar{1}$00). Symbol $\frac{h}{l} \cdot \frac{k}{l} = \frac{2}{3}$.

Form	*a* 100	*U* 123	*h* [023]	*i* $\bar{1}$23	𝔟 $\bar{2}$23	Φ $\bar{5}$46	*a* $\bar{1}$00
Symbol		1/3	0	1/3	2/3	5/6	∞

Dividing at 0 and considering the last part:

Symbol	1/3	3/3	5/6	∞
$\frac{3v}{2}=$	1/2	1	5/4	∞
N_2	1/2	1	2	∞

This zone is thus normal, with 5/4 or $\bar{5}$46 extra. This form, described by Ungemach and confirmed by the present investigation, may be considered to be well established.

Zone No. 9.—Pyramid zone.

(100) : (043) : ($\bar{1}$00). Symbol $\frac{h}{l} \cdot \frac{k}{l} = \frac{4}{3}$.

Form	*a* 100	𝔗 343	𝔍 043	t $\bar{1}$.20.15	𝔣 $\bar{1}$42	ϭ $\bar{3}$43	*a* $\bar{1}$00
Symbol	∞	1	0	1/15	1/3	1	∞

Dividing at 0 and considering the last part:

	0	1/15	1/3	1	∞
$3v$	0	1/5	1	3	∞

Dividing at 1:

	0	1/5	1		1	3	∞
$\frac{v}{1-v}$	0	1/4	∞	$v-l$	0	2	∞
$4v$	0	1	∞	$v/2$	0	1	∞
N_1	0	1	∞	N_1	0	1	∞

Zone No. 10.—Pyramid zone.

(100) : (021) : ($\bar{1}00$). Symbol $\frac{h}{l}\cdot\ \frac{k}{l}=2.$

Form	a 100	β 121	S [021]	ρ' $\bar{2}.10.5$	i $\bar{1}42$	3 $\bar{2}63$	B $\bar{1}21$	x_1 $\bar{3}42$	a $\bar{1}00$
Symbol		1	0	2/5	1/2	2/3	1	3/2	∞

Dividing at 0 and considering the second part:

0 2/5 1/2 2/3 1 3/2 ∞.

Dividing at 1:

	0			2/5	1/2		2/3		1
$\frac{v}{1-v}$	0			2/3	1		2		∞
N_3	0	1/3	1/2	2/3	1	3/2	2	3	∞

The zone thus dissected is shown to be normal. It contains the unusual new form $\bar{2}.10.5$.

Zone No. 11.—Oblique pyramid zone.

(110) : (012) : (110). Symbol $\frac{k}{l}\cdot$

Form	m 110	Q 122	$\mathfrak{D}$ 134	g 012	$\mathfrak{o}$ $\bar{1}.6.14$	μ' $\bar{1}.4.10$	E $\bar{1}38$	$\mathfrak{N}$ $\bar{1}26$	μ $\bar{1}14$	ϵ $\bar{1}02$	m $\bar{1}10$
Symbol	∞	1	3/4	1/2	6/14	2/5	3/8	2/6	1/4	0	∞

Reversing:

	0	1/4	1/3	3/8	2/5	3/7	1/2	3/4	1	∞
$2v$	0	1/2	2/3	3/4	4/5	6/7	1	3/2	2	∞

Dividing at 1:

	0		1/2		2/3	3/4	4/5	6/7	1
$\frac{v}{1-v}$	0		1		2	3	4	6	∞
$v/2$	0		1/2		1	3/2	2	3	∞
N_3	0	1/3	1/2	2/3	1	3/2	2	3	∞

Zone No. 12.—Positive pyramid zone.

(101) : (010). Symbol $\frac{k}{l}\cdot\ \frac{h}{l}=l.$

Form	o 101	n 111	$\mathfrak{R}$ 454	$\mathfrak{T}$ 343	β 121	b 010
Symbol	0	1	5/4	4/3	2	∞
v-1		0	1/4	1/3	1	∞
$2v$		0	1/2	2/3	2	∞
N_3		0 1/3	1/2	2/3 1 3/2	2 3	∞

This zone, though incomplete, is normal with no extra forms.

Zone No. 13.—Positive pyramid zone.

$(010) : (102) : (0\bar{1}0)$. Symbol $\frac{k}{l} \cdot \frac{l}{h} = 2$.

Form	*x* 102	Λ 112	*Q* 122	𝔓 192	𝔔 1.10.2	𝔑 1.12.2	*b* 010
Symbol	0	1/2	1	9/2	5	6	∞

Dividing at 1 and considering the last part:

	1	9/2	5	6	∞
$v-1$	0	7/2	4	5	∞
$2v$	0	7	8	10	∞
$v-6$	0	1	2	4	∞
$v/2$	0	1/2	1	2	∞
N_2	0	1/2	1	2	∞

This zone is also entirely normal.

Zone No. 14.—Negative pyramid zone.

$(\bar{1}06) : (\bar{1}16) : (010)$. Symbol $\frac{k}{l} \cdot \frac{l}{h} = 6$.

Form	[$\bar{1}06$]	ω $\bar{1}16$	j_1 $\bar{5}.6.30$	𝔑 $\bar{1}26$	*b* 010
Symbol	0	1/6	1/5	1/3	∞
$2v$	0	1/3	2/5	2/3	∞
$\frac{v}{1-v}$	0	1/2	2/3	2	∞
N_3	0 $\frac{1}{3}$	1/2	2/3 1 $\frac{3}{2}$	2 3	∞

This zone is normal.

Zone No. 15.—Negative pyramid zone.

$(010) : (102) : (010)$. Symbol $\frac{k}{l} \cdot \frac{l}{h} = 2$.

Form	ξ $\bar{1}02$	ϵ $\bar{1}12$	*M* $\bar{1}22$	𝔯 $\bar{1}32$	𝔦 $\bar{1}42$	*b* 010
Symbol	0	1/2	1	3/2	2	∞
N_3	0 $\frac{1}{3}$	1/2	$\frac{2}{3}$ 1	3/2	2 3	∞

This zone though incomplete is entirely normal.

Zone No. 16.—Negative pyramid zone.

$(010) : (101) : (010)$. Symbol $\frac{k}{l} \cdot \frac{h}{l} = 1$.

Form	H $\bar{1}01$	ν $\bar{1}11$	β $\bar{3}43$	l_1 $\bar{3}53$	*B* $\bar{1}31$	*b* 010
Symbol	0	1	4/3	5/3	2	∞
$v-1$		0	1/3	2/3	1	∞
N_3		0	1/3	$\frac{1}{2}$ 2/3	1 $\frac{3}{2}$ 2 3	∞

This zone is normal though incomplete.

Zone No. 17.—Negative pyramid zone.

(010) : (302) : (010). Symbol $\frac{k}{l} \cdot \frac{h}{l} = \frac{3}{2}$.

Form	Σ	*P*	x_1	g_1	*b*
	$\bar{3}02$	332	$\bar{3}12$	362	010
Symbol	0	3/2	2	3	∞
$v-1$	0	1/2	1	2	∞
N_2	0	1/2	1	2	∞

This zone is entirely normal and is complete.

Zone No. 18.—Diagonal zone.

(110) : (101) : (011) : ($\bar{1}$10). Symbol $\frac{k}{l}$.

Form	*m*	*q*	φ	Λ	*U*	𝔇	m_x	𝔩	𝔯	*B*	*m*
	110	312	101	112	123	134	011	$\bar{1}$43	$\bar{1}$32	$\bar{1}$21	$\bar{1}$10
Symbol	∞	1/2	0	1/2	2/3	3/4	1	4/3	3/2	2	∞
N_4	......	......	$0_{\frac{1}{4}\,\frac{1}{3}\,\frac{2}{5}}$	1/2	$_{\frac{3}{5}}$ 2/3	3/4	1	4/3	3/2 $_{\frac{5}{3}}$	$2_{\frac{5}{2}\,3\,4}$	∞

This zone though incomplete is normal.

Zone No. 19.—Diagonal zone.

(120) : (102) : (011) : (120). Symbol $\frac{h}{l}$.

Form	*c*	*n*	𝔥	*w*	*x*	m_x	𝔰	ϑ		*o*
	120	111	768	324	102	011	$\bar{1}.1\bar{2}.10$	$\bar{2}\bar{9}5$	$\bar{1}\bar{4}2$	$\bar{1}\bar{2}0$
Symbol	∞	1	7/8	3/4	1/2	0	$\bar{1}$/10	$\bar{2}$/5	$\bar{1}$/2	∞

Dividing at 0 and reversing the first part:

	0		1/2	3/4	7/8	1	∞
$2v$	0		1	3/2	7/4	2	∞
N_2	0	$\frac{1}{2}$	1			2	∞

This zone is normal with 2 forms missing, and 1 form, 768, which is here listed as new, extra. The second part of the original zone is:

	0	1/10		2/5	1/2	∞
$5v$	0	1/2		2	5/2	∞
N_2	0	1/2	1	2		∞

Though incomplete this portion is normal.

Zone No. 20a.—Positive vertical pyramid zone.

(001) · (120). Symbol $\frac{k}{l} \cdot \frac{h}{k} = \frac{1}{2}$,

Form	*O*	β	*Q*	*U*	*c*
	120	121	122	123	001
Symbol	∞	2	1	2/3	0
N_2	∞_3	2	$_{\frac{3}{2}}1$	2/3	$_{\frac{1}{2}\,\frac{1}{3}}$ 0

This zone is normal with 4 forms missing.

Zone No. 20 b.—Negative vertical pyramid zone.

(001) : ($\bar{1}20$). Symbol $\frac{-k}{l}$.

	c	$\mathfrak{R}$	α	i	M	B	g_1	f_1	o
Form	001	$\bar{1}26$	$\bar{1}24$	$\bar{1}23$	$\bar{1}22$	$\bar{1}21$	$\bar{3}62$	$\bar{3}61$	$\bar{1}20$
Symbol	0	1/3	1/2	2/3	1	2	3	6	∞
N_3	0	1/3	1/2	2/3	$1\frac{3}{2}$	2	3	....	∞

The zone is normal with only one form missing and one extra. The extra form is $\bar{3}61$ which is here described as new.

Zone No. 22.—Diagonal zone.

(120) : (011) : ($\bar{1}02$) : ($\bar{1}\bar{2}0$). Symbol $\frac{h}{l}$.

	o	mx	d	α	λ	ξ	Φ	ν	x_1	o
Form	120	011	$\bar{1}35$	$\bar{1}24$	$\bar{1}13$	$\bar{1}02$	$\bar{5}46$	$\bar{1}11$	$\bar{3}42$	$\bar{1}\bar{2}0$
Symbol	∞	0	1/5	1/4	1/3	1/2	5/6	1	3/2	∞

Dividing at 1:

	0	1/5	1/4	1/3	1/2	5/6	1
$\frac{v}{1-v}$	0	1/4	1/3	1/2	1	5	∞
$2v$	0	1/2	2/3	1	2	10	∞
N_3	0 $\frac{1}{4}$	1/2	2/3	1 $\frac{3}{2}$	2 3		∞

The zone is normal except for the form $\bar{5}46$ which does not fit in.

Zone No. 23.—Vertical zone.

(140) : (001) : (140). Symbol $\frac{k}{l}$.

	Θ	c	μ′	ε′	f	j	Θ
Form	140	001	$\bar{1}.4.10$	$\bar{1}48$	$\bar{1}43$	$\bar{1}42$	$\bar{1}40$
Symbol	∞	0	2/5	1/2	4/3	2	∞
N_4	....	0 $\frac{1}{4}$ $\frac{1}{3}$	2/5	1/2 $\frac{3}{5}$ $\frac{2}{3}$ $\frac{3}{4}$ 1	4/3	$\frac{3}{2}$ $\frac{5}{3}$ 2 $\frac{5}{2}$ 3 4	∞

This zone is normal though incomplete.

EXPLANATION OF PLATES.

Plate 103.

Gnomonic projection of forms observed on datolite from Westfield showing distribution in zones. The zone numbers correspond to those used in the discussion of zones according to Goldschmidt's Law of Complication.

Plate 104.

Datolite crystals from Westfield, Massachusetts. Large crystals showing type I habit with characteristic mutual interference surfaces and molds of anhydrite crystals. Crystals lightly coated with ammonium chloride. Natural size. Cat. No. 94253, U.S.N.M.

Plate 105.

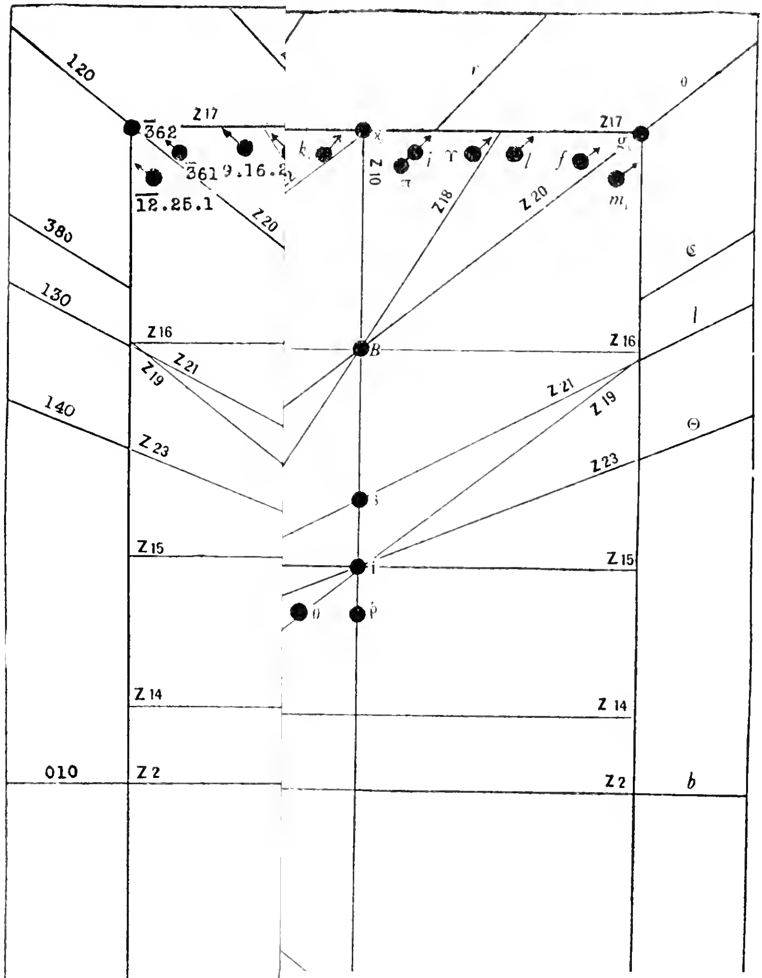
Datolite crystals from Westfield, Massachusetts. Group of large crystals showing characteristic habit and mode of aggregation. The large crystal in the center of the group shows characteristic parallel growth. Crystals natural size. Lightly coated with ammonium chloride. Cat. No. 86002, U.S.N.M. Gift of C. S. Bement.

Plate 106.

Datolite crystals from Westfield, Massachusetts.

Upper. Group of crystals of Type 4 habit. The crystal figure 24 came from this group. Coated with ammonium chloride. 1½ times natural size.

Lower. Crystals lining cavity in vein of granular datolite. Coated with ammonium chloride. 1½ times natural size.

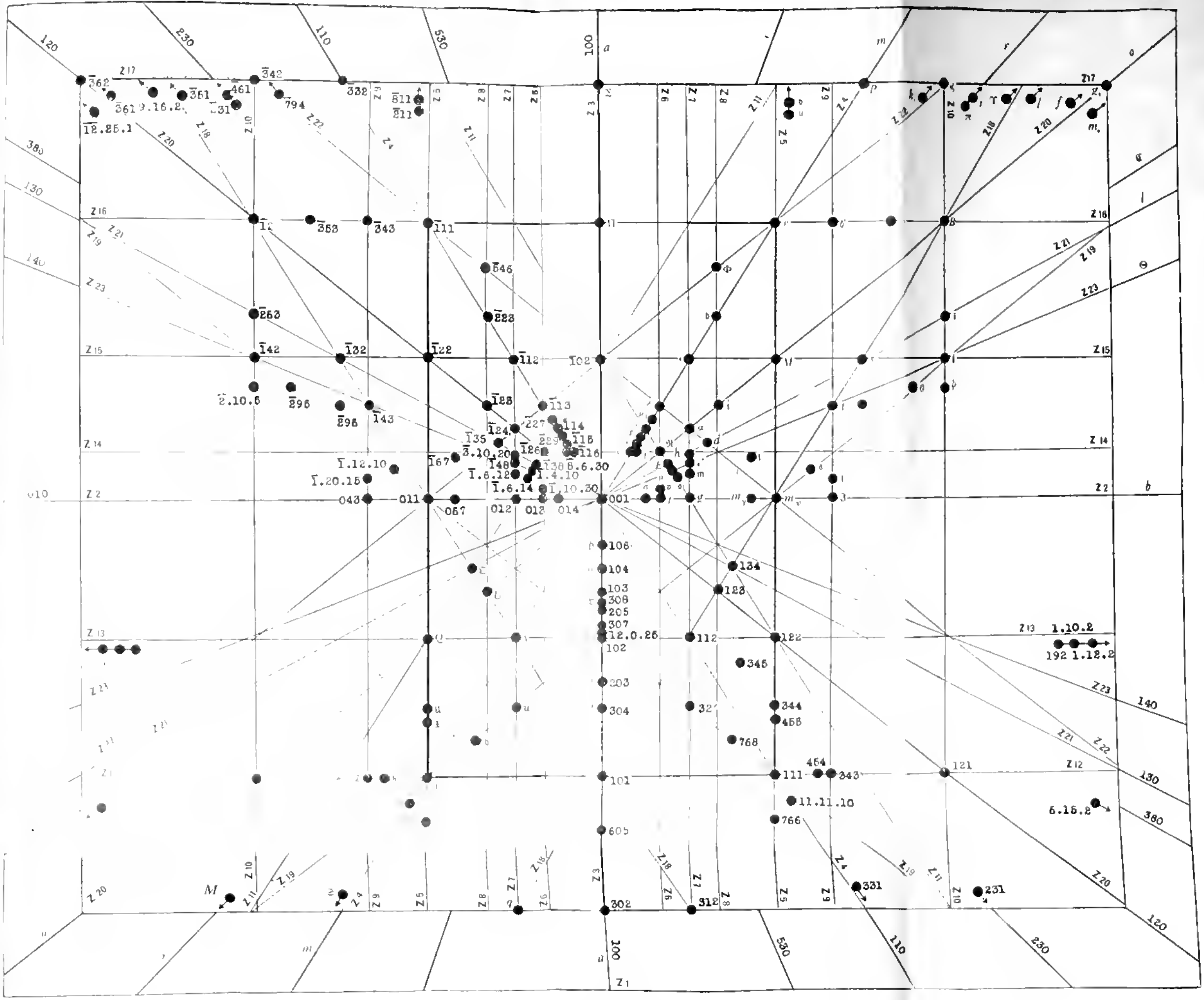


DATOLITE CRYSTALS FROM WESTFIELD, MASSACHUSETTS.

FOR EXPLANATION OF PLATE SEE PAGE 539

DATOLITE CRYSTALS FROM WESTFIELD, MASSACHUSETTS.

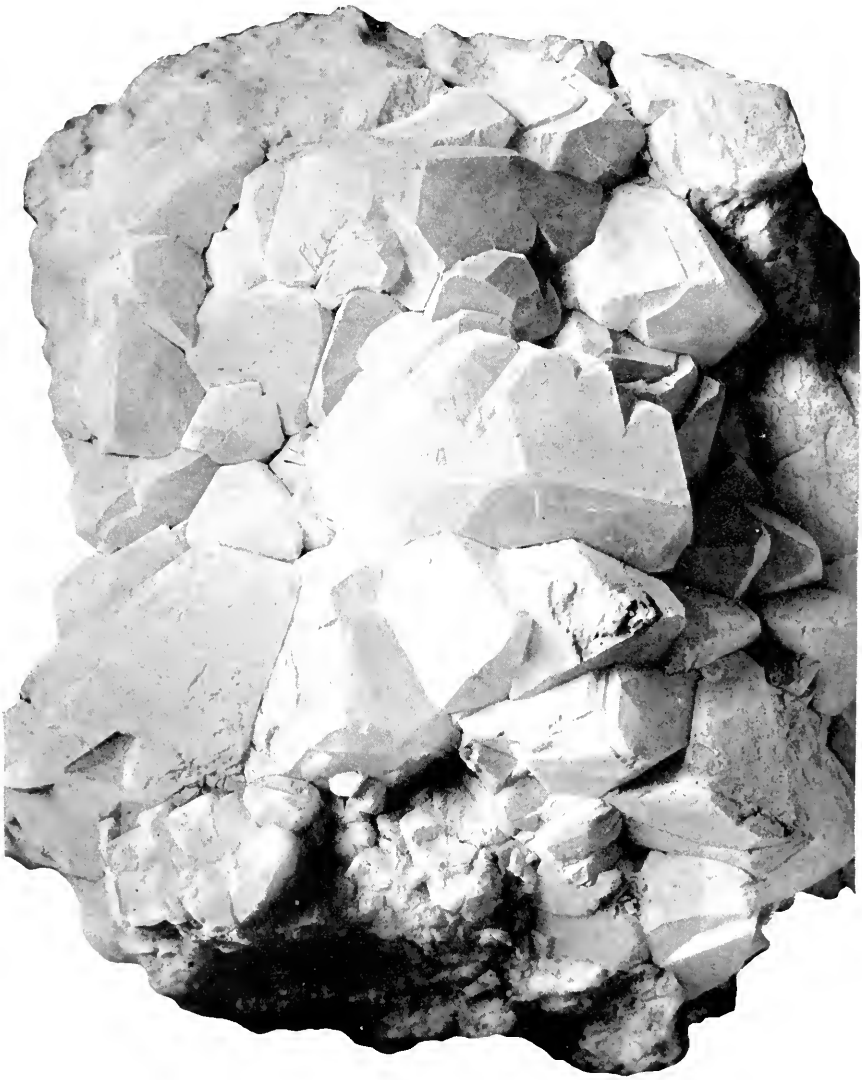
FOR EXPLANATION OF PLATE SEE PAGE 539.



Gnomonic Projections in Dana Orientation Showing Forms and Zones Occurring on Datolite from Westfield, Massachusetts.

For explanation of plate see page 639.

27177—21 (To face page 539.)



DATOLITE CRYSTALS FROM WESTFIELD, MASSACHUSETTS.

FOR EXPLANATION OF PLATE SEE PAGE 539

DATOLITE CRYSTALS FROM WESTFIELD, MASSACHUSETTS.

FOR EXPLANATION OF PLATE SEE PAGE 539

TWO NEW GENERA OF NEMATODES, WITH A NOTE ON A NEGLECTED NEMATODE STRUCTURE.

By Maurice C. Hall,

Senior Zoologist, United States Bureau of Animal Industry.

In this paper two species are removed from two large genera, in which they do not belong, for the sake of accuracy and convenience, the present names being erroneous and misleading, and the species of such economic interest as to make accurate naming desirable. A very distinctive structure, present in one of these worms, has been found to be frequently present in nematodes, but apparently overlooked or misinterpreted. It is given the name of "telamon" in this paper.

One of the species for which a new genus is necessary is *Filaria osleri* from the trachea and bronchi of the dog. This species was originally called *Strongylus canis bronchialis* by Osler in 1877, but as it has none of the distinctive characters of *Strongylus* in even the broad sense in which that term was used by the older zoologists, and as it has a trinomial name instead of a binomial name, it was renamed *Filaria osleri* by Cobbold in 1879. At the present time there are over 900 specific names and variations in the genus *Filaria*, and *F. osleri* is so remote from the type species, *F. martis* Gmelin, 1790, from the mink, that the worm ought not to be placed in the superfamily Filarioidea. I have been unable to obtain specimens of this worm for study, and the existing descriptions are unsatisfactory, but the fact that the worm has so little in common with *Filara* makes it advisable to remove it from this genus. As it does not seem to fit any existing genus, I am proposing a new genus for it, naming the genus in honor of the late Dr. William Osler, who discovered the worm and after whom the species is named. Tentatively the worm is referred to the superfamily Spiruroidea.

OSLERUS, new genus.

Generic diagnosis.—Spiruroidea: Small worms (up to 1.5 cm. long according to Rabe). Mouth structure uncertain; probably without distinct lips (according to Osler the mouth is simple and the conical head is without papillae. Milks agrees with Neumann's description of it as having two or three prominences or concentric lips, behind which there are three papillae; according to Blumberg, the head bears several papillae; according to Rabe, the mouth is surrounded by two or three concentric folds, and near it there is one large eminence with two smaller ring-shaped ones behind it). The male has two unequal yellowish spicules. (The inequality is not very great, as is the case in species of the genus *Filaria*, since the type species of *Oslerus* has spicules 48 and 56 μ long). The posterior extremity of the male is bluntly rounded, according to Rabe; somewhat pointed, according to Osler; or somewhat pointed and slightly bent, according to Blumberg. The female has a rounded tail end and the vulva is very close to the anus (Rabe says just anterior to the anus, and Milks agrees with this; Blumberg says 20 μ anterior of the anus; and Osler says the anus and vulva open to the exterior by a cloaca, or common channel). The worms are ovoviviparous, the eggs hatching in the uterus, giving rise to embryos which are blunt anteriorly and pointed posteriorly.

The only known species occurs in the trachea and bronchi, and apparently in the pulmonary parenchyma also, of the dog.

Type species.—*Filaria osleri* Cobbold, 1879.

The fact that this worm is ovoviviparous would suggest an affinity with the Filarioidea. Its location in the lining of the respiratory tract and the presence of the vulva directly in front of the anus excludes it from the Filarioidea and relates it to the Spiruroidea near the Gongyloneminae, which also have the vulva close to the anus. The fact that it is ovoviviparous does not fit in well with the known members of the Spiruroidea, but as there is more or less variation in the matter of depositing eggs or bearing embryos within the limits of the larger groups, this may be regarded as a variation within the reasonable definition of the superfamily, the worm being regarded as an aberrant development.

This worm is designated as *Oslerus osleri* (Cobbold, 1879) Hall, 1921.

The other species for which a new generic name is necessary is *Strongylus rubidus* Hassall and Stiles, 1892, from the stomach of swine.

This species belongs in the superfamily Strongyloidea, but not in the genus *Strongylus*. This genus in the old extended sense contains at present over 350 specific names and variations of one sort and another, and has been restricted in its accurate meaning to forms congeneric with its type species, *Strongylus equinus* Mueller, 1784, from the large intestine of Equidae. The superfamily Strongyloidea is usually divided into the families Strongylidae, Trichostrongylidae, and Metastrongylidae. The genus *Strongylus* is the type genus of the family Strongylidae. *Strongylus rubidus* belongs in the family Trichostrongylidae. It has affinities with such genera of Trichostrongylidae as *Cooperia* Ransom, 1907, *Ostertagia* Ransom, 1907, and *Ornithostrongylus* Travassos, 1914, but it differs from these genera in certain respects which appear to be of generic value. The generic name *Hyostrongylus* is therefore proposed for it, with the following diagnosis:

HYOSTRONGYLUS, new genus.

Generic diagnosis.—Trichostrongylinae: Male bursa with small but distinct dorsal lobe and well-developed lateral lobes. (There is a distinct bulla just anterior of the bursa in the type species.) The latero-ventral ray is larger than the ventro-ventral ray, and its tip is turned back towards the ventro-ventral. The externo-lateral and medio-lateral rays diverge slightly, the postero-lateral ray diverging more widely from the medio-lateral. The short externo-dorsal ray arises at the base of the dorsal ray and lies about midway between the postero-lateral rays and the short dorsal ray. The dorsal ray bifurcates near its tip, and has also two small branches at about two-thirds of the distance from the base. Two equal spicules (120 μ long by 20 μ wide anteriorly in the type species), tapering to a point, with a wavy ridge running the length of the spicule and supporting a curved membranous portion, which terminates in a second point. Posterior of the position usually occupied by these spicules in the body is a narrow brown gubernaculum (60 μ long in the type species), situated in the dorsal wall of the cloaca and terminating by a colorless connection in a brown, oblong structure. Ventral of this is a structure (fig. 1), readily seen in fresh material, but so transparent as to be difficult to detect in glycerine jelly mounts or alcoholic material. This structure has a central portion shaped like a spur or a wishbone, situated in the ventral wall of the cloaca near its aperture, and with the point of the spur extending anteriorly; the two posterior points of the spur turn dorsally into the lateral walls of the cloaca and then extend anteriorly as flattened curved plates in the lateral walls of the cloaca. This structure I have named the *telamon*, a term of Greek origin used in architecture for an ornamental supporting structure. In the female worm the tail is rounded, not mucronate; the anus is very near the posterior end of the body and the vulva is about one-sixth to one-seventh of the body length from the posterior end;

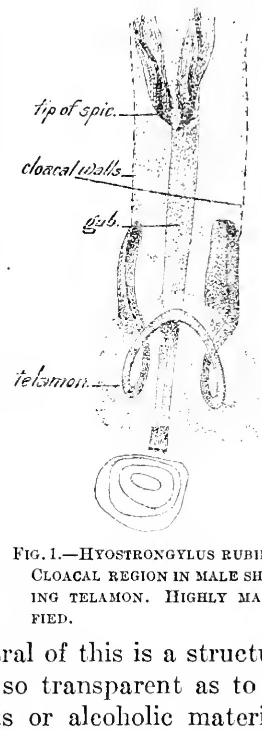


FIG. 1.—HYOSTRONGYLUS RUBIDUS. CLOACAL REGION IN MALE SHOWING TELAMON. HIGHLY MAGNIFIED.

the vulva is a long, narrow transverse slit, sometimes slightly salient. There are a very short vagina and two divergent ovejectors. Eggs are elliptical, comparatively thin-shelled, and segmenting when deposited.

The only known species occurs in the stomach of swine.

Type species.—*Strongylus rubidus* Hassall and Stiles, 1892. This worm is designated as *Hyostrongylus rubidus* (Hassall and Stiles, 1892) Hall, 1921. Travassos, in an undated reprint which has just come to hand, puts *S. rubidus* in the genus *Ostertagia*, but this species lacks the accessory bursal membrane characteristic of species of *Ostertagia*.

The type species, *Hyostrongylus rubidus*, has already been described by Hassall and Stiles (1892) in their original report on this worm, but the following point should be noted in regard to this species: In their original description, Hassall and Stiles figure the lateral portions of the telamon as filamentous. This is due to the fact that this structure is colorless and highly transparent, very difficult to find or study in alcoholic or mounted material, and they have drawn the outline and overlooked the included structure. It has been found advantageous in studying this structure to resort to staining with gentian violet. This is a very rapid, penetrating, and amenable stain, which can be used in water or any strength of alcohol, the specimens being subsequently mounted in glycerine jelly or in balsam. It clears rapidly and shows a tendency to decolorize, so it is perhaps better suited for staining material for immediate study than for permanent mounts. It stains the rays of the bursa and many of the internal organs very well, and also stains the accessory supporting structure which is designated as the telamon in such forms as *Hyostrongylus rubidus*. The so-called chitinous structures, such as the spicules, which are brown, do not take the stain, as a rule. Staining develops the fact that there is a transparent structure which connects the posterior end of the gubernaculum proper to the irregularly oval or quadrangular structure, which Hassall and Stiles regarded as the cloacal aperture, showing that these are parts of one structure. The quadrangular structure is too small to permit the passage of the spicules, even if it represented a true aperture. It is situated on the conical tip of the body, inside of the bursal cavity, and gives the tip of the body an appearance of being bifid or bicornate in profile when seen in some views. The cloacal aperture is ventral of this conical body termination and is very vague in outline, even in stained preparations.

The gubernaculum and telamon appear to be modifications of the cloacal wall, either by local thickening and condensation or by the deposition of material of suitable hardness for the protection of the cloacal walls from the passage of the sharp, pointed spicules, and for the direction of the spicules; they also support the cloacal wall and aperture, the spicules when these are extruded, and the genital cone in some cases; a platelike gubernaculum projecting from the dorsal wall of the cloaca may also aid in separating the spicules to form a suitable channel for the passage of the spermatozoa. Apparently the term *gubernaculum* should be restricted to the more or less longitudinal structure in the dorsal wall of the cloaca toward the anterior end, and the term *telamon* used for the supporting structure of variable form near the cloacal aperture.

The study of the telamon in the genus *Hyostrongylus* naturally led to an examination of other nematodes to ascertain if this structure was commonly present. A closely related worm, *Ornithostrongylus quadriradiatus* (Stevenson, 1904), Travassos, 1914, was first considered, since *H. rubidus* and *O. quadriradiatus* were both originally described from this laboratory, the Zoological Division of the Bureau of Animal Industry, with a description and figure of a peculiar structure in the cloaca. Examination showed that the star-shaped structure (fig. 2) figured by Stevenson is a telamon corresponding in its general location and evident function with the telamon in *H. rubidus*. An examination of species of the trichostrongyle genera *Cooperia, Ostertagia, Haemonchus, Graphidium,* and *Citellinema* shows what are apparently telamons in these genera, indicating that the telamon will be found generally present in the Trichostrongylidae. What appears to be a telamon is present among the Strongylidae in the genera *Bustomum* and *Oesophagostomum*. Among the Metastrongylidae it appears likely that what has been called the unpaired accessory structure in *Synthetocaulus pulmonalis* (=*Synthetocaulus commutatus*) must be regarded as a gubernaculum, and what have been called the paired accessory structures must be regarded as the elements of a telamon. The chitinous arc in which the body terminates in the genus *Synthetocaulus* may also prove to be an element of the telamon. An examination of a number of published figures of male nematodes indicates that what is apparently a telamon has been figured by various authors, sometimes without explanatory labeling and sometimes as a gubernaculum or part of the spicules. Outside of the Strongyloidea this structure appears to be present in some form in the Oxyuroida and perhaps in the Spiruroidea and Filarioidea. It appears to be best developed in forms having comparatively short spicules and poorly developed in forms having long linear spicules, so far as I have examined them. In its simplest form the telamon seems to be a ring-shaped structure, complete or incomplete, surrounding the cloacal aperture. This elementary form is modified by the

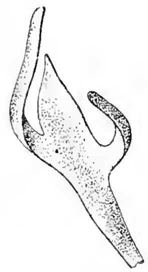


FIG. 2.—ORNITHOSTRONGYLUS QUADRIRADIATUS. TELAMON, × 470. FROM STEVENSON, 1904.

development of processes anteriorly along the walls of the cloaca and along the sides of the genital cone. It seems probable that this relatively hard and distinct structure with its wide variation in shape will prove of value as a generic and specific character. The material of which it is composed gives the impression of being very similar to that forming the wall of the sucker in such genera as *Heterakis*, where the sucker is strongly developed. What is apparently the same material appears to be present in the region of the vulva in the female, apparently serving the same purpose as a supporting structure. This seems to be a quite distinct structure in *Trichostrongylus*, and for the time being this may be referred to as the vulvar support.

THREE NEW MYRMECOPHILOUS BEETLES.

By William M. Mann.

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

The three species of ant-guests described below include a most bizarre ecitophile of uncertain systematic affinities, taken in Mexico in 1913, a species of the genus *Ecitophya* from Brazil and a *Fustiger* from Honduras, the latter the first of its subfamily from the Central American region.

Family STAPHYLINIDAE

Subfamily Aleocharinae

CREMATOXENINI, new tribe.

Near Myrmedoniini. Maxillary palpi, 4-jointed. Labial palpi, 3-jointed. Antennae 11-jointed, inserted in frontal foveae separated by a strong carina. Abdomen oval behind, in front constricted into an elongate, 2-jointed pedicel.

CREMATOXENUS, new genus.

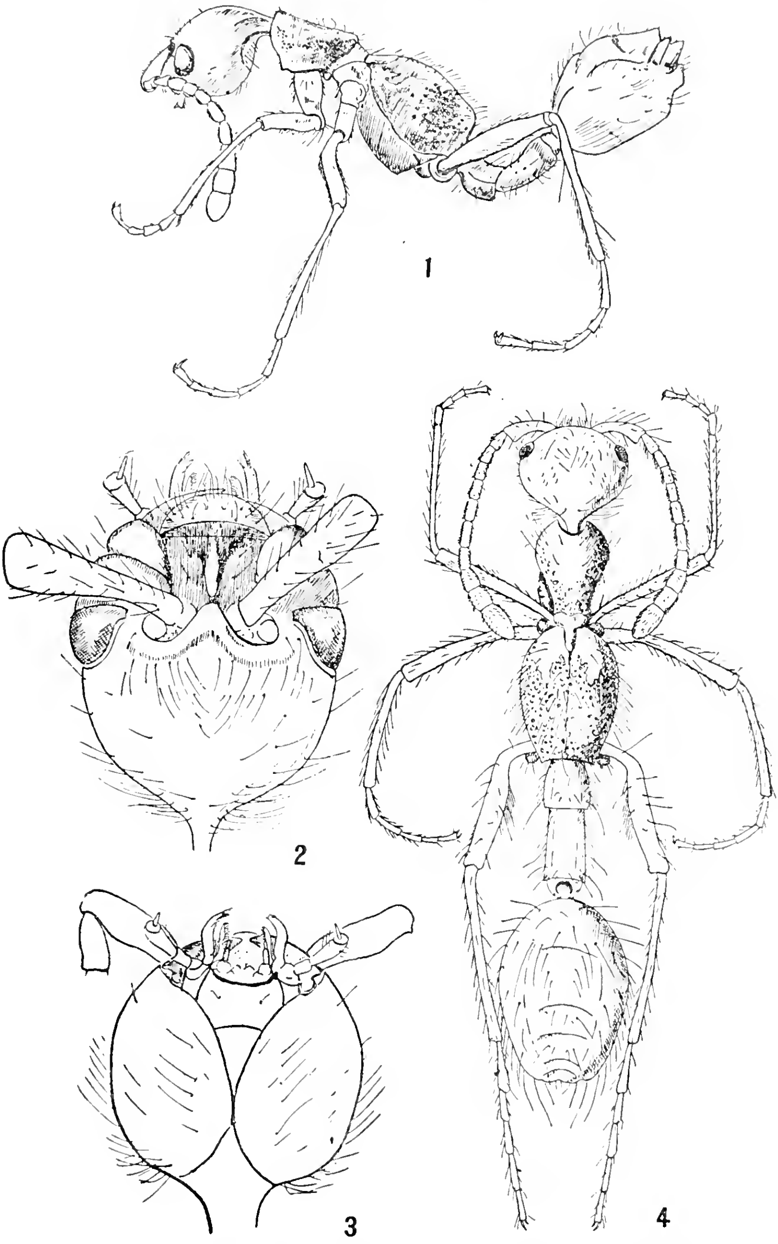
Moderate sized, myrmecoid species, strongly constricted between pronotum and elytra. Head very thick in profile, extended behind into a narrow neck. Eyes well developed, large and rather flat. Maxillary palpi large, 4-jointed; first joint short; second elongate, about half as long as the third, which is elongate, clavate, and circular and nearly plane at tip; forth joint short and awl-shaped. Maxillary lobes very large, the outer coarsely setigerous apically, the inner with a row of fine hairs on the inner margin. Mentum large, concave at anterior border. Ligula membraneous, apparently bilobed. Labial palpi 3-jointed; basal joint short and thick; second and third joints elongate, the second considerably thicker and nearly twice as long as the third. Antennae situated on front of head in large circular foveae which are separated by a strong, median carina; 11-jointed, first joint scapiform, as long as the following three joints together. Clypeus rather flat, nearly straight at anterior border. Mandibles small and arcuate. Pronotum elongate, constricted behind, inflexed nearly vertically at sides; in profile the anterior border is truncate and forms an angle with the ventral border. Prosternum in front of coxae strongly concave. Mesothorax very small, separated from metathorax by a strong constriction. Scutellum large, elongate, trilobed, the posterior lobe much longer than the others. Metanotum in profile convex in front, then shallowly concave, with a declivous posterior surface separated from the basal part by a rounded angle; from above, large, elongate, with convex sides and truncate posterior border. Elytra apparently fused, suture nearly obsolete, indicated by a faint impression; humeri subgibbous. Metasternum large and convex. Abdomen with a slender, two-jointed petiole, nearly as long as the posterior portion and separated from it by a constriction; posterior portion short and oval, dorsum with a feeble marginal line; segments indistinctly separated. Tarsi 4–5–5 jointed. Legs long and slender. Posterior femora strongly bent basally. Front and middle coxae large, elongate and contiguous; posterior coxae separated.

Genotype.—*Crematoxenus aenigma,* new species.

CREMATOXENUS AENIGMA, new species.

Length, 4 mm. Color dark brownish red, shining, the pronotum, metanotum, first segment of the petiole, the antennae, and legs less so than the remainder. Posterior portion of pronotum and the elytra (except the humeri) rather coarsely punctate, remainder of body and the head sparsely and very finely punctate; antennae densely punctate; legs shallowly punctate. Head, body, and legs with abundant fine, yellow hairs, long and erect ones mingled with others shorter and suberect. Antennal funiculus with shorter and stiffer curved hairs. Ventral surface of thorax finely punctate and sparsely pilose.

Head a little longer than broad, sides convex. Clypeus broad, very shallowly concave at anterior border. Labrum broader than long and broadly rounded in front. Antennal scape about as long as the following three joints together; funiculus slightly thickened apically, all joints longer than broad, the first and second subequal and longer and considerably more slender than the third and fourth; joints five to nine each slightly longer than the one preceding; terminal joint shorter than the two preceding joints together. Pronotum much narrower than head, broadest at anterior fourth where it is twice as wide as at base, sides in front strongly convex, behind feebly concave. Elytra together longer than broad and one-third broader than pronotum, convex at sides, truncate behind, the declivous posterior portion less than one-third as long as the basal part. First segment of petiole longer than broad, about half as long and distinctly broader than the second, second joint at base much smaller than the first, in profile half as thick in front as the first, gradually thickened posteriorly, from above but little broader behind than in front, and with nearly straight sides.



Figs. 1–4.—Crematoxenus aenigma. 1. Habitus drawing, from side, the petiole held as in the specimen. 2. Head, from above. 3. Head, from beneath. 4. Dorsal view, with the abdomen straightened. Drawn by A. G. Böving.

Type locality.—San Miguel, Hidalgo, Mexico.

Type.—Cat. No. 23936, U.S.N.M.

Host.—*Eciton* (*Acamatus*) *melanocephalum*, subspecies *xipe* Wheeler.

The ants, which formed the type series of the subspecies, were taken in the act of raiding a nest of *Pheidole vasleti*, var. *acolhua* Wheeler, and I picked up the beetle without noticing that it was different from the ants.

Unfortunately I took but one specimen of this anomalous species, and, not wanting to risk dissecting out the mouth parts, have ventured to describe it only as seen under the binocular. The mandibles are tightly closed and their structure can not definitely be made out. The segments on the posterior portion of abdomen are very indistinct. The first seems to be as long as the remaining ones together.

The actual systematic position of the species is doubtful. Because of the structure of the mouth parts and the tarsal formula I have placed it near the tribe Myrmedoniini in the Aleocharinae.

In general habitus, the structure of the antennae, the constricted thorax, the curious modification of the metanotum with its basal and declivous portions, the petiolate abdomen, and in pilosity and color *Crematoxenus* is quite the most ant-like beetle that I know of.

After I had failed to distinguish it, both in the field and when mounting up the type series of ants, two preparators at different times mounted ants from the vial and the beetle was noticed only when there remained but three ants, when the twisted appearance of the specimen attracted attention. Since mounting the specimen I have exhibited it to several entomologists as a new ant or as a new Proctotrypid without being contradicted.

The abdomen in the specimen is slightly elevated and probably is carried that way in life.

Tribe MYRMEDONIINI.

ECITOPHYA CONSECTA, new species.

Length, 5 mm. Form elongate, slender; color brown, opaque, densely and finely punctate throughout and with moderately long, suberect hairs on head, body, and appendages. Head three times as long as broad, broadest behind eyes and narrowed toward occipital border; strongly and broadly impressed from immediately back of eyes to half the distance to occipital border. Antennae about half as long as the body, somewhat thickened apically; the first joint about five times as long as the second and about two-thirds as long as the third, fourth joint one-fourth as long as the third, remaining joints each slightly longer than the one preceding; apical and penultimate joints subequal. Prothorax twice as long as broad, the dorsum with a strong entire median groove and large depressions laterally. Elytra together about one and one-third times as long as broad, sides parallel, except in front of humeri and at apical corners where they are oblique; surface impressed near front border; each elytron with a thick, low and broadly rounded carina which extends obliquely from the humerus to near the middle of posterior border. Abdomen

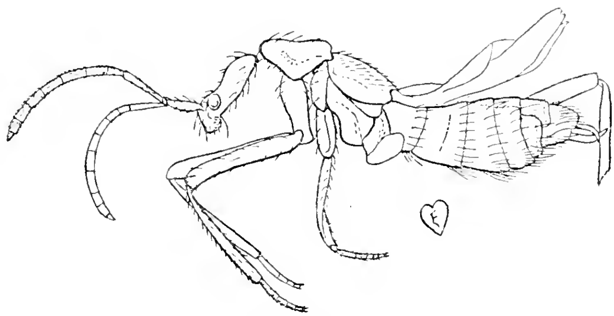


FIG. 5.—ECITOPHYA CONSECTA, NEW SPECIES. DRAWN BY E. HART.

about three times as long as broad, broadest at middle; first five segments rather strongly margined. Legs very long and slender.

Type locality.—Abuna, Rio Madeira, Brazil.

Host.—*Eciton vagana* F. Smith.

Type.—Cat. No. 23080, U.S.N.M.

Described from a unique specimen found with the host ant.

The column of ants had spread out to attack me and the beetle taken to flight and was hovering over the ants.

This species resembles *Ecitophya simulans* Wasmann and both belong to Wasmann's "Mimikry typus." Rev. Eric Wasmann has kindly compared *consecta* with the type of *simulans*. The latter species differs in its more robust form, thicker head, in the antennae being much shorter and stouter and with the last two antennal joints shorter.

The type specimen is imperfect, lacking the left posterior leg and part of the right one.

Family PSELAPHIDAE.

Subfamily CLAVIGERINAE.

FUSTIGER CLAVIPILIS, new species.

Female.—Length, 1.4 mm. Color uniformly brownish red. Head twice as long as broad, a little broader in front than behind; sides behind eyes subparallel; coarsely punctate and with fine and short striolae. Antennae coarsely punctate, more sparsely apically, as long as head; terminal joint clavate, plane and circular at tip. Eyes composed of about 15 facets, situated at middle of sides of head. Prothorax nearly as long as head, a little narrower in front than behind, sides moderately convex; surface moderately convex in front, flat behind; sculpture coarse, similar to head. Mesosternum coarsely and irregularly longitudinally striate. Elytra more than twice as broad as prothorax, broadest behind middle; posterior corners narrowly rounded, border concave; finely punctate, basally with numerous short striae and two long ones extending subparallel to the sutural striae; humeri with oblique margins, which extend backward as very short striae. Abdomen regularly and distinctly, though finely punctate, a little longer than elytra, strongly convex posterior to the pit, which is broad and deep and grooved at bottom; lateral tubercular structures small, elongate, fascicles thin. Propygidium four times as broad as long. Legs short and rather stout.

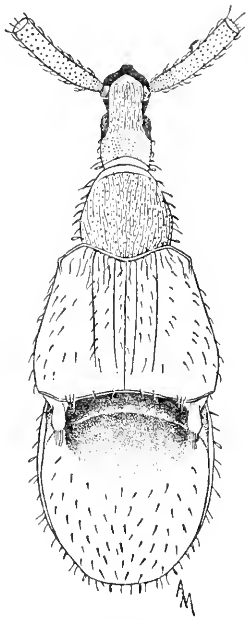


FIG. 6.—PUSTIGER CLAVIPILIS, NEW SPECIES. DRAWN BY A. MOTTER.

Hairs abundant, curved, rather short and stiff. A few clavate hairs mingled with the others on the neck and abdomen.

Type locality.—Lombardia, Honduras.

Host.— *Wasmannia auropunctata* Roger.

Type.—Cat. No. 23937, U.S.N.M.

Described from a single specimen taken in a nest of the host ant. On the posterior border of the elytra the hairs are longer and on either side several are grouped into thin fascicles.

TERTIARY FOSSIL PLANTS FROM VENEZUELA.

By Edward W. Berry,
Of the Johns Hopkins University, Baltimore.

The collection which forms the basis for the present contribution was made by C. F. Bowen during 1919, and was presented by him to the United States National Museum (accession No. 63946). The bulk of the material was collected from a light-colored clay interbedded with sandstone and exposed on a small hill in the northeastern outskirts of the town of Betijoque, District of Betijoque, State of Trujillo, Venezuela. The second lot of material was collected from a yellowish sandy micaceous clay exposed along the trail 2½ miles northwest of La Salvadora and between 25 and 30 miles south of Betijoque on the same side of Lake Maracaibo. The third lot comprises the single specimen of Entada, already described.[1] The last was collected from the base of a great thickness of dark shales underlying the plant-bearing series and overlying a sandstone which has an estimated thickness of from 700 to 1,000 feet, and is in turn underlain by black shales and limestones of Cretaceous (?) age, at Mesa Pablo, about 5 miles southwest of Escuque, on the south side of the Rio Caus.

The beds containing these fossil plants are part of a thick series of sandstones, conglomerates, and some interbedded shales which Mr. Bowen informs me are similar in lithologic characters to the Lance and Fort Union beds of the western United States, except that they are somewhat coarser. This series is reported to be of enormous thickness (10,000 to 12,000 feet), and is exposed in a narrow belt bordering the Cordillera de Merida around the entire basin of Lake Maracaibo.

The beds are highly tilted in places, and were evidently deposited before the last great orogenic disturbance of the region. About 2,000 feet below the plant horizon Mr. Bowen observed a thick bed of lignite, which is perhaps of interest in comparison with the Tertiary section on the Island of Trinidad. I understand that the lower third of the series in Venezuela is reported to contain numerous lignite

[1] Berry, E. W., Amer. Journ. Sci., vol. 50, pp. 310-313, fig. 1, 1920.

beds in this general region. I was interested in the possible presence of tuffs in the series as an item for comparison with the fossil plant locality in the Cordillera de Bogota of Colombia, but none were observed. Naturally during a reconnaissance in a region of this sort many beds of lignite or tuffs might be entirely overlooked even if they were exposed.

The plant-bearing series is underlain by several thousand feet of black shale, from which a few marine fossils were collected, and which is hence presumably of marine origin. From the facies of the plant fossils I am inclined to think that the plant-bearing series represents a complex of littoral, estuarine, and continental deposits, some of the latter of palustrine origin and others detrital.

In his account of the Cordillera de Merida, Sievers [2] described a series of interbedded shales and sandstones with lignite and petroleum at least 800 meters thick, overlying the Cretaceous limestones that have been referred to the Albian stage. These he called the Cerro de Oro beds. He had no paleontological data regarding their age. The Cerro de Oro beds, probably a complex, have been compared with the Trinidad beds named the Caroni series by Wall and Sawkins.

The exact age of the Caroni series [3] has never been satisfactorily settled, but probably will be when the collections from the Island of Trinidad, which are accumulating in the United States National Museum, are studied. W. P. Woodring, who monographed the Bowden molluscan fauna (Burdigalian), informs me that a cursory examination of the Trinidad Mollusca suggests a Miocene age for the Caroni fauna.

To the westward the Cerro de Oro series of Sievers is apparently represented in the Cordillera de Bogota, Colombia by the Guaduas formation of Hettner [4] consisting of bright-colored clays, ferruginous sandstones, and conglomerates. Underlying the Guaduas are Cretaceous coal-bearing beds referred to the Guadalupe formation. Karsten considers the former Tertiary and separated by an unconformity from the Cretaceous, but Hettner is inclined to consider both formations Cretaceous.

Subsequent scattered references to this general region show the presence of marine beds of probably middle Miocene (Helvetian) age at several localities in Colombia, and others at Cumana, Venezuela, which Douvillé correlates with the Burdigalian stage of Europe. The recent studies of Vaughan and his associates in Central America and the Antilles demonstrate that the upper Miocene was a period of uplift around the perimeters of the Caribbean and that there was profound deformation during Pliocene times.

[2] Sievers, W., Die Cordillere von Merida, Geog. Abh., vol. 3, no. 1, 1889.
[3] Guppy, R. J. L., Agr. Soc. Trinidad and Tobago, Proc., vol. 12, pt. 10, pp. 330–334, Oct., 1912.
[4] Hettner, A., Die Kordillere von Bogota, Petermanns Mitt. Ergänz., vol. 22, no. 104, 1892.

The only fossil plant that I find recorded from Venezuela is a *Weichselia* described by Schlagintweit[5] from Santa Maria and of Lower Cretaceous age, although Karsten[6] mentions ferns, reeds and dicotyledonous leaves from Santa Maria and Nariqual in association with the coal. No specimens appear to be in the Berlin or Rostock collections to verify this statement except the aforementioned fern, which is a Lower Cretaceous form, widely distributed throughout the Peruvian Andes and Coastal region, and also known from the European Wealden.

The present report enumerates but 16 species, all but two of which are new to science. The following nine forms are from Betijoque:

Blechnum betijoquensis Berry.
Sabalites, species.
Heliconia elegans (Engelhardt) Berry.
Coussapoa villosoides Berry.
Ficus betijoquensis Berry.
Anona guppyi Berry.
Trigonia varians Engelhardt.
Simaruba miocenica Berry.
Rhizophora boweni Berry.

The locality near La Salvadora furnished the following seven species:

Leguminosites venezuelensis Berry.
Leguminosites entadaformis Berry.
Sophora salvadorana Berry.
Antholithus venezuelensis Berry.
Apocynophyllum salvadorensis Berry.
Burserites venezuelana Berry.
Trigonia varians Engelhardt.

The locality at Mesa Pablo yielded the single species, *Entada boweni* Berry, which is stratigraphically below the two preceding main plant horizons.

As will be observed there is only a single form common to the two principal localities—namely, *Trigonia varians* Engelhardt, but this, it seems to be, is sufficient to indicate the practical synchroneity of these two localities, which is also borne out by Mr. Bowen's field observations. Hence it will be expedient to consider the flora as a whole in discussing the ecology and age which it indicates.

The 16 identified species represent 15 genera, 13 families, and 10 orders. They comprise a fern, 2 monocotyledons, and 13 dicotyledons. They include the abundant remains of a species of *Blechnum*, a genus of ferns with a large number of existing tropical species, well represented in northern South America. The monocotyledons

[5] Schlagintweit, O., Centralblatt Min. Geol. u Paläont., Nos. 19 and 20, pp. 315–319, 1919.
[6] Karsten, H., Zeits. Deutsch. Geol. Gesell., vol. 2, p. 354, 1850.

comprise a fragment of a generically undeterminable fan palm and a fragment of a large leaf of the American wild banana, *Heliconia*, which forms thickets in the rain forests of the present day in central and northern South America.

Among the Dicotyledons there are two species of Moraceae—a fig belonging to the immense cosmopolitan genus *Ficus*, and a species of *Coussapoa* representing an exclusively American tropical type of Central and South America. No other dicotyledonous family except the Leguminosae is represented by more than a single species. The order Ranales is represented by a species of *Anona*, a genus which, except for two or three forms of tropical Africa and Asia, is exclusively American with three score or more existing species.

The representation of the order Rosales is most interesting. It may be noted that none of the forms recorded came from the Betijoque locality, which has an assemblage that suggests a partially inundated tidal estuary border. The forms referred to the Rosales all belong to the leguminous alliance and include the striking specimen of a sea bean, two species referred to Leguminosites, one of which suggests the leaflets of *Entada*, and a species of *Sophora*—a tropical and often coastal type in modern floras.

The order Geraniales contains representatives of the three families Simarubaceae, Burseraceae, and Trigoniaceae of the genera *Simaruba*, *Burserites*, and *Trigonia*, respectively. The first is to-day confined to the American Tropics; *Burserites* is a form genus named from its resemblance to the existing genus *Bursera* which is confined to the American Tropics. The third is likewise exclusively American and tropical in the existing flora.

The Myrtales is represented by the form from Betijoque, which I consider as a species of mangrove of that familiar tropical plant association of tidal estuary mud flats. The Ebenales are doubtfully represented by the floral remains referred to *Antholithus* and tentatively considered as belonging to the family Symplocaceae. The order Gentianales is represented by a species referred to the form genus *Apocynophyllum*.

All of the foregoing are types which in existing floras are tropical in their distribution; all belong to types which are exclusively American or largely represented in America, and several genera have their modern representatives confined to the South American Tropics. The flora is not only tropical but lowland in character. This is indicated by the predominantly coastal types present, such as *Sophora*, *Rhizophora*, *Simaruba*, *Burserites*, *Entada*, etc., and is not negatived by any of the described species, since none would be out of place in such an association. Moreover it may be noted that all of the dicotyledons are coriaceous or subcoriaceous types with entire margins—features that distinguish existing lowland tropical forests.

It may therefore be concluded that this flora indicates a rain forest climate, and that at the time it lived the ancient margin of the Caribbean in this region belonged to the "tierra caliente," as so much of it still does.

The question of the geologic age of the flora is not nearly so simple a problem nor one that can be as satisfactorily answered. All but two of the species are new and hence without any known distribution in other regions. None are represented in the Tertiary floras that I have described from Costa Rica, Panama, or Dominica. I had hoped to have collections from the Caroni series of Trinidad for comparison, but these have not yet been received. None are present in the undescribed Pliocene flora that I collected in Bolivia.

The two species previously known—*Heliconia elegans* and *Trigonia varians*—were both described by Engelhardt from near Santa Ana, in the Cordillera de Bogota, from a tuff occurring in the mountains along the Rio Magdalena at 970 meters (State of Honda). Unfortunately the age of the Santa Ana flora is unknown. Its describer, Engelhardt, did not venture to suggest its age more precisely than Tertiary.

It comprises 35 species, and its chief contrast to the Venezuelan flora is the presence of 10 different species of Lauraceae—a family that, strangely enough, is not represented in the Venezuelan collections. I have previously suggested [7] that the Santa Ana flora was lower Miocene and the same age as the flora from near Tumbez in the Peruvian coastal region, that from the so-called Navidad beds of Chile, and that from the Loja basin in southern Ecuador. My reasons for this suggestion were the presence of the Santa Ana species *Persea macrophylloides* and *Moschoxylon tenuinerve* in the Chilean lower Miocene; the presence of *Phyllites strychnoides* at Loja, in Ecuador; and the presence of *Condaminea grandifolia* near Tumbez, Peru, thus making 4 of its 35 species present in beds of known lower Miocene age.

In addition, I tentatively identified [8] fragments of six additional species from Peru as questionably identical with Santa Ana forms.[9] These latter, however, I do not regard as of much weight in precise correlation, since all were fragmentary and all of the identifications were queried.

Pointing toward a younger age are the facts that two of the Santa Ana species—*Nectandra areolata* and *Buettneria cinnamomifolia*—are undoubtedly present in Costa Rica in beds that are about the same age or younger than the Gatun formation of the Canal Zone, the

[7] Berry, E. W., Bull. Geol. Soc. Amer., vol. 29, pp. 637–648, 1919.

[8] Idem.

[9] Berry, E. W., Proc. U. S. Nat. Mus., vol. 55, pp. 279–294, pl. 14–17, 1919.

datum plane in the case of the Costa Rican beds being an unconformably underlying marine shale with invertebrates. Furthermore, the Santa Ana plants are contained in a tuff, and all of the tuffs known to me from the Caribbean to Patagonia are late Tertiary to Recent, and correspond to the great period of vulcanism that started in the late Tertiary.

This is slender evidence, to be sure, but a considerable body of facts is accumulating to prove the recency of the last and greatest period of orogenesis in the Andes.

I think that the Venezuelan fossil plants are of approximately the same age as those in the tuffs near Santa Ana, Colombia. Both are undoubtedly Miocene. Those from Venezuela are said to antedate the last great orogenesis of the Cordillera de Merida, which is really nothing but a northeasterly continuation of the Andean Cordillera de Bogota. Moreover, the latest considerable transgression of the Caribbean Sea, represented by the deposits that presumably underlie the whole Maracaibo basin, but are now largely masked by Pleistocene and Recent deposits, except where they are uplifted along the flanks of the mountains, occurred, according to the present conceptions as elaborated by Vaughan [10] during the lower and middle Miocene, or, in terms of European geology, during Burdigalian and Helvetian times.

Summarizing these statements, the Venezuelan plant-bearing beds represent a series that may be compared with the Gatun formation of the Canal Zone, which has been satisfactorily shown to be of Burdigalian and Helvetian age, although Toula [11] considered the contained and mixed (in the collecting) fauna as Pliocene. The underlying marine shales are probably Burdigalian or Helvetian, and the fossil plants could therefore be Burdigalian, Helvetian, or younger. From the fact that they antedate the latest extensive orogenesis of the region, which I regard as Pliocene, since conclusive evidence of Pliocene orogenesis is available in the Antilles and elsewhere in this general region, and because the upper Miocene has been demonstrated to have been a time of general uplift, I am inclined to regard the fossil plants as representing the middle Miocene, although they may be upper Miocene. They seem to me to be distinctly pre-Pliocene, although it must be admitted that the present collection is far too small to warrant an uncompromising conclusion. It is also realized that our knowledge of this vast region is very limited, so that the present suggestion of age is made with all due reservation. By implication, the same age would be indicated for the plant-bearing tuffs near Santa Ana, Colombia.

[10] Vaughan, T. W., Bull. 103, U. S. Nat. Mus., 1919.

[11] Toula, F., Jahrb. k. k. Geol. Reichanstalt, vol. 58, pp. 673-760, 1908; vol. 61, pp. 487-530, 1911.

Phylum PTERIDOPHYTA.

Class LEPTOSPORANGIATAE.

Order POLYPODIALES.

Family POLYPODIACEAE.

Genus BLECHNUM Linnaeus.

BLECHNUM BETIJOQUENSIS, new species.

Plate 107, fig. 1.

Fronds of medium size, pinnate. Pinnae ovate-lanceolate, with an acuminate apex and a rounded base. Midvein stout, prominent. Lateral veins numerous, closely spaced, parallel, simple or once forked, craspedodrome, diverging from the midvein at wide angles and curving gently upward. Margins, except in the basal region, with small crenate-serrate teeth. No traces of sori or fertile pinnae.

This species, which is clearly new, is represented by a considerable amount of broken material, which is sufficient, however, to show the pinnate character of the frond and all of the details of the sterile pinnae. In the absence of fruiting characters its generic reference is beset with difficulties, since it resembles a number of existing tropical American forms which have been variously assigned to the genera *Blechnum*, *Lomariopsis*, *Stenochlaena*, etc., by students of living ferns.

The genus *Gymnogramme* has a Neuropteroid instead of a Taeniopteroid venation, which eliminates it from consideration. On the whole it has seemed best to refer the present species to the genus *Blechnum*, although the generic limits of this and other tropical fern genera are variously interpreted by different authorities and are evidently not clearly understood. The genus has a large number of mostly tropical species, and is well represented at the present time in northern South America. The present species may be compared with *Blechnum serrulatum* Richards, *Blechnum brasiliense* Desveaux, and other members of the genus to be found in the rain forest country from Central America to Brazil and Bolivia, all of which show a general similarity to the fossil species.

Collected from light colored clay interbedded with sandstone, exposed on a small hill on the northeastern outskirts of the town of Betijoque.

Holotype.—Cat. No. 36423, U.S.N.M.

Phylum ANGIOSPERMOPHYTA.

Class MONOCOTYLEDONAE.

Order SCITAMINALES.

Family MUSACEAE.

Genus HELICONIA Linnaeus.

HELICONIA ELEGANS (Engelhardt.)

Musophyllum elegans Engelhardt, Abh. Senck. Naturf. Gesell., vol. 19, p. 25, pl. 2, figs. 1–3; pl. 5, fig. 1, 1895.

Oblong leaves, evidently of large size, but only preserved as fragments. These indicate a leaf up to 20 cm. in maximum width and with an estimated length of at least 70 cm. Margins entire except where the lamina was mechanically split. Midrib stout, prominent, and cylindrical, about .5 cm. in diameter in the preserved material. Leaf substance of considerable consistency. Lateral veins closely spaced, parallel, diverging from the midrib at wide angles that vary from 70 to 90 degrees in different specimens. The laterals are relatively straight but curve slightly upward, particularly in the marginal region. At regular intervals of about one centimeter there is a slightly stouter lateral. All terminate in the margins.

This species was described by Engelhardt from a tuff near Santa Ana in the valley of the Rio Magdalena in Colombia. The single fragment, shown in the accompanying figure, and 10.5 cm. in length by 12 cm. in width, was collected in Venezuela. It is obviously identical with the Colombian material. Both are here transferred to the genus *Heliconia*. Two additional fossil species are known from tropical America, namely, a fragment from the Tertiary of Costa Rica and a well marked species from the Pliocene of the montaña country of eastern Bolivia. The latter was a much smaller form than the present species and lacked any differential development of the lateral veins.

The genus *Heliconia* has between 30 and 40 existing species. These are confined to the American tropics, where they range from the Antilles to Brazil and Bolivia. They are exceedingly common in Central America and the lower montaña region of Peru and Bolivia, where I have observed species at elevations up to around 6,000 feet, associated with many representatives of the tropical lowland flora.

The genus *Musophyllum* was established by Goeppert[12] in 1854 for fossil banana leaves from the island of Java. Subsequently about a dozen different species have been referred to this genus. The bulk

[12] Gœppert, H. R., Tertiarflora Insel Java, p. 39, 1854.

of these are European and range in age from Oligocene through the Mediterranean Miocene. They appear to have reached southern Europe during the Oligocene, coming from eastern and central Africa, since several are remarkably close to the existing *Musa ensete* of Abyssinia, and consequently appear to have been ancestral to the Old World genus Musa.

The North American records include a form, *Musophyllum complicatum* Lesquereux, which has a considerable distribution in the

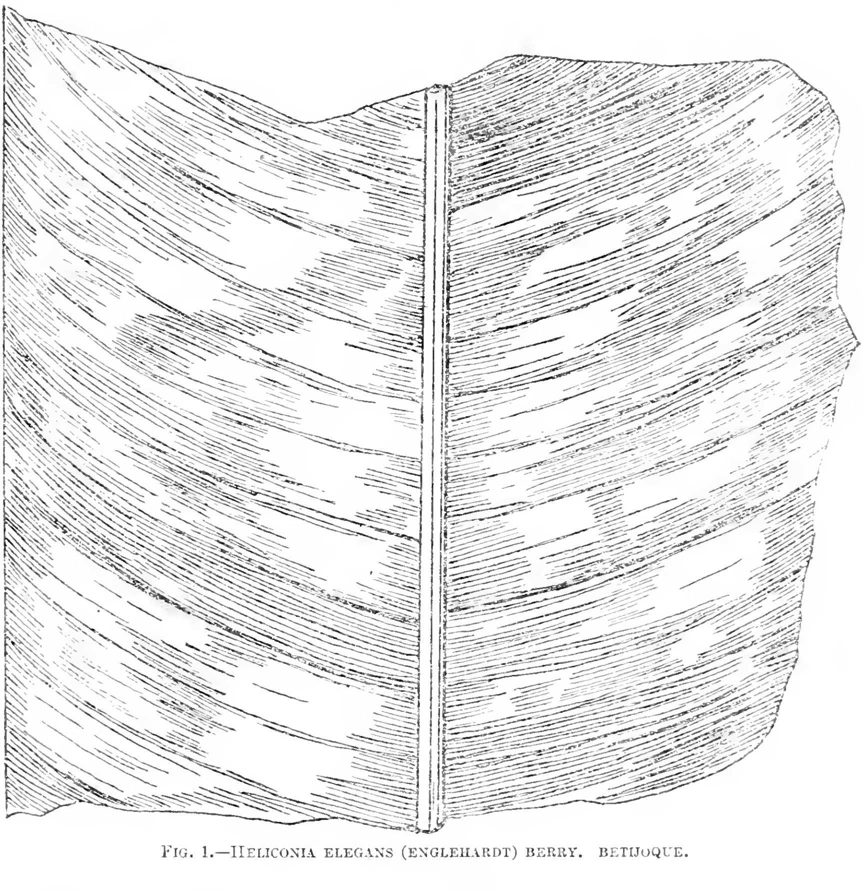


Fig. 1.—Heliconia elegans (Englehardt) Berry. Betijoque.

earlier Eocene of the present Rocky Mountain region, and a second from the basal Eocene of Wyoming. The genus has not yet been discovered in the Tertiary floras of the Atlantic or Gulf Costal Plain.

Aside from the actual resemblance between these fossil American forms and the existing *Heliconias*, it seems to me that general considerations point to the conclusion that the genus *Musa* was never present in the Western Hemisphere, despite the fact that it flourishes so greatly under cultivation in the American Tropics at the present time.

The fossil described above is from a clay shale interbedded with sandstone, exposed on a small hill on the northeastern outskirts of the town of Betijoque.

Plesiotype.—Cat. No. 36424, U.S.N.M.

Order ARECALES.

Family ARECACEAE.

Genus SABALITES.

SABALITES, species.

Plate 109, fig. 3.

Fragments of the basal part of a leaf of some species of fan palm, showing neither the size of the leaf or the character of the petiole or rays. The present material is worthless beyond the fact that it indicates the presence of fan palms in this fossil flora. The leaf appears to have been small, but there are no features that serve to suggest its botanical affinity, and it is referred to the form-genus *Sabalites* as a matter of convenience and without the slightest implication that it may be related to the existing species of *Sabal*. In this connection attention should be called to similar material described as *Palmacites*, species, by Engelhardt[13] and coming from the Cauca valley in Colombia. This is identical in appearance with the Venezuelan material, but this similarity is without significance in the case of such fragmentary material as has been collected from both of these regions.

Although a number of palm leaves from Tertiary horizons have been referred to the form-genus *Palmacites*, this usage is objectionable, despite the appropriateness of the name for fragments whose exact relations are undeterminable, since Brongniart[14] proposed *Palmacites* for palm trunks, the type of the genus being his *Endogenites echinatus* from the middle Eocene of the Paris Basin.

The present material comes from the clay outcrop at Betijoque. The modern genus *Mauritia*, with about 10 American species of fan palms, often congregate in modern Venezuelan swamps, and it is possible that the fossil fragment may represent a Tertiary member of this genus.

Type.—Cat. No. 36425, U.S.N.M.

[13] Engelhardt, H., Abh. Senck. Natur. Gesell., vol. 19, p. 40, pl. 4, fig. 8, 1895.

[14] Brongniart, A., Prodrome, p. 120, 1828.

Class DICOTYLEDONAE.

Order URTICALES.

Family MORACEAE.

Genus COUSSAPOA Aublet.

COUSSAPOA VILLOSOIDES, new species.

Plate 108, figs. 1–4.

Leaves of large size, but not large for this genus, broadly ovate in general outline, widest at or below the middle, narrowing distad to the bluntly pointed tip. Base wide and full, slightly cordate. Margins entire, but slightly undulate. Texture coriaceous, the upper surface polished, the lower surface villous. Length about 15 cm. Maximum width about 12.5 cm. Petiole very stout, thin, and flush on the upper surface of the leaf, but very prominent on the lower surface. Secondaries 8 to 10 opposite to alternate pairs, which, except for the basal and opposite pair, diverge from the midrib at regular intervals, at angles of about 45°, and pursue nearly straight subparallel courses, curving somewhat toward their tips and abruptly comptodrome close to the margins. The basal pair, which may be considered as representing the first stage in the development of lateral primaries, although they are no stouter than the strictly pinnate secondaries above them, diverge from the midrib at the top of the petiole and immediately below the normal second pair of secondaries; their angle of divergence from the midrib approaches 90° and they curve rather regularly upward subparallel with the lower lateral margins, each giving off on the outside about four camptodrome tertiaries or pseudo-secondaries, all but the lowest pair of which follow the basal margins of the leaf, pursuing rather straight courses. The tertiaries are relatively stout, well marked on the lower surface of the leaf but faint on the upper surface; they are very closely spaced, are for the most part simple, but slightly curved, and percurrent at right angles to the secondaries. The nervilles are prevailingly at right angles to the tertiaries, and where the latter fork, as they frequently do, the cross nerville joins one limb with the other, so that the tertiaries appear more nearly parallel and more generally simple than they really are.

The present species is exceedingly well marked, and so similar to certain existing species of *Coussapoa* as to amount almost to identity. Although I have not seen all of the existing species of *Coussapoa*, since several are not represented in American Herbaria, the fossil is exceedingly like *Coussapoa ruizii* Klotsch and *Coussapoa villosa* Poeppig and Endlicher, of which I have had numerous specimens from Central America. The latter is, I think, the form figured by Ettingshausen in his Blattskelet. Dikotyledonen as *Artocarpus*, species, to which I refer in a subsequent paragraph. The modern leaves vary considerably in size, as would probably prove true in the

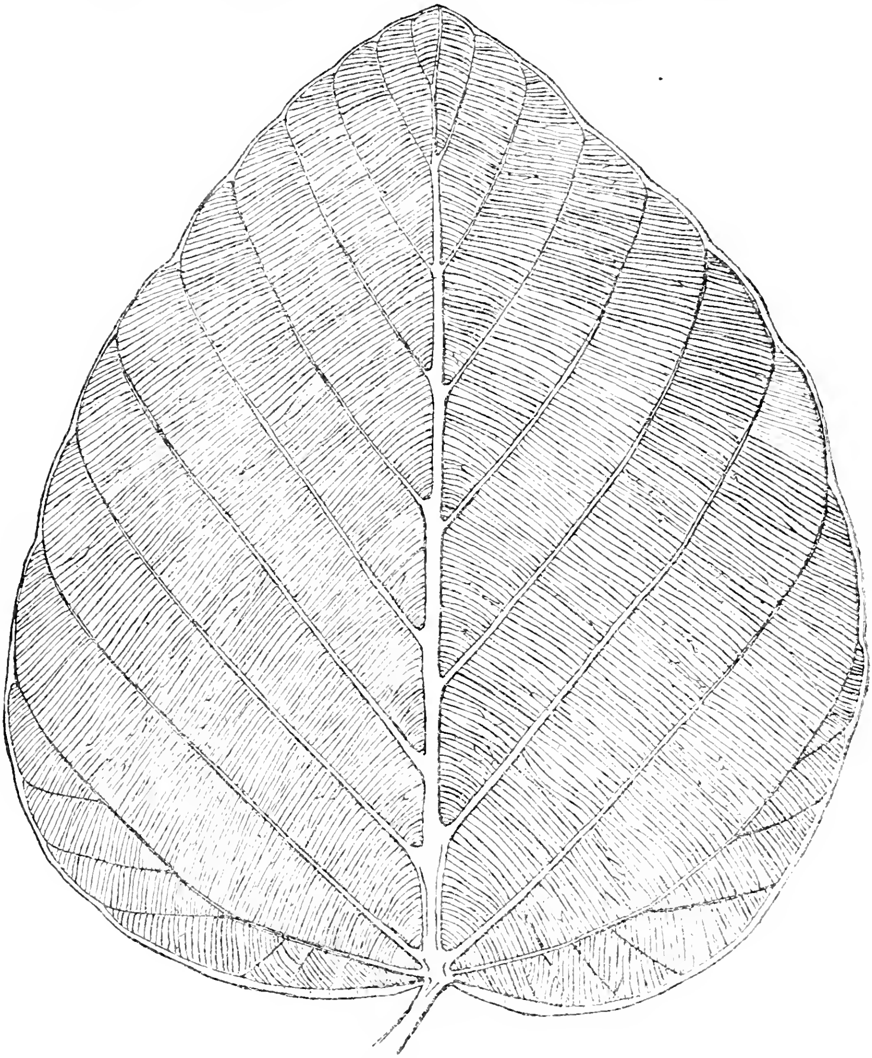


FIG. 2.—RESTORATION OF COUSSAPOA VILLOSIODES, NEW SPECIES, NATURAL SIZE.

case of the fossil were more material available for study; this is certainly true of an undescribed fossil species which I collected from the Pliocene of Bolivia.

The only observable differences between the Tertiary *Coussapoa villosoides* and the existing *Coussapoa villosa* are that occasionally a distal tertiary in the latter becomes somewhat stouter and diverges at a slightly different angle; and in the fossil between the lowest branch from the basal secondary that follows the basal leaf margin and the next normal branch above, there are three or four straight cross veins cutting diagonally across the normally oriented percurrent tertiaries.

This striking new species, which comes from Betijoque, is represented solely by fragments, which fortunately, however, include the central basal portion and several other parts of the lamina. The leaf was recognized as a member of the Moraceae by its venation, but no attempt was made to identify it until after the restoration shown in text figure 2 had been reconstructed. I mention this in order to show that its almost exact agreement with the leaves of modern species of *Coussapoa* did not have even a subjective influence in the restoration, which was based entirely upon the material studied.

Subsequently the very great similarity of the fossil to a recent leaf from the American tropics figured by Ettingshausen as an unnamed species of *Artocarpus* was noted.[15] This led to an examination of the *Artocarpus* material in the United States National Herbarium. Some of the Old World species of *Artocarpus*, as, for example, *Artocarpus ovatifolia* of the Philippines or *Artocarpus chaplasha* of the Indian region have somewhat similar entire leaves, but the resemblance is not especially close. Material of all of the existing genera of the Artocarpoideae was next examined, and although certain general similarities were naturally to be noted, especially in the case of *Inophloeum* (*Olmedia*) *armatum* (Miquel) Pittier, it was seen that the fossil did not belong to this subfamily.

Subsequently the search was continued to the remaining genera of the Moraceae, and this resulted in the conclusive determination of the fossil as a species of *Coussapoa*. The genus has not heretofore been certainly found fossil. In the existing flora it includes about 15 species of shrubs and trees with the characteristic areolation shown in text figure 2, but varying in the degree of divergence of the secondaries, and, in some forms, this results in a basal primary on either side of the midrib instead of a strictly pinnate arrangement of the secondaries.

A species of the tripalmate venation type, as yet undescribed, is exceedingly abundant in the Pliocene of eastern Bolivia. Engelhardt[16] in 1891 referred a form from the lower Miocene of Coronel, Chile, to the genus *Coussapoa*, but his material was very inconclusive, and scarcely warrants the conclusion that this genus was a member of the south Chilean Miocene flora, at least not unless more

[15] Ettingshausen, C., Blattskelet. Dikot., p. 33, pl. 6, fig. 6, 1861.
[16] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 16, p. 649. pl, 3, fig. 2, 1891.

convincing material from that region is subsequently discovered, which would not be at all surprising.

All of the existing species, which are not especially well represented in the larger American Herbaria, are confined to the tropics of Central and South America. The presence of this type with such unusually clearly marked characteristics in the Tertiary flora of Venezuela is of the greatest interest.

Cotypes.—Cat. Nos. 36426, 36432, 36433, 36444, U.S.N.M.

Genus FICUS Linnaeus.

FICUS BETIJOQUENSIS, new species.

Plate 108, fig. 5.

Leaves broadly ovate, presumably nonlobate and entire in outline, of medium size, palmately veined. Apex pointed. Base truncate, slightly decurrent. Length about 12 cm. (estimated). Maximum width, at or below the middle, about 10 cm. Texture subcoriaceous. Petiole stout, its total length unknown. Midrib stout, prominent, stouter than the lateral primaries. Lateral primaries one on each side, stout, relatively straight, diverging from the base of the midrib at angles of about 45 degrees, giving off about six camptodrome secondaries on the outside. A wide interval separates the primaries from the lowest secondaries that diverge from the midrib. The secondaries are less stout than the primaries, diverging at more open angles, and camptodrome. Tertiaries well marked, percurrent or alternating in the median region, connected by well marked nervilles at nearly right angles to the tertiaries. Venation typical of the short and wide forms of *Ficus.*

The present species is represented in the clays at Betijoque by the single specimen figured, which is unfortunately incomplete. Since it shows sufficient characters to enable it to be recognized if future collections are made, it has seemed best to figure it and describe it as completely as is possible from the nature of the material.

It belongs to a genus which shows considerable diversity of features among its very many species. They are present in all tropical countries at the present time and some extend for considerable distances into the Temperate zones. A large number of fossil species have been described from the Upper Cretaceous and Tertiary rocks of different parts of the world. Little is to be gained, however, from detailed comparisons with fossil species from other regions, or with the more or less unknown existing species of the Venezuelan region.

Holotype.—Cat. No. 36427, U.S.N.M.

Order RANALES.

Family ANONACEAE.

Genus ANONA Linnaeus.

ANONA GUPPYI, new species.

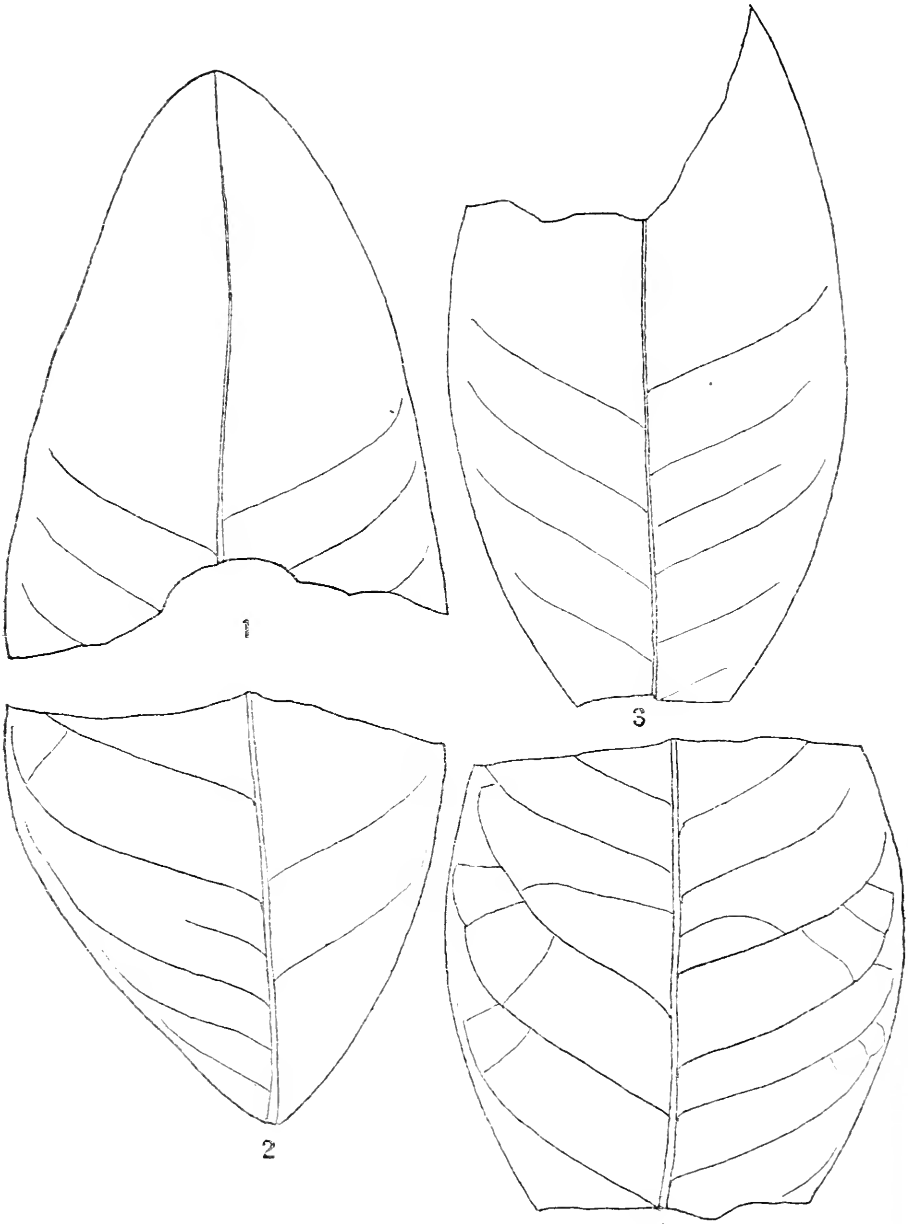
Leaves of variable but mediumly large size, ovate in general outline, widest at or below the middle, narrowing slowly upward to the obtuse tip, and more rapidly downward to the broadly cuneate base. Length averaging between 12 cm. and 13 cm. Maximum width ranging from 5.3 cm. to 6.2 cm., averaging about 6 cm. A single specimen is somewhat inequilateral. Margins entire, very faintly undulate in some specimens. Texture subcoriaceous. Petiole missing. Midrib stout, prominent on the lower surface of the leaf. Secondaries remote, 10 to 12 pairs, diverging from the midrib at wide angles of 60 to 70°, generally but slightly curved upward until they approach the marginal region where they are camptodrome. These leaves have all been mined by the aquatic larvae of insects, so that the tertiary venation is much obscured. A few percurrent nervilles are distinguishable.

I have ventured to name this obviously new species in honor of H. B. Guppy, whose enlightened researches have added so much to our knowledge of the distribution of plants.

The existing species of *Anona*, many of which are economically valuable, number about 60, all of which are American except two or three forms of Africa and tropical Asia. Several are widely cultivated in all tropical countries, and their original home has been a matter of dispute, since the cultivation of some of the species probably antedates the discovery of America. A. De Candolle, after his extended systematic studies of the Anonaceae, reached the conclusion that *Anona* was of American origin and that the ancestors of the cosmopolitan cultivated forms probably came from the West Indies or from the neighboring part of the American mainland. This is unquestionably true, not only of the cultivated forms, but of the genus as a whole, since fossil species are recorded from the late Cretaceous and early Eocene of North America.

The total number of known fossil forms is between 20 and 30. Around the perimeters of the Gulf of Mexico and the Caribbean there are four well-marked species in the lower Eocene of the Mississippi embayment region; an upper Eocene species in Texas; and a Miocene species in Costa Rica. A species is known from the Miocene of northern coastal Peru, two have been described from the lower Miocene of southern Chile, and there is a species in the Pliocene of Bolivia.

The present species may be compared with a number of the numerous existing species of the Caribbean hinterland of Central



1 2 3 4

FIG. 3.—ANONA GUPPYI, NEW SPECIES. BETIJOQUE.

and northern South America. Specimens are abundant, but broken, in the clays at Betijoque.

Cotypes.—Cat. Nos. 36428, 36429, 36430, 36431, U.S.N.M.

Order ROSALES.

Family MIMOSACEAE.

Genus ENTADA Adanson.[17]

ENTADA BOWENI Berry.

Plate 109, fig. 1.

Entada boweni Berry, Amer. Journ. Sci., vol. 50, pp. 310–313, fig. 1, 1920.

Seed of large size, about 5.25 cm. in diameter, lenticular in form, reniform in surface view, and depressed elliptical in cross section. The surface view would be almost perfectly circular except for the pronounced sinus at the hilum. The sclerotest or hard lignified seed coat is gone from the face of the specimen, exposing the thick reniform upper cotyledon. The inner face of the lower cotyledon is shown in the upper left-hand corner of the specimen, where a portion of the upper cotyledon is broken away. Where the two cotyledons join, the hypocotyl or plumule is conspicuous, indicating the incipient germination of the seed before it was finally buried by sediment. The outer surface of the cotyledon is slightly furrowed as in the existing sea bean. The central area is somewhat collapsed exactly as would be the case in the modern bean if the cotyledons were somewhat softened and the central air cavity upon which its buoyancy depends had been collapsed by pressure. Around the greater part of the edge of the seed the sclerotesta is preserved, being replaced by what is presumably marcasite. This test is thick and about 3 mm. in diameter around the edges of the seed.

The single specimen was collected from dark shales overlying a sandstone at Mesa Pablo, about 5 miles south, 84 degrees west, of Escuque, on the south side of the Caus River, inland from Lake Maracaibo. The age is Tertiary, but has not as yet been more definitely determined.

Holotype.—Cat. No. 36435 U.S.N.M.

The counterpart of the specimen if present in the shale was not collected, and I assume that it carried the face of the test and the small fragment of the upper cotyledon which is missing. I have dissected a number of seeds of the existing *Entada scandens,* and their correspondence with the fossil is most remarkable, the only observable difference being the partially developed plumule or hypocotyl in the fossil which, as I have suggested above, was probably due to germination. The cotyledons appear to have been infiltered with ferruginous salts before they had time to decay, becoming flattened by the escape of gas from the central intercotyledonary cavity.

[17] This is often made a synonym of *Pusaetha* Linnaeus, as for example by Taubert in Engler and Prantl

Entada scandens is probably the best known tropical plant distributed by ocean currents, since its large, lenticular, dark kidney colored seeds have been for ages cast up by the waves on the eastern shores of the Atlantic from the Azores northward to Nova Zembla. These seafaring qualities and vitality are remarkable, as is the distribution of the parent plant, since it is found in all of the Tropics and yet presents certain apparent anomalies. It is normally a climber of immense proportions with truly gigantic pods, and belongs to a genus with some 15 existing species, about half of which are African. There are three or four in the American Tropics, one or two in the southeastern Asiatic region, and one in Madagascar. Most of these are not strand plants, and although *Entada scandens* also grows in inland situations, it is as a strand plant that it is principally known, since it frequents mangrove associations and the jungle immediately behind tropical beaches.

The fossil is so much like the existing sea bean that one is justified in assuming that it, like the descedant, was distributed by ocean

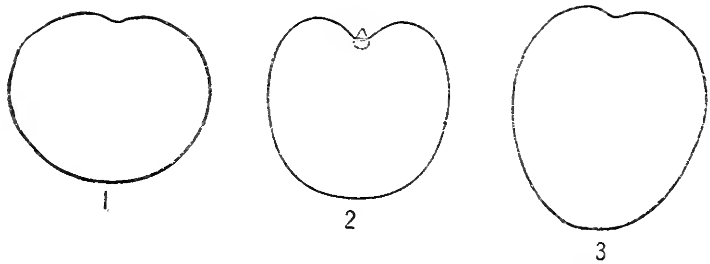


FIG. 4.—1. ENTADA SCANDENS (LINNAEUS) KUNTZE. OUTLINE OF A SEED FROM JAMAICA. 2. E. BOWENI BERRY, MESA PABLO. 3. E. SCANDENS. OUTLINE OF A SEED FROM CUBA. ONE-HALF NATURAL SIZE.

currents, and its occurrence in a clay lens in what appears to have been a rather widespread marine series of deposits, adds some probability to this conjecture; and as its horizon antedates the last seaway across the Isthmus of Panama, it is not difficult to account for the presence of the modern species on both the Atlantic and Pacific sides of South America.

Entada has not certainly been found fossil heretofore except in the case of the subfossil seeds of the existing sea bean buried in the coastal deposits of Scandinavia, where they had been carried from the Antilles by the Gulf Stream. Unger long ago described two different species of fossil pods which he referred to the genus *Entada*. These were *Entada primogenita* [18] from the Miocene of Radoboj in Croatia and *Entada polyphemi* [19] from the Oligocene of Sotzka in Styria. They are both large pods, although not so large as the Venezuelan fossil or the existing sea bean. The second is rather suggestive of *Entada*,

[18] Unger, F., Sylloge, vol. 2, p. 36, pl. 11, fig. 22, 1862.
[19] Idem., fig. 23.

but as Schenk points out at some length[20] both resemble other leguminous pods and are hence inconclusive, although not entirely improbable.

There can not be the slightest doubt regarding the botanical affinity of the present fossil, since it agrees in every detail with the existing species. It adds another to the considerable list of plants of the sea drift that have been discovered in recent years in the tropical and subtropical floras of the American Tertiary.

Family PAPILIONACEAE.

Genus SOPHORA Linnaeus.

SOPHORA SALVADORANA, new species.

Plate 107, fig. 4.

Leaflets sessile, elliptical, and slightly inequilateral in outline, with a rounded apex and base, the latter somewhat narrower than the former. Margins entire. Leaf substance thin but of a firm consistency, perhaps meriting the term subcoriaceous. Length about 4.75 cm. Maximum width about 2 cm. Midrib stout, prominent and curved. Secondaries stout and prominent; about eight opposite to alternate, regularly spaced, subparallel pairs diverge from the midrib at angles of about 45° and are camptodrome in the marginal region. Tertiary areolation obsolete by reason of the coarseness of the matrix.

The present species may be compared with numerous existing and fossil species of *Sophora*. There are about 25 existing species of shrubs and small trees referred to the genus. These are scattered over the warmer parts of both hemispheres and some are found upon all tropical seashores. Two arborescent forms occur along our western Gulf coast, where they show a preference for moist calcareous soils along streams. One of these Texan species, *Sophora secundiflora* DeCandolle, the coral bean, has leaflets very similar to those of *Sophora salvadorana*. Other existing species are likewise very similar to the latter, as, for example, *Sophora tomentosa* Linnaeus, a cosmopolitan tropical strand plant. The dry pods of the latter float for a week or two and then decay, liberating the buoyant seeds, which float uninjured for several months, according to the experiments of both Schimper and Guppy.[21]

The genus is well represented in European Tertiary floras from the Eocene to the Pliocene and is common in the earlier Tertiary floras of the Mississippi embayment region of the United States.

---

[20] Schenk, A., Palaeophytology, p. 702, 1890.

[21] Guppy, H. B., Plant Dispersal, pp. 147, 579, 1906.

Among the described fossil forms *Sophora salvadorana* greatly resembles *Sophora europaea*,[22] which was compared by Unger, its original describer, with the existing *Sophora tomentosa*. *Sophora europaea* has been identified by numerous students at a large number of European localities, extending from the Oligocene through the Miocene.

The present species is based upon two specimens from the yellowish sandy micaceous clay found along the trail, 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36436, U.S.N.M.

POSITION UNCERTAIN.

Genus LEGUMINOSITES Bowerbank.

LEGUMINOSITES VENEZUELENSIS, new species.

Plate 107, fig. 2.

Leaflets small, apparently sessile, very inequilateral, with an acute apex and a very inequilateral base. Margins entire. Texture subcoriaceous. Length about 1 cm. Maximum width about 5 mm. Midrib thin, somewhat curved. Secondaries immersed, a few camptodrome pairs, more ascending in the narrower side of the lamina, the basal one in the wider side of the lamina more prominent than the others.

This small leaflet has a characteristic form; the acute tip is not obviously inequilateral, but the lamina on one side is twice as wide as on the other; the base on the narrow side curves to form an acute angle with the midrib; that on the broad side continues downward to form a prominent auricle.

This species is based upon a single specimen and its counterpart from the sandy clays near La Salvadora. Consequently it seems desirable to refer it to the form-genus Leguminosites rather than to attempt comparisons with recent species of Leguminosae, which are so numerous in this region at present, and so extremely difficult to differentiate by means of the leaflets alone. The following genera contain forms in this region which show similarities with the fossil—namely *Enterolobium*, *Zygia*, and *Lysiloma* among the Mimosaceae, and *Cassia*, *Caesalpinia*, and *Swartzia* among the Caesalpiniaceae.

Holotype.—Cat. No. 36437, U.S.N.M.

LEGUMINOSITES ENTADAFORMIS, new species.

Plate 107, fig. 3.

Leaflets elliptical in form, nearly equilateral in outline, widest in the middle and about equally rounded at the apex and base, the latter slightly broader than the former. Margins entire, regular. Texture

[22] Unger, F., Die fossile flora von Sotzka, p. 57, pl. 42, figs. 1-5, 1850.

subcoriaceous. Length about 4 cm. Maximum width about 3.2 cm. Midrib thin, but prominent. Secondaries immersed; 9 or 10 camptodrome pairs diverge from the midrib at regular intervals, at angles of about 55 to 60°, pursue a curved ascending subparallel course, and are camptodrome in the marginal region. Tertiaries obsolete.

This species is based upon the single specimen figured, and because of this paucity of material it is referred to the form-genus Leguminosites. It has been compared with the somewhat similar forms in genera likely to occur in this region, such as *Mimusops*, *Laguncularia*, *Sophora*, *Cassia*, *Chrysobalanus*, etc. In size, texture, and venation, as well as in its intangible facies, it suggests the Leguminosae, among which there are a considerable number of analogous or homologous forms. Without being able to decide upon its generic affinity, I have suggested, in the specific name proposed, its possible relationship with *Entada*, which is represented by a fossil seed at Mesa Pablo in this region and at a not very different horizon.

The specimen comes from the sandy clays, 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36438, U.S.N.M.

Order GERANIALES

Family SIMARUBACEAE.

Genus SIMARUBA Aublet.

SIMARUBA MIOCENICA, new species.

Plate 109, fig. 2.

Leaves pinnate. Leaflets sessile or subsessile, small, elliptical in general outline, with a bluntly pointed apex and base. Margins entire, slightly revolute. Texture subcoriaceous. Length about 4 cm. or less. Maximum width, midway between the apex and the base, 2 cm. or less. These leaflets are slightly inequilateral, one side (the proximal) of the lamina being 1 to 2 millimeters narrower than the other. The midrib is stout, somewhat curved, and prominent on the under side of the leaflet. The secondaries are fairly stout, numerous, approximately equally spaced, and prominent; they diverge from the midrib at angles between 60 and 70°, pursue subparallel and almost straight courses. and are abruptly camptodrome close to the margins. The tertiaries are relatively stout and mostly percurrent, although there are some nervilles from the midrib that run subparallel with the secondaries part way toward the margins.

The single specimen upon which this species is based came from the clay outcrop at Betijoque, and shows parts of five leaflets, and from their disposition it appears that their arrangement was alternate. Of these the central one in the accompanying figure is much the largest, and the distal one is considerably smaller. On the whole the material is more satisfactory than is usually the case.

Holotype.—Cat. No. 36439, U.S.N.M.

The Simarubaceae is a mostly tropical family of shrubs and trees, with persistent alternate exstipulate leaves made up of small coriaceous leaflets, and with drupaceous fruits. The genus *Simaruba* has about a half dozen existing species, all trees, which are confined to the American tropics, where they range from the coasts of southern peninsular Florida to the middle Amazon basin. The present fossil species is practically identical with the existing *Simaruba officinalis* Macfarlane of the Antilles and Caribbean coastal regions. If the present fossil were not indicative of a pinnate compound leaf, I would be disposed to consider it as representing a small leaf of the sapotaceous genus *Chrysophyllum*, which a single leaflet greatly resembles.

The only other fossil species known to me is *Simaruba eocenica* Berry,[23] from the lower Eocene of the Mississippi embayment deposits in western Tennessee, which resembles the existing *Simaruba glauca* De Candolle.

Family BURSERACEAE.

Genus BURSERITES Berry.

BURSERITES VENEZUELANA, new species.

Plate 107, fig. 7.

Leaves pinnate. Leaflets small, petiolulate, inequilateral-ovate in form; with acuminate tips and broadly cuneate bases. Length about 4.7 cm. Maximum width, midway between the apex and the base, about 2.25 cm., of which about two-thirds is on one side of the midrib. Margins entire, somewhat undulate. Texture subcoriaceous. Petiolule enlarged, about 4 mm. in length. Midrib stout, prominent, curved. Secondaries stout, regularly spaced, subparallel; about eight pairs diverge from the midrib at angles of from 40 to 65 degrees, curve regularly, and are camptodrome in the marginal region. Tertiaries thin, mostly obsolete; a few percurrent nervilles can be made out.

The present species may be compared with various existing species of the genus *Bursera* Jacquin and *Protium* Burmeister. Except that the leaflets are about twice as large they are very similar to those of the existing West Indian Birch or Gumbo Limbo. Among the 16 genera of the family, *Bursera* is the only one that reaches the United States, and *Bursera simaruba* Sargent is a large tree ranging from southern Florida throughout the West Indies and Central America to Colombia and Venezuela. The genus contains about 40 existing

[23] Berry, E. W., U. S. Geological Survey Prof. Paper 91, p. 252, pl. 54, fig. 7, 1916.

species, confined to the American Tropics in the Antillean, Central American, and northern South American regions.

The genus *Protium*, with which the fossil also shows resemblances, has only about four-fifths of its 50 existing species in the American Tropics, the others being scattered in India, Java, Madagascar, and Mauritius. The family Burseraceae comprises 10 oriental, 4 occidental, and 2 genera common to both hemispheres. Of the 300 or more existing species over two-thirds are oriental. So far as I know the only previously described fossil member of the family is *Burserites fayettensis* Berry[24] of the Fayette sandstone (upper Eocene) in Louisiana and Texas.

The present species is unfortunately represented by the single folded specimen figured, which comes from the yellowish sandy micaceous clays along the trail, 2½ miles northwest of La Salvadora.

Family TRIGONIACEAE.

Genus TRIGONIA Aublet.

TRIGONAI VARIANS Engelhardt.

Plate 107, fig. 8.

Trigonia varians Engelhardt, Abh. Senck. Naturf. Gesell., vol. 19, p. 35, pl. 7, figs. 4–6; pl. 9, fig. 9, 1895.—?Berry, Proc. U. S. Nat. Mus., vol. 55, p. 290, 1919.

This species was described by Engelhardt from several different sized specimens collected from tuffs near Santa Ana in the Magdalena Valley, Colombia. Rather poor material from the lower Miocene of northern Peru was tentatively identified as this species by the writer in 1919. This last record remains of doubtful value, but in the Bowen collection from Venezuela there are seven specimens from the two principal plant localities that are unquestionably identical with Engelhardt's type material from Colombia. The species may be more fully described as follows:

Leaves of variable size, ovate to obovate in general outline. Apex and base about equally pointed. Margins entire, slightly undulate. Texture subcoriaceous. Length ranging from 6 cm. to 13 cm. Maximum width, at or slightly above the middle, ranging from 3 cm. to 5.25 cm. A maximum sized specimen from Betijoque is figured on the accompanying plate. Petiole stout, its length unknown. Midrib stout, prominent on the undersurface of the leaf, usually curved. Secondaries stout, prominent on the under surface; 9 to 12 opposite to alternate pairs diverge from the midrib at fairly regular intervals and at angles of 55 degrees or less, ascending subparallely, becoming camptodrome in the marginal region.

[24] Berry, E. W., U. S. Geol. Surv. Prof. Paper (in press).

Tertiaries thin but well marked on the underside of the leaf, consisting of rather closely spaced percurrent nervilles, which may be all that can be made out if the preservation is not good; these are connected by anastomosis, so that their course is usually not straight, the whole forming a relatively open, isodiametric areolation.

The genus *Trigonia*, not otherwise known in the fossil state, comprises about 30 existing species of reclined or climbing shrubs, which are confined to the region between Central America and southern Brazil.

The Bowen collection contains four specimens from Betijoque and two from near La Salvadora.

Plesiotype.—Cat. No. 36441, U.S.N.M.

Order MYRTALES.

Family RHIZOPHORACEAE.

Genus RHIZOPHORA Linnaeus.

RHIZOPHORA BOWENI, new species.

Plate 109, fig. 4.

Stout leaves, elliptical in general outline, abruptly acuminate distad and rounded at the base. The two specimens collected (counterparts) are conspicuously inequilateral, but this is considered as probably an abnormality. The margins are entire and the texture is coriaceous. Length between seven and eight centimeters. Maximum width about 4.5 cm. Petiole stout, about 7 mm. or 8 mm. in length. Midrib stout, prominent on the under and channeled on the upper side. Secondaries camptodrome, diverging at wide angles, immersed in the leaf substance. The leaf has been galleried by insect larvae and also shows suberized patches such as are commonly seen on the leaves of the existing species.

The present species agrees with the leaves of the existing *Rhizophora mangle* Linnaeus in general size, form, and texture; in the thin, open, wide angled, immersed secondaries; in the stout petiole; in the stout midrib, prominent on the lower and channeled on the upper surface; in the decurrent base. It differs in its inequilateral form and acuminate tip.

There are three existing species of *Rhizophora*. *Rhizophora mangle* of the American Tropics is found as far north as Mosquito Inlet and Cedar Key in peninsular Florida. It occurs throughout the Bahamas and Antilles and very generally throughout Central America and northern South America, having in comparatively recent times extended its range northward from the Bahamas to Bermuda. On the west coast of America it is found from southern California to the Galapagos Islands. *Rhizophora mucronata* Lamarck ranges from southern Japan to northern Australia and westward to eastern Africa; *Rhizophora conjugata* Linnaeus is confined to tropical Asia. Doubtless modern systematists will differentiate additional specific forms, but judging by the rather uniform habits of these plants, such differentiation will be based upon minor features. The mangroves possess the singular ability of thriving in sea water, and their manner of life and development have become well adapted both structurally and physiologically to their mode of life, so that they have become widely disseminated and individually abundant. In fact they are the most remarkably specialized plants for their habitat that are known and their specialization appears to have been in a measure reached during the Tertiary period.

It is possible that leaves of this genus may not have been recognized although present in paleobotanical collections. However, since the genus is almost exclusively tropical and most known Tertiary floras are not strictly tropical, the geological record of *Rhizophora* may be as meager as it seems. Only three fossil species have heretofore been referred to *Rhizophora* and only one of these has any claim to such an affinity. A single specimen was described by Massalongo [25] from the later Tertiary (Messinian) of the east coast of Italy, and a second form was referred to this genus by Ettingshausen. The latter came from the Ligurian-Aquitanian of Austria and was compared with the existing *Rhizophora parvifolia* Roxburg of the East Indies.[26] The similarity of this form to various members of the Myrtaceae and Leguminosae, however, led Schenk to express doubts as to its identity.[27] The third and in my judgment only authentic fossil species, *Rhizophora eocenica* Berry [28] was described from the upper Eocene (Jackson) deposits of Georgia. The presence of a fossil species in the later Tertiary of Venezuela serves to explain, if explanation were needed, the presence of the modern mangrove on both the Atlantic and Pacific shores of America.

The present species is named for the collector C. F. Bowen, and comes from Betijoque.

Holotype.—Cat. No. 36442, U.S.N.M.

[25] Massalongo, A., Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 407, 1859.

[26] Ettingshausen, C., Die Tertiare Flora von Haering in Tirol, p. 82, pl. 27, figs. 28, 29, 1853.

[27] Schenk, A., Zittel's Handbuch, Ab. 2, p. 632, 1890.

[28] Berry, E. W., U. S. Geol. Surv. Prof. Paper 84, p. 141, pl. 29, figs. 1, 2, 1914.

Order EBENALES (?).

Family SYMPLOCACEAE (?).

Genus ANTHOLITHUS Brongniart.

ANTHOLITHUS VENEZUELENSIS, new species.

Plate 107, fig. 5.

Calyx or coralla five parted, gamopetalous or gamosepalous, divided more than halfway to the base into five, broadly ovate, very faintly mucronate, divisions. Diameter, 5 mm. The matrix is coarse, so that the preservation is not of the best. The calyx or coralla is tiny and seems to have been of considerable consistency.

The botanical position of floral remains unless they are unusually well preserved, which they usually are not, is beset with almost unsurmountable difficulties. In the present case the small size precludes their reference to such genera as *Getonia*. After considerable comparison the choice of relationship appears to me to narrow to the order Ebenales, and more especially to the families Styracaceae and Symplocaceae. Both are still plentiful in the American Tropics; the latter, to which I tentatively refer the present specimen, having about one-third of the existing 150 to 200 species confined to the American, and chiefly the South American Tropics. The balance of the existing species are oriental and chiefly southeastern Asiatic.

A considerable number of fossil forms, both of *Symplocos* and *Styrax*, have been described. Thus there are about 15 forms of *Symplocos* recorded from the Oligocene and Miocene of Europe; and about 20 forms of *Styrax*, mostly from the European Tertiary, but including two forms from the early Eocene of the western United States, and two from the lower Miocene of Chile. In addition to the latter, Englehardt has described foliage of *Styrax* from near Santa Ana in the Magdalena Valley in Colombia,[29] and I have tentatively identified the same form from the Miocene of northern coastal Peru.[30]

The present specimen, of which the original and the counterpart are preserved, comes from 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36443, U.S.N.M.

[29] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 32, pl. 5, fig. 9, 1895.
[30] Berry, E. W., Proc. U. S. Nat. Mus., vol. 55, p. 293, pl. 15, fig. 2, 1919.

Order GENTIANALES.

Family APOCYNACEAE.

Genus APOCYNOPHYLLUM Unger.

APOCYNOPHYLLUM SALVADORENSIS, new species.

Plate 107, fig. 6.

Leaves linear-lanceolate in outline, about 13 cm. in length and 2.4 cm. in maximum width, with a somewhat narrowed rounded base. Apex missing, so that the total length as given may be slightly overestimated. Margins entire, even. Petiole missing. Midrib thin on the upper surface of the leaf, stout and prominent on the lower surface. Secondaries numerous, thin, regularly spaced, subparallel and camptodrome.

This species is of a somewhat uncertain botanical affinity since it exhibits no conclusive diagnostic characters. It approaches most nearly to the various fossil species that have been referred to the form-genus *Apocynophyllum*, and which suggest various existing tropical genera of the family *Apocynaceae*, such as *Plumiera*, *Prestonia*, *Thevetia*, etc.

Three specimens are represented from the sandy clays 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36444. U.S.N.M.

EXPLANATION OF PLATES.

Plate 107.

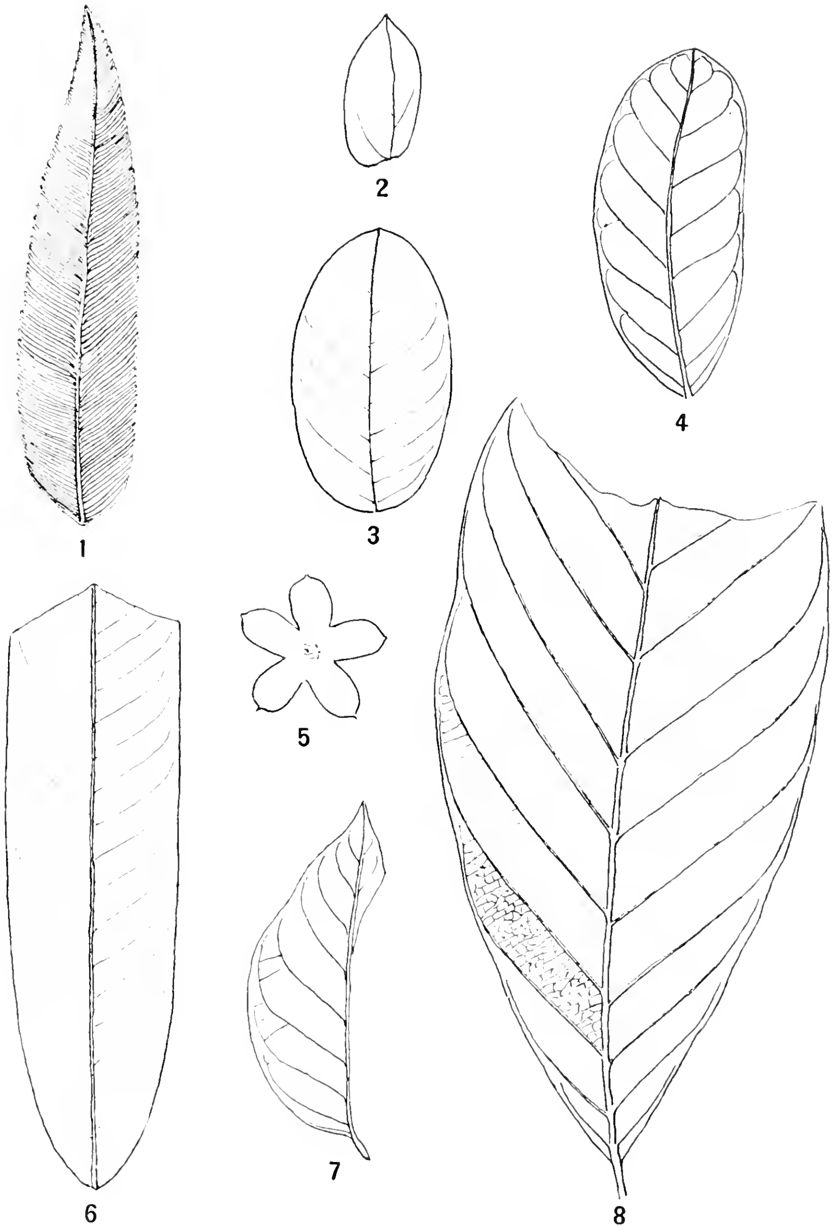
Fig. 1. *Blechnum betijoquensis*, new species. Betijoque.
2. *Leguminosites venezuelensis*, new species × 2. La Salvadora.
3. *Leguminosites entadaformis*, new species. La Salvadora.
4. *Sophira salvadorana*, new species. La Salvadora.
5. *Antholithus venezuelensis*, new species × 4. La Salvadora.
6. *Apocynophyllum salvadorensis*, new species. La Salvadora.
7. *Burserites venezuelana*, new species. La Salvadora.
8. *Trigonia varians* Engelhardt. Betijoque.

Plate 108.

Figs. 1–4. *Coussapoa villosoides*, new species. Betijoque.
5. *Ficus betijoquensis*, new species. Betijoque.

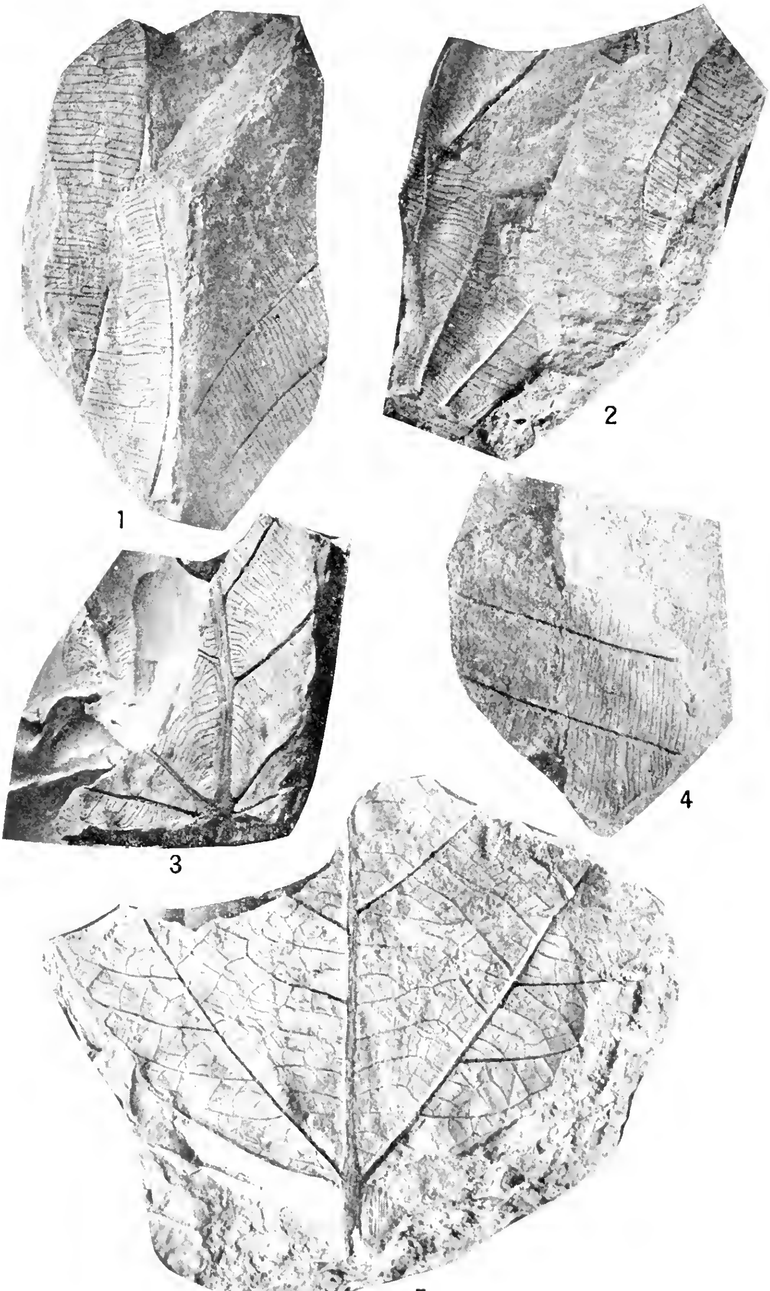
Plate 109.

Fig. 1. *Entada boweni* Berry. Mesa Pablo.
2. *Simaruba miocenica*, new species. Betijoque.
3. *Sabalites*, species. Betijoque.
4. *Rhizophora boweni*, new species. Betijoque.



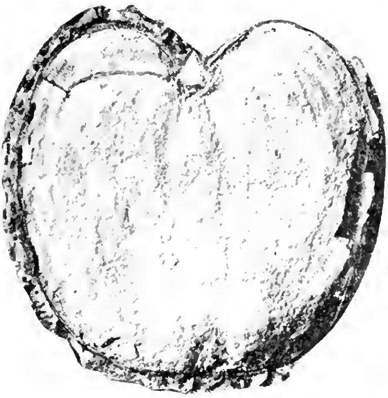
TERTIARY FOSSIL PLANTS FROM VENEZUELA.

FOR EXPLANATION OF PLATE SEE PAGE 579.



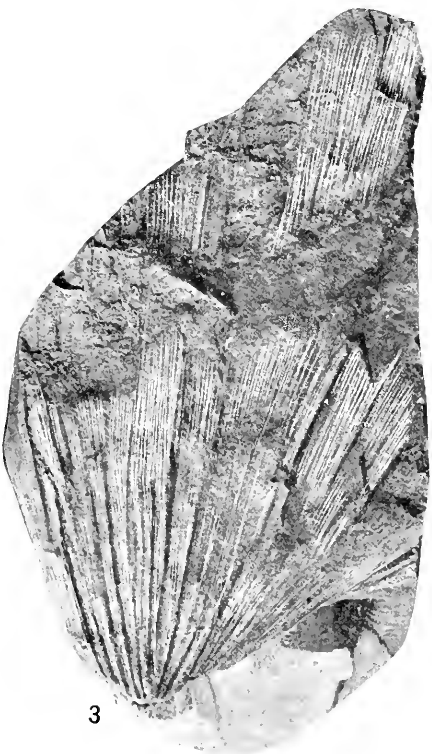
TERTIARY FOSSIL PLANTS FROM VENEZUELA.

FOR EXPLANATION OF PLATE SEE PAGE 579.



1

2



3

4

TERTIARY FOSSIL PLANTS FROM VENEZUELA.

FOR EXPLANATION OF PLATE SEE PAGE 579.

THE FAUNA OF THE ARUNDEL FORMATION OF MARYLAND.

By Charles W. Gilmore.

Associate Curator, Division of Paleontology, United States National Museum.

INTRODUCTION.

The vertebrate fauna of the Arundel formation of Maryland has long been a subject of interest to all workers in American Mesozoic formations. The correlation of this fauna with the Morrison (Atlantosaurus, Como) beds fauna of the Rocky Mountain region by Prof. O. C. Marsh, and the later [1] and more positive confirmation of that conclusion by Dr. R. S. Lull, has been quite generally accepted as the correct interpretation. The present communication gives the results of a more recent study of all known specimens from the Arundel formation, and the conclusions reached are quite at variance to those of my predecessors. The evidence appears to show—first, that the vertebrate fauna as a whole is not to be closely correlated with that of the Morrison formation of the West; second, that it contains forms having undoubted Upper Cretaceous affinities; third, that it consists of a combination of dinosaurian forms hitherto unknown in any fauna of this continent—that is, the intermingling of Sauropodous dinosaurs with those having Upper Cretaceous affinities.

While the discussion of several phases of this question are necessarily inconclusive, due to the paucity of the materials, yet the main contentions, I believe, can be fully maintained.

SOURCE OF MATERIALS.

Practically all of the vertebrate materials known from the Arundel formation of Maryland are now assembled in the United States National Museum. These comprise all of the specimens collected by the late J. B. Hatcher, in 1887 and 1888 for the United States Geological Survey; the Goucher College collection brought together by Prof. Arthur Bibbins during the years 1894, 1895, and 1896; and a few single specimens that have been acquired by the United States National Museum from various sources.

[1] Maryland Geol. Survey, Lower Cretaceous, 1911, pp. 173-178.

The Government materials which form the bulk of the collection, as said by Hatcher,[2] were "found in a bed of iron ore near Bladensburg [Muirkirk], Maryland. The exact locality of the Marsh material was certain iron ore mines on the farm of Mr. William Coffin, and especially in that one locally known as "Swampoodle" and situated about 1½ miles northeast of Beltsville, on the Baltimore & Ohio Railway, some 13 miles from Washington."

As to the occurrence of these fossils Hatcher says:

> No two bones or fragments of all that material collected from the Potomac beds in Maryland were found in such relation to one another as to demonstrate that they belonged to the same individual. In any discussion as to the affinities of these various genera and species of small Sauropod dinosaurs, not only the immature nature of the remains upon which they have been based, but also the scattered and disarticulated state in which found, must be constantly borne in mind.

The above remarks as to the scattered state of the specimens apply equally well to those other remains in the collection, subsequently brought together by Professor Bibbins and others.

THE ARUNDEL FAUNA.

Our knowledge of the Arundel fauna had its beginning as early as 1859, when Dr. Christopher Johnston gave the generic name *Astrodon*[3] without description to certain reptilian teeth obtained by a Mr. Tyson from a bed of iron ore near Bladensburg, Maryland.

In 1865 these teeth were fully described and figured as *Astrodon johnstoni* by Dr. Joseph Leidy,[4] they being the first remains of a Sauropod dinosaur to be named and described from North America.

Twenty-three years later Prof. O. C. Marsh made the next contribution[5] to our knowledge of this fauna, when he established two genera and five new species all pertaining to the dinosauria. These were *Pleurocoelus nanus*, *P. altus*, *Priconodon crassus*, *Allosaurus medius*, and *Coelurus gracilis*. The presence of turtle and crocodilian remains was mentioned, but it was 10 years later that Dr. O. P. Hay, described a turtle under the name of *Glyptops caelatus*.[6]

The next important paper dealing with this fauna was that by Prof. R. S. Lull[7] in which he revised and described all of the materials available at that time. Two species of dinosaurs *Creosaurus potens*, *Dryosaurus grandis* and a crocodilian reptile *Goniopholis affinis* were described as new, and the presence of a fossil gar fish was mentioned for the first time.

---

[2] Annals of the Carnegie Museum, vol. 2, 1903, pp. 11-13.

[3] Amer. Journ. Dental Sci., vol. 9, 1859, p. 341.

[4] Smiths. Contr. Knowl., vol. 14, art. 6, 1865, pp. 102-119, pl. 13, figs. 20-23; pl. 20, fig. 10

[5] Amer. Journ. Sci., ser. 3, vol. 25, 1888, pp. 89-94.

[6] Fossil Turtles of North America, Carnegie Institution, Washington, 1908, pp. 52, 53, pl. 7, figs. 1, 2.

[7] Rept. Geol. Survey of Maryland, Lower Cretaceous, 1911, pp. 173-211, pls. 11-20.

The complete fauna as recognized by Lull in 1911, and the revised fauna as now determined by Gilmore are shown in the two parallel columns below:

Vertebrate Fauna of the Arundel Formation.

Listed by Lull in 1911.	Revised by Gilmore in 1921.
	THEROPODA.
Allosaurus medius Marsh.	*Dryptosaurus? medius* (Marsh).
Creosaurus potens Lull.	*Dryptosaurus? potens* (Lull).
Coelurus gracilis Marsh.	*Coelurus? gracilis* Marsh.
	Ornithomimus affinis Gilmore
	SAUROPODA.
Pleuroceolus nanus Marsh.	*Astrodon nanus* (Marsh).
Pleuroceolus altus Marsh.	*Astrodon altus* (Marsh).
Astrodon johnstoni Leidy.	*Atrodon johnstoni* Leidy.
	ORTHOPODA.
Priconodon crassus Marsh.	*Priconodon crassus* Marsh.
Dryosaurus grandis Lull.	
	CROCODYLIA.
Goniopholis affinis Lull.	*Goniopholis? affinis* Lull.
	TESTUDINATA.
Glyptops caelatus Hay.	*Glyptops caelatus* Hay.
	PISCES.
Ganoid *fish.*	*Ganoid fish.*
	Undetermined fish.

The reasons for the above changes in the 1921 list are discussed below under their respective headings in the order as given above.

DISCUSSION OF THE MEMBERS OF THE ARUNDEL FAUNA.

Order DINOSAURIA.

DRYPTOSAURUS? MEDIUS (Marsh).

Plate 110, fig. 2.

This species was originally established by Marsh on a number of cotypes,[8] all but one, the crown of a single large tooth (Cat. No. 4972, U. S. N. M.), Lull subsequently removed to the genus *Dryosaurus*, as the cotypes of the new species *D. grandis* Lull,[9] and more recently referred by me[10] to the genus *Ornithomimus*. At this time *Dryptosaurus ? medius* rests on a single tooth shown in plate 110, figure 2. So far as the type material is concerned it will always

[8] Amer. Journ. Sci., vol. 35, 1888, p. 93.
[9] Maryland Geol. Survey, Lower Cretaceous, 1911, pp. 183-186.
[10] Bull. 110, U. S. National Museum, 1920, pp. 119-121.

remain a form of doubtful affinities. It is determinable as to suborder (the Theropoda), but in the present state of our knowledge concerning the carnivorous dinosauria it is not determinable generically, and should therefore be regarded as an indeterminate type.

The few scattered bones referred to this species by Lull can be assigned, with equal propriety, to *Dryptosaurus? potens* Lull, founded on a somewhat more adequate type. I have already, in the paper cited above, attempted to show that two caudal vertebrae, from the distal part of the tail formerly referred to this species, probably pertain to an Ornithomimid dinosaur, and some of the other bones may eventually find a similar fate in other directions.

It is quite probable that these scattered elements represent more than one kind of the large carnivorous dinosauria in this formation, but to definitely determine that fact more diagnostic materials must necessarily be found.

DRYPTOSAURUS? POTENS (Lull).

Plate 111, fig. 2.

This species was originally referred by Lull[11] to the genus *Creosaurus*, a genus established by Marsh on materials from the Morrison formation of Wyoming. In a recent paper[12] giving the results of a detailed study and comparison of the type with other Theropod specimens I arrived at the following conclusions:

1. That the genus *Creosaurus* should be abandoned to become a synonym of *Antrodemus*.

2. That the type specimen, consisting of a single vertebral centrum (see pl. 111, fig. 2), pertains to the caudal series and not to the presacral region as originally determined.

3. That a comparison of the type specimen with the homologous element in *Antrodemus* (compare figs. 1 and 2, pl. 111), shows such dissimilarities as to render its assignment to that genus out of the question.

4. That the closest resemblance of the type vertebral centrum appears to be with the caudals of *Dryptosaurus aquilunguis* Cope (compare fig. 2, pl. 111, with fig. 2, pl. 114), and it was therefore provisionally referred to that genus.

When viewed in profile the straightness of the ventral border with distinct keel at once distinguishes this bone from all known carnivorous dinosaurs of the Morrison formation. In *Tyrannosaurus* and *Gorgosaurus* from the western Upper Cretaceous the concavity of the lower border of the anterior caudal vertebrae is markedly straighter than in any of the Morrison Theropods, and in *Dryptosaurus* as figured by Cope (see pl. 114, fig. 2), from the Upper Cretaceous of

[11] Lower Cretaceous of Maryland, Maryland Geol. Survey, 1911, pp. 186–187, pl. 14, fig. 4.

[12] Bull. 110, U. S. National Museum, 1920, pp. 116–119, pl. 32.

New Jersey is found the nearest approach to the straight ventral border of the specimen under consideration.

Although fully recognizing the inadequate nature of the type material the resemblances pointed out above appear highly significant, and taken in conjunction with their similar geographical distribution leads me to believe its assignment to *Dryptosaurus* to be the logical disposition of this species at this time.

COELURUS? GRACILIS Marsh.

Plate 110, fig. 5.

Coelurus gracilis Marsh was also established on a very poor specimen consisting of an ungual phalanx, the tip of which is missing, as shown in plate 110, figure 5.

The original description is as follows:

> The smallest Dinosaur found in these deposits is a very diminutive carnivore, apparently belonging to the genus *Coelurus*. It was not more than one-half of the size of the western species and its proportions were extremely slender. The bones are very light and hollow, the metapodials being much elongated and their walls extremely thin. An ungual phalanx of the manus measures about 25 mm. in length and 14 mm. in vertical diameter at the base. This animal could not have been more than 5 or 6 feet in length.

One would infer from the above description that Marsh had other bones besides the ungual, but I find none in the collection which could by any stretch of the imagination be so referred.

Three teeth in the Goucher College collection were referred by Lull to this form, two of them having come from the same locality as the type. These, of course, have been arbitrarily associated. The comparison of these teeth with the tooth of *Coelurus fragilis*, figured by Marsh [13] from the Morrison and which Lull has shown differ considerably in the almost total reduction of the crenulation of the anterior convex border, and their larger size, offers but little assistance in getting at the true affinities of these teeth. Furthermore, as I have shown,[14] the tooth of *C. fragilis* does not belong to the type materials, it having been received at the Yale Museum some time in advance of the type, so there is no evidence of their association.

That the (type) ungual pertains to the fore foot of a small carnivorous dinosaur there can be no question, but that it is referable to the genus *Coelurus* remains to be demonstrated. In the present state of our knowledge of the carnivorous dinosauria I doubt the possibility of determining the genus to which it belongs, at least with any certainty of the correctness of the identification.

A careful comparison of the type specimen has been made with all available carnivore unguals in the collections of the United States

[13] 16th Ann. Rep. U. S. Geol. Surv., pt. 1, 1896, pl. 7, fig. 1.

[14] Bull. 110, U. S. National Museum, 1920, p. 128.

National Museum and the American Museum of Natural History, from the Morrison, Lance, and Belly River formations, and those which were found to resemble it most nearly were from the Belly River formation. No fewer than four unguals in the American Museum of Natural History collections, except for their larger size, were exact counterparts of the bone under consideration (compare figs. 4 and 5, pl. 110). None of these, however, have been identified. One of them is illustrated here together with the type to show their close resemblance. While the observations recorded above may be of little moment, it appears significant that two bones from widely separated geological horizons should show such startling close resemblances, especially since the Arundel fauna contains other members that have unquestioned Upper Cretaceous affinities.

ORNITHOMIMUS AFFINIS Gilmore.

Plate 112, figs. 1 and 3; plate 113, figs. 1 and 3; plate 114, fig. 1.

Ornithomimus affinis was founded [15] on a number of cotypes, consisting of an astragalus, metatarsals, and other elements of the hind feet. In 1888 [16] those same bones were used by Prof. O. C. Marsh as the cotypes of the species *Allosaurus medius*, all of which excepting a tooth were subsequently referred by Lull [17] to the Orthopoda and to the new species *Dryosaurus grandis*. In a recent paper [18] I have shown that these cotypes do not pertain to the herbivorous dinosauria but to the carnivorous Theropoda, and in all probability to the genus *Ornithomimus*. The species name "*grandis*" having been previously used, it became necessary to assign a new name and the term *O. affinis* was selected to designate this species.

The recognition of an Ornithomimid dinosaur in the Arundel fauna was entirely unexpected for previously representatives of the family Ornithomimidae had only been known from the Judith River, Belly River, Edmonton, Denver, and Lance formations of the Rocky Mountain region, all Upper Cretaceous, while the Arundel on the highest authority, has been regarded of Lower Cretaceous age. Thus the range of this dinosaurian family is greatly extended both geologically and geographically.

Since these cotypes have been described in detail in a recent paper [19] it appears unnecessary to do more here than to call attention to those features which demonstrate the Theropod nature of these bones, followed by a summary of the reasons for assigning them to the genus *Ornithomimus*.

---

[15] Bull. 110, U. S. National Museum, 1920, pp. 137.

[16] Amer. Journ. Sci., vol. 35, 1888, p. 93.

[17] Lower Cretaceous, Geol. Survey of Maryland, 1911, pp. 183–186.

[18] Bull. 110, U. S. National Museum, 1920, pp. 137–142.

[19] Idem, pp. 137–142.

In the parallel columns below the Theropod nature of the cotypes are clearly demonstrated by contrasting their important structural features with the homologous bones of the Orthopod hind foot.

Theropod characteristics of the cotypes of Ornithomimus affinis.	*Characteristics of the Orthopod pes.*
1. Astragalus with ascending process.	1. Ascending process always absent.
2. Astragalus narrow fore and aft as compared with transverse diameter.	2. Astragalus wide fore and aft, as compared with transverse diameter.
3. Articular surface on distal end of metatarsal III, extending higher on front than on back of bone.	3. Extent of articular surface on front and back of distal end of metatarsal III, subequal.
4. Unguals of hind feet compressed.	4. Unguals of hind feet depressed.
5. Lateral pits on distal ends of foot bones deep and their borders well defined.	5. Lateral pits on distal ends of foot bones shallow or wanting, their borders when present, illy defined.
6. Articular ends of foot bones, having well finished surfaces.	6. Articular end of foot bones, usually lacking refinement of their surfaces.

The Ornithomimid character of these cotypes was established by a direct comparison with the foot bones of the fine skeleton of *Ornithomimus (Struthiomimus) altus* Lambe and other Ornithomimid materials in the American Museum of Natural History, New York. In every instance such close resemblances were found as to leave little doubt of their generic identity.

For the present purposes it is thought the similarities of these bones may be most clearly demonstrated by showing homologous bones of the Arundel and Belly River Ornithomimids side by side. In plates 112 and 113 are thus illustrated a number of these bones reproduced here from photographs. Their close similarities, in some instances, down to the minutest details appears to me to be sufficient to demonstrate their pertaining to animals of congeneric relationship.

SAUROPODOUS DINOSAURS.

Prof. R. S. Lull has given such a thorough and detailed discussion [20] of the Sauropod Dinosaur remains from the Arundel formation that for the present purposes a detailed discussion of them appears unnecessary. After a thorough examination of the materials I fully concur in his conclusions. Lull recognized three species of Sauropodous dinosaurs from the Arundel *Astrodon johnstoni, Pleurocoelus nanus,* and *P. altus.* Hatcher contended [21] that—

> Since these remains were found in essentially and perhaps identically the same locality and horizon, and, in consideration of the very great similarity which they exhibit, there appears no good reason for considering them as pertaining to either different genera or species. *Astrodon johnstoni* Leidy, having priority, should, therefore, be retained, while *Pleurocoelus nanus* would become a synonym of that genus and species.

[20] Lower Cretaceous, Md. Geol. Survey, 1911, pp. 183–204.

[21] Annals Carnegie Museum, vol. 2, 1903, pp. 11–12.

Lull observes:

I am inclined to agree with Hatcher in considering *Astrodon* and *Pleurocoelus* synonyms, but not in the synonym of the species, *P. nanus* with *Astrodon johnstoni:* * * * *Pleurocoelus altus*, on the other hand, is represented by but few bones, and could readily have been the possessor of teeth like those of *Astrodon johnstoni.* * * * It is therefore quite possible that *Pleurocoelus altus* should be considered as synonymous with *Astrodon johnstoni*, in which case the latter name would take precedence. It seems preferable, however, in view of the rarity of the remains, to let the matter rest in abeyance until further proof is obtained.

The materials clearly show the presence in the Arundel of a large and small species of the Sauropodous dinosauria, and while I fully concur in Lull's view of the continued use of all the named species, I think it preferable to assign all to the genus *Astrodon*, which clearly has priority.

PRICONODON CRASSUS Marsh.

Plate 110, fig. 3.

Priconodon crassus was founded by Marsh [22] on a single tooth (Cat. 2135, U. S. N. M.) (see pl. 110, fig. 3), his original description being as follows:

The existence of another herbivorous dinosaur in the same horizon of the Potomac formation is indicated by a number of fragmentary remains, the most characteristic of which is the tooth figured below. This may be regarded as the type specimen. Although resembling somewhat the teeth of *Diraconodon* [*Diracodon*] from the Jurassic of the West, it is quite distinct. It has the narrow neck, swollen base, and flattened crown of that genus, but the serrated edges meet above at a sharp angle, instead of forming a wide curve at the apex. The surface shown in fig. 7 [pl. 110, fig. 3, left] is much worn by the opposing tooth. In figure 9 [pl. 110, fig. 3, right] the pit formed by the succeeding tooth is seen near the top of the fang.

Lull, in his study [23] of the Arundel vertebrates, consisting of the type and subsequently discovered materials, recognized five other teeth pertaining to *Priconodon crassus*, and a vertebral centrum was questionably referred by him to this species. The latter I regard as pertaining to the sacrum, and have tentatively assigned [24] it to *Ornithomimus*.

Lull recognized the resemblance of these teeth to those of *Palœoscincus costatus* Leidy. He says:

This tooth [the type] resembles somewhat that of *Palaeoscincus costatus* Leidy, from the Judith River beds, though the type of *Palaeoscincus* is slightly smaller than that of the present species. The swelling shoulder in *Priconodon* is more prominent and rounded than in *Palaeoscinus*, and in the latter the cusps are much sharper and more prominent, though less numerous on one edge of the crown. The median ridge of *Priconodon* is also lacking.

In his concluding remarks Lull says:

The tooth of *Priconodon* comes nearest Leidy's *Palaeoscincus* from the Judith River, to which it could readily be ancestral, as the evolutionary tendency on the part of the Orthopoda is to increase the number and decrease the size of the teeth.

[22] Amer. Journ. Sci., ser. 3, 1888, vol. 25, p. 93, figs. 7–9.

[23] Report Maryland Geol. Survey, Lower Cretaceous, 1911, p. 208.

[24] Bull. 110 U. S. National Museum, 1920, p. 142.

After comparing the type and other teeth of *Priconodon* with the teeth of *Palaeoscincus* and *Stegosaurus* in the National Museum collections, I fully concur in Lull's conclusions as to their close resemblance to those of *Palaeoscincus*, but do not see that they are any closer to the latter than to *Stereocephalus tutus* Lambe,[25] also an Upper Cretaceous form from the Belly River of Alberta, Canada.

In size, method of wear, and general characteristics the teeth of *Priconodon* certainly indicate closer affinities with the armored dinosaurs of the Upper Cretaceous than with *Stegosaurus* of the Morrison formation.

Although our classification of the American armored dinosauria is somewhat in confusion at the present time, the discoveries of recent years, much of the material as yet undescribed, shows that the Upper Cretaceous forms belong to families distinct from the Morrison Stegosauridae. Whether the Nodosauridae, Ankylosauridae, or Scelidosauridae all represent valid families I am not prepared to say, but it is to one of these, probably the Nodosauridae, that *Priconodon* should be assigned rather than the tall plated Stegosauridae as classified by Hay,[26] Lull,[27] and others.

Order LORICATA

Family CROCODYLIDAE.

GONIOPHOLIS? AFFINIS Lull.

Plate 110, fig. 1.

This crocodilian was founded on very scanty materials, the selected type being the crown of a single tooth (Cat. No. 8452, U.S.N.M.) (pl. 110, fig. 1), though other teeth and part of a dermal scute were mentioned in the original description.[28]

Lull points out that while the teeth resemble, in size and shape, those of crocodiles from the Morrison formation, yet they differ by "having secondary ridges between the main ridges on the proximal portion of the crown." The sculpturing of the scute is also shown to be coarser than on any of those from the Morrison of the West.

In view of the present state of our knowledge concerning the extinct Crocodilia I do not believe it is possible to definitely determine the genus to which a form based on such meager materials belongs, and until more diagnostic specimens are found it will undoubtedly remain a species of uncertain affinities. At this time it has no apparent value for the correlation of this fauna and should be eliminated from such consideration. Except for showing the presence in the Arundel fauna of an extinct crocodilian these fragmentary specimens have but little significance.

[25] Contributions Canadian Paleontology, vol. 3, pl. 2, 1902, pp. 55–57.

[26] Bull. 179, U. S. Geol. Surv., 1902, p. 496.

[27] Rept. Md. Geol. Surv., 1911, Lower Cret., p. 207.

[28] Idem, pp. 210–211, pl. 20, fig. 7.

Order TESTUDINATA.

Family PLEUROSTERNIDAE.

GLYPTOPS CAELATUS Hay.

There have been no additional discoveries of turtle remains in the Arundel formation since Dr. O. P. Hay described [29] *Glyptops caelatus* in 1908, so that our knowledge of this form rests entirely on the type, a fragmentary specimen, from which little information can be obtained as to its relationships to the other species of the genus. At my request Doctor Hay was kind enough to reexamine the type materials for the present study and reports as follows:

> I can not say whether *Glyptops caelatus* is more or less closely related to the Morrison forms than to those from the Lower Cretaceous. In comparing the Morrison and Arundel faunas I think I would not put *G. caelatus* in the balance.

From the above statement it appears, therefore, on the highest authority, that the Arundel turtle remains can not contribute anything of value to the present discussion of this fauna.

CLASS PISCES.

At this time the known fish remains of the Arundel fauna consist of a single scale of a Ganoid and a tooth which, in the sculpturing of its flattened grinding surface, slightly resembles those of *Ptychodus* from the Niobrara formation of the Upper Cretaceous. It probably represents an undescribed form. The specimen (Cat. No. 10294, U.S.N.M.) was found by Mr. C. Englehart in 1894 near Contee, Maryland.

SUMMARY.

In the preceding review of the several genera and species of fossil vertebrates that comprise the known fauna of the Arundel formation of Maryland, it is apparent that most of them were established on very meager and, in some instances, inadequate materials. The proper treatment of such more or less indeterminate forms has long been one of the difficult problems in modern vertebrate paleontology. In the handling of this fauna in the past, but little discrimination has been made as to the adequate or inadequate nature of the specimens on which the names were based. To regard all members of a fauna as generically and specifically determinable, when from the very character of the type specimens they can only be determined as to order or family, is an erroneous practice.

While in making up faunal lists it is necessary to include such forms, it should always be specified to what extent such questionable genera and species are determinable. The neglect of such a precaution has in the past sadly misled workers in their final conclusions

[29] Fossil Turtles of North America, 1908, pp. 52, 53, pl. 7, figs. 1, 2.

where faunal lists have been used to prove the synchronous nature of widely separated formations.

The contention of Marsh,[30] corroborated by Hatcher,[31] and the later even more positive assertion of Lull[32] that the Arundel fauna "correlates the beds wherein they are found absolutely with the Morrison (Como) of the west," is a conclusion which this recent study shows can not be maintained.

Forms that have been founded on single teeth or a single bone, especially in the reptilia, do not permit of an accurate diagnosis of that form, and neither does it permit of a satisfactory comparison with other specimens. Some of these, as the types of *Coelurus gracilis*, *Dryptosaurus? medius*, and *Dryptosaurus? potens*, are certainly determinable as to suborder, possibly family, but are not surely determinable generically, as the genera of carnivorous dinosaurs are now distinguished. The remaining Theropod, *Ornithomimus affinis*, is certainly distinguishable as to family, possibly as to genus.

While the synonymy of the two genera and three species of the Sauropoda found in the Arundel fauna is somewhat uncertain at this time, the materials are entirely sufficient on which to characterize at least one good genus and two species, and for the purposes of the present discussion this appears entirely adequate.

The Orthopoda is represented by the single genus and species, *Priconodon crassus*, based on a single tooth. At this time our knowledge of the armored dinosauria is such that we do not know whether the teeth are diagnostic of genera or not. Taking into account the highly specialized character of the teeth in the few known forms, it would appear that perhaps in this group of reptiles, when sufficiently well known, it will be found that the teeth are diverse enough in their characters to at once tell to which particular genus they pertain.

The above review of determined forms shows the evidence for the correlation of the Arundel fauna with the Morrison, rests entirely on the presence of Sauropodous dinosaurs in both formations, and the apparent occurrence of one genus *Astrodon* (*Pleurocoelus*) common to both, although a review of the Morrison materials identified as pertaining to *Astrodon* (*Pleurocoelus*) by both Marsh and Hatcher is scanty and not altogether reassuring as to the soundness of their identifications. It is my conclusion that, with the exception of *Astrodon* (*Pleurocoelus*), there is not another one of the named dinosaurian specimens from the Arundel which at this time can be said to be closely allied to any of the Morrison forms.

On the other hand the presence of an Ornithomimid dinosaur pertaining to the family Ornithomimidae, which has never before been

[30] Amer. Journ. Sci., vol. 11, 1896, pp. 435–436.

[31] Annals Carnegie Museum, vol. 2, 1903, pp. 13–14.

[32] Lower Cretaceous, Geol. Survey of Maryland, 1911, p. 178.

known below the Upper Cretaceous (Belly River); an armored dinosaur, *Priconodon crassus*, which Lull, correctly recognizes as having its closest affinities with *Palaeoscincus* of the Upper Cretaceous; a carnivorous dinosaur having a caudal vertebra most nearly resembling the Upper Cretaceous *Dryptosaurus* from New Jersey; and the smaller Theropod *Coelurus? gracilis* based on a claw of the fore foot, that except for its much smaller size has its exact counterparts in collections from the Belly River formation.

Summing up the evidence, such as it is, we have on the one hand in the Arundel the presence of Sauropodous dinosaurs which have been generally considered as not having survived after the close of the Morrison, and on the other hand one family of known Upper Cretaceous occurrence, and at least three other forms which have their closest resemblances with Upper Cretaceous dinosaurs. Imperfect as it is, the weight of the vertebrate evidence would appear to favor a higher position in the geological scale than has been attributed this fauna in the past.

In this connection it is of interest to find that this conclusion is more in accord with the paleobotanical evidence, as interpreted by Berry, than the previously accepted correlation of the Arundel with the Morrison. Berry,[33] in comparing the floras of the Arundel and Kootanie of Montana, observes:

> The two floras have a great many elements in common, and upon the basis of the floras alone the conclusion would be reached that the base of the Kootanie was approximately the same age or slightly older than the base of the Patuxent (a formation conformably underlying the Arundel). When the faunas are considered it develops that the Morrison fauna, which is considered by many paleontologists to be of Jurassic age, is found conformable beneath the beds containing the Kootanie flora, which is of unquestioned Lower Cretaceous age. Along the Atlantic seaboard this is reversed and the bulk of the flora corresponding to that of the Kootanie underlies beds containing a large representation of the Morrison fauna, and which also has been considered to be Jurassic age by Marsh and others.

West.	East.	
	Patapsco unconformable.	Potomac Group.
	Arundel Dinosaurs.	
Kootanie Plants.	Patuxent Plants.	
Morrison Dinosaurs.		

[33] Lower Cretaceous, Maryland Geol. Survey, 1911, pp. 155–156.

Berry's conclusion, based alone on the evidence of the floras, that the Patuxent and Kootanie formations are of approximately the same age, as graphically shown in the foregoing diagram, is now fully in accord with the vertebrate evidence as indicating a higher position in the Lower Cretaceous for the Arundel formation than has been previously given it. The only difference between these two lines of evidence is that, whereas "the Patuxent-Arundel floras are essentially a unit of early cretaceous age whose affinities all lie with the floras which preceed them," the affinities of the Arundel vertebrate fauna is divided, the Sauropod dinosaurs having close relationships with the preceding fauna and all others apparently having their closest affinities with those faunas which succeeded the Arundel.

EXPLANATION OF PLATES.

Plate 110.

Fig. 1. Tooth of *Goniopholis*? *affinis* Lull. Type. Cat. No. 8452, U.S.N.M. Natural size after Lull. See p. 589.

Fig. 2. Tooth of *Dryptosaurus*? *medius* (Marsh). Type. Cat. No. 4972, U.S.N.M. Natural size. Lateral view. See p. 583.

Fig. 3. Tooth of *Priconodon crassus* Marsh. Type. Cat. No. 2135 U.S.N.M. Natural size. Outer, edge, and inner views. After Marsh. See p. 588.

Fig. 4. Ungual phalanx of the manus of an unidentified dinosaur from the Belly River formation, Upper Cretaceous of the Red Deer River, Alberta, Canada. Cat. No. 5387, Amer. Mus. Nat. Hist. Twice natural size. Lateral view. See p. 586.

Fig. 5. Ungual phalanx of the manus of *Coelurus*? *gracilis* Marsh. Type. Cat. No. 4973, U.S.N.M. Twice natural size. Lateral view. With the exception of the difference in size, note the close similarity of figures 4 and 5. See p. 585.

Plate 111.

Fig. 1. Anterior caudal centrum of *Antrodemus valens* Leidy. From the Morrison formation of Wyoming. Cat. No. 8367, U.S.N.M. About one-half natural size. Viewed from the left side. See p. 584.

Fig. 2. Anterior caudal centrum of *Dryptosaurus*? *potens* (Lull) from the Arundel formation of Maryland. Type. Cat. No. 3049, U.S.N.M. About one-half natural size. Viewed from the left side. Compare the straight ventral border of this bone with the anterior caudals of *Dryptosaurus aquilunguis*, pl. 114, fig. 2. See p. 584.

Plate 112.

Fig. 1. Second phalanx digit III, right, of *Ornithomimus affinis* Gilmore, Cotype. Cat. No. 5703, U.S.N.M. Anterior view. Natural size. See p. 586.

Fig. 2. Second phalanx digit III, right, of an Ornithomimid dinosaur from the Belly River formation, Upper Cretaceous, Alberta, Canada. Cat. No. 5201, Amer. Mus. Nat. Hist. Anterior view. Natural size. See p. 586.

Fig. 3. Proximal phalanx of digit II, left *Ornithomimus affinis* Gilmore, Cotype. Cat. No. 5453, U.S.N.M. Anterior view. Natural size. See p. 586.

Fig. 4. Proximal phalanx of digit II, left, of an Ornithomimid dinosaur, same as fig. 2. Natural size. See p. 586.

PLATE 113.

FIG. 1. Second phalanx digit IV, right, of *Ornithomimus affinis* Gilmore, Cotype. Cat. No. 8456, U.S.N.M. Anterior view. Natural size. See p. 586.

FIG. 2. Second phalanx digit III, right of an Ornithomimid dinosaur from the Belly River formation, Upper Cretaceous, Alberta, Canada. Cat. No. 5201, Amer. Mus. of Natural History. Anterior view. Natural size. See p. 586.

FIG. 3. Distal portion of metatarsal III, right of *Ornithomimus affinis* Gilmore, Cotype. Cat. No. 5684, U.S.N.M. Anterior view. Natural size. See p. 586.

FIG. 4. Distal portion of metatarsal III, left of an Ornithomimid dinosaur from the Belly River formation, Upper Cretaceous of Alberta, Canada. Cat. No. 5201, Amer. Mus. Nat. History. Anterior view. Natural size. See p. 586.

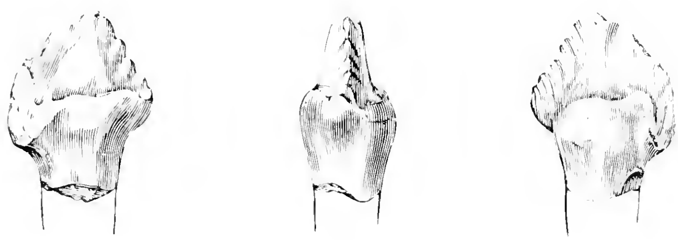
PLATE 114.

FIG. 1. Distal portion of metatarsal II, right, of *Onithomimus affinis* Gilmore. Cotype. Cat. No. 5704, U.S.N.M. Lateral view. Natural size. See p. 586.

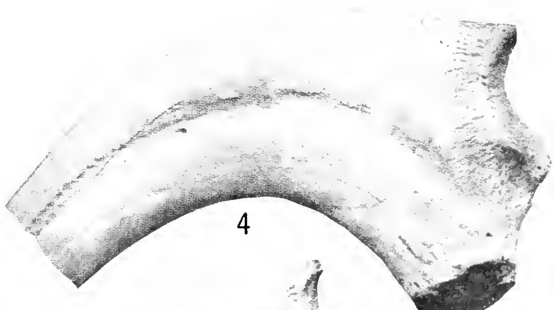
FIG. 2. Anterior caudal vertebrae of *Dryptosaurus aquilunguis* Cope. Very much reduced. Compare with fig. 2. Plate II. After Cope. See p. 584.

1

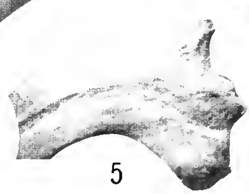
2



3



4



5

FAUNA OF ARUNDEL FORMATION OF MARYLAND.

FOR EXPLANATION OF PLATE SEE PAGE 594.

1

2

FAUNA OF ARUNDEL FORMATION OF MARYLAND.

FOR EXPLANATION OF PLATE SEE PAGE 593.

1

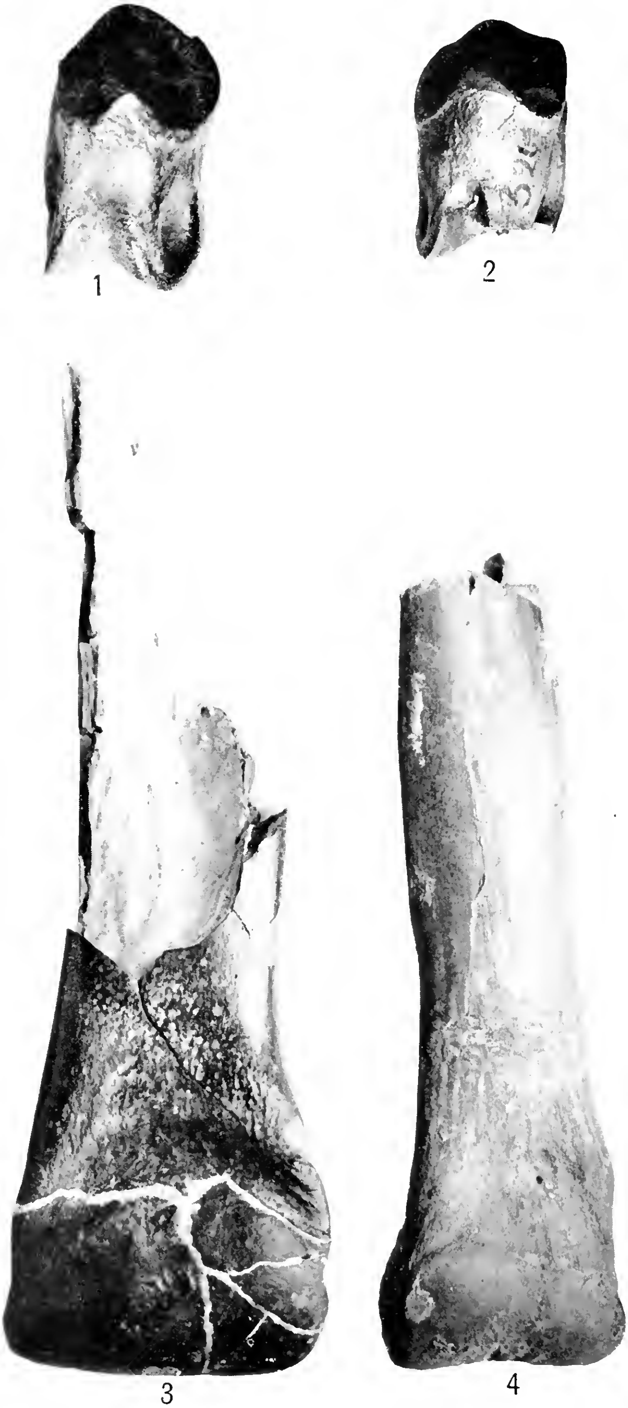
2

3

4

FAUNA OF ARUNDEL FORMATION OF MARYLAND.

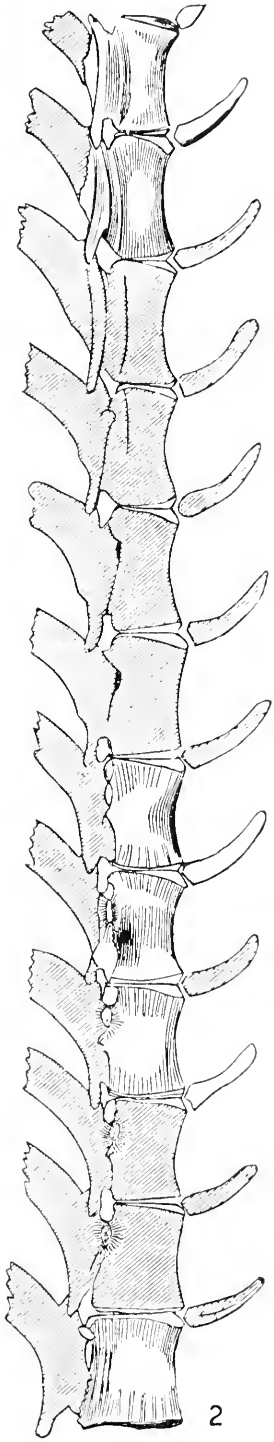
FOR EXPLANATION OF PLATE SEE PAGE 594.



FAUNA OF ARUNDEL FORMATION OF MARYLAND.

FOR EXPLANATION OF PLATE SEE PAGE 594.

1



2

FAUNA OF ARUNDEL FORMATION OF MARYLAND.

FOR EXPLANATION OF PLATE SEE PAGE 591.

SOME INTERESTING DRAGON-FLY NAIADS FROM TEXAS.

By Clarence Hamilton Kennedy.
Of Ohio State University, Columbus.

On October 20, 1920, the writer received from the United States National Museum a small collection of Gomphine naiads for identification. These were collected by J. D. Mitchell and labeled, "From Colleto Creek and sloughs in creek bottom near Victoria, Texas, July 2, 1920." This is in southeastern Texas in the valley of the Guadaloupe River. The collection, while small, is of interest, first, because all Gomphine records from this southwestern boundary of the Austro-riparian faunal region are interesting, and, secondly, because it contains at least one new form. It is unfortunate that these were not reared to make their identity positive. All are quite immature, having been collected in July; they would have emerged in the spring and early summer of 1921.

No data are readily available on the nature of the stream in which they were caught, but the evidence is that it is very sandy. This is suspected because the collection includes *Progomphus obscurus*, which is found only in the sandiest streams, and because none of the naiads show traces of mud in their hairy covering, as Gomphine naiads from sandy streams are spotlessly clean, while those from mud bottom are always filthy.

Because our knowledge of Gomphine Odonata is so limited the writer has been to pains to illustrate these fully.

PROGOMGHUS OBSCURUS (Rambur).

Plate 115, figs. 1–7.

The material consists of 35 naiads, ranging in length from 7 mm. to 28 mm. The largest two, 25 and 28 mm. in length, would undoubtedly have emerged during the season of 1920, as the *Progomphus* season is a long one. Whether the numerous smaller examples would have emerged the same season or one or two seasons later it is impossible to say, as so little is known concerning the life history of *Progomphus*. Burrowing insects in general are slow feeders and consequently slow growers. It is impossible to give a table of measurements because about 20 of the specimens are broken.

The small specimens are the smallest *Progomphus* naiads the writer has seen, and are interesting in that they show by the way the mature naiads differ from them, the direction in which the latter are specialzed. Figure 1 represents the mature naiad. The specimens 7 mm. ong differ from the mature naiad as follows:

1. The wing pads are minute triangular flaps.
2. The dorsal spines on segments 2 and 3 are lacking. (See fig. 7).
3. The superior pair of anal appendages are mere tubercles. (See fig. 7).
4. The fourth segment of the antenna is only one-third as long as the third. (In the mature naiad it is nearly one-half as long as segment 3). (See figs. 2 and 4.)
5. Labium with two triangular teeth on the middle lobe besides the usual row of truncate teeth. (In the adult there are not noticeable triangular teeth). (See fig. 6).
6. Lateral labial lobe with several broad though shallow teeth. (See fig. 5.)

It can be legitimately inferred that these ontogenetic changes point out the phylogeny of this most specialized of burrowing Odonate naiads. They must have developed through a Gomphus-like form that had the characters of these very young naiads. It is interesting to note that these specializations have developed more in the naiad of *borealis*[1], and that on naiadal characters alone *obscurus* is more generalized than *borealis.* This pair of species agrees with *Amphiagion* and a number of other pairs of closely related species of Odonata in which the western form is more specialized than the eastern. It is interesting to those studying distribution to find that these *obscurus* naiads from Texas, where both *obscurus* and *borealis* are found, are in no wise intermediate in characters between the two species but are true *obscurus* naiads.

GOMPHUS (ARIGOMPHUS) SUBAPICALIS Williamson ? or SUBMEDIANUS Williamson.?[2]

Plate 115, figs. 8–12.

Four specimens, 14–19 mm. in length. Wing pads minute, triangular, barely reaching beyond the apex of segment 1. Probably 1 year old or half grown.

By Doctor Needham's key,[3] to the naiads of the subgenera of the genus Gomphus these run out to the subgenus *Arigomphus.* Muttkowski and Whedon [4] discuss the naiads of this subgenus to which

[1] See Kennedy, Odonata of Central California and Nevada. Proc. U. S. Nat. Mus., vol. 52, pp. 527-529, 1917.

[2] In the Bulletin of the Bureau of Fisheries, vol. 36, p. 250, Prof. C. B. Wilson records this species from Illinois opposite Fairport, Iowa. In a letter to the writer he states that exuviae were collected there, but were lost when the Fairport Laboratory burned.

[3] Needham, American Gomphinae. Can. Ent., vol. 29, pp. 167–168, 1897.

[4] Muttkowski and Whedon, On Gomphus cornutus Tough. Bull. Wis. N. H. Soc., vol. 13, pp. 88-101, June, 1915.

they ascribe the species *australis*, *cornutus*, *furcifer*, *pallidus*, *subapicalis*, *submedianus*, *villosipes*, and *whedoni*. The only species of this group known to be regional are *subapicalis* and *submedianus*. I think we can ascribe these naiads to one or the other of these species with little doubt. They were collected from a sluggish stream or sloughs such as are inhabited by members of this group.[5]

The following is a description of this naiad: Head small, body very flat, abdomen lanceolate, broadest at segments 4 and 5, tapering abruptly at segment 8 to the narrow segments 9 and 10.

Head triangular, the eyes noticeably small, though surrounded by a large eyelike area. (See fig. 10.) Labium as in *furcifer*,[6] with the middle lobe but slightly rounded and bearing a single median tooth among the long needlelike scales. (See figs. 9 and 11.) Lateral lobes with their apices but slightly incurved and bearing six obliquely truncated teeth besides the end tooth. (See fig. 9.)

Abdomen with a low, rounded, and interrupted mid-dorsal keel extending from the apex of segment 3 to the middle of segment 9 and on segments 8 and 9 terminating in a short rounded point. Segments 6 to 9 with lateral spines, short on segments 6 to 8, but those on 9 nearly as long as segment 10. Apex of abdomen upturned; segment 8 slightly more than one and a half times as long as segment 7. Segment 10 longer than wide, one-half as long as 9. Anal appendages less than segment 10 in length. (See fig. 12.)

This naiad differs from those of *australis*, *cornutus*, and *furcifer* in the great length of the lateral spines on segment 9; it differes from the naiads of *pallidus* and *villosipes* in that the abdomen is noticeably suddenly contracted at segment 8. Thus this naiad combines the shape of the abdomen in *australis*, *cornutus*, and *furcifer* with the long spines on segment 9 found in *pallidus* [7] and *villiosipes*.

GOMPHUS (STYLURUS) PLAGIATUS Selys.

A single immature naiad 25 mm. long; its wing cases reaching to the middle of segment 2.

This subgenus has had the following species ascribed to it by Williamson [8]: *Amnicola*, *scudderi*, *plagiatus*, *spiniceps*, and *notatus*. To these we can now add *olivaceus* and *intricatus*. The naiad of *notatus* is unknown. This naiad agrees, except in its immaturity, with a reared *plagiatus* in the writer's collections.

DROMOGOMPHUS SPOLIATUS (Hagan).

A single naiad 25 mm. long. This is immature with the wing cases reaching barely beyond segment 1.

[5] Muttkowski and Whedon, Gomphus cornutus Tough, Bull. Wis. N. H. Soc., vol. 13, p. 99. 1915.

[6] Walker, The nymph of Gomphus furcifer, Can. Ent., Dec. 1904.

[7] Hagen's description (Trans. Amer. Ent. Soc., vol. 12) does not agree with Cabot's figure in that the figure has short spines on segment 9.

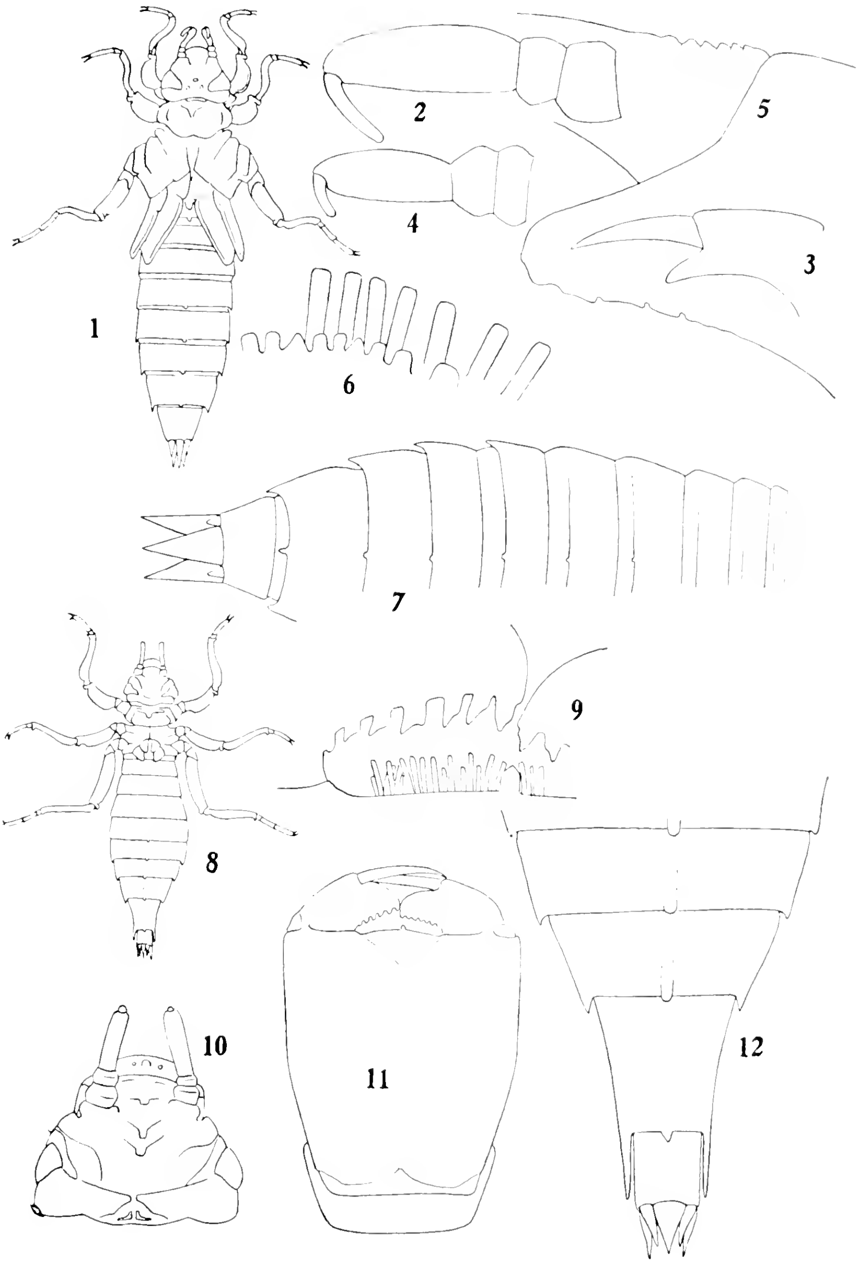
[8] The subgenus Stylurus, Trans. Amer. Ent. Soc., vol. 18, p. 207, 1901.

EXPLANATION OF PLATE 115.

The drawings are by the author.

Figs. 1–7.—*Progomphus obscurus.*—1, mature naiad; 2, antenna of mature naiad; 3, lateral labial lobe of mature naiad; 4, antenna of young naiad; 5, lateral labial lobe of young naiad; 6, a portion of the armature of the median labial lobe, showing the two triangular teeth; 7, abdomen of young naiad, showing the armature.

Figs. 8–12.—*Gomphus* (*Arigomphus*), species ?—8, naiad; 9, labial armature; 10, head; 11, labium; 12, segments 7–10 of the abdomen.



DRAGON-FLY NAIADS FROM TEXAS.

FOR EXPLANATION OF PLATE SEE PAGE 598.

DESCRIPTIONS OF SPECIES OF PLEISTOCENE VERTEBRATA, TYPES OR SPECIMENS OF MOST OF WHICH ARE PRESERVED IN THE UNITED STATES NATIONAL MUSEUM.

By Oliver P. Hay,

Associate of the Carnegie Institution of Washington.

INTRODUCTION.

In the paper which follows there are described fossil remains of Pleistocene Mammalia, which have been found at three principal places: Denver, Colorado; Wenatchee, Chelan County, Washington; and Anita, Coconino County, Arizona. In addition to the species from these places there are described remains of camels and of rodents and lagomorphs from various localities west of the Mississippi River; also bones of a sloth from near Williston, Levy County, Florida.

1. COLLECTION OF FOSSIL VERTEBRATE REMAINS FOUND AT DENVER, COLORADO.

In the United States National Museum there is a small collection of fossil mammals which was presented in 1915 by Prof. George L. Cannon, of the Eastern High School of Denver. Nearly all of these remains had been found by Mr. E. Blackburn, about 1902, and given to Professor Cannon. They had been discovered mostly about one-half mile south of Fairmount Cemetery, on the western side of Platte River, in the fine deposit which was laid down by Platte River and regarded sometimes as loess. The depths at which the bones were found are not known. The Quaternary geology of the quadrangle has been described by Dr. S. F. Emmons, aided by Professor Cannon.[1] According to the geological map of that quadrangle,[2] the Quaternary deposits along the Platte consist of ancient river drift (Terrace) and of a later alluvium. The former is mapped along the eastern shore of the river from Denver northward. On the western shore there is indicated only the later alluvium. Nevertheless, in this later deposit there have been found remains of horses and camels. The present writer believes that these deposits are about as old as the first interglacial stage. It can not be said that deposits laid down at an early

[1] Mon. U. S. Geol. Surv., vol. 27, 1896, pp. 255-278.
[2] Idem, pl. 2.

period and containing camel bones had been reworked during a later Pleistocene time; for there is present the lower end of the fore-arm, all the bones of the wrist (except the pisiform), and the upper end of the cannon bone, evidently of one individual.

The remains obtained from Professor Cannon are identified as follows: *Equus*, species indeterminable; *Camelops huerfanensis; Bison*, species indeterminable.

Besides these there is present an astragalus of a prong-horn antelope, but there is no certainty that it is not that of a comparatively recent individual.

EQUUS, species indeterminable.

An indeterminable species of horse is represented by a right third metacarpal (Cat. No. 8217), a left metatarsal (Cat. No. 8216), and an anterior first phalanx. These have the appearance of having lain in the same kind of deposit and may have belonged to the same individual. The metacarpal has a total length of 244 mm. and a side-to-side diameter of 37 mm. at the middle of the length. The total length of the metatarsal is 268 mm.; its side-to-side diameter at the middle of the length, 37 mm. The length of the phalange is 78 mm.

CAMELOPS HUERFANENSIS.

Plate 116, figs. 1–7.

What is believed to be *Camelops huerfanensis* is represented by a number of fine teeth and by various bones. It is not known to what extent the various bones and teeth were associated, but the teeth were not probably found with the bones. Measurements are presented both of the teeth, and of some of the bones. Such measurements may be of use in the identification of other remains. The teeth are to be compared with those of the type of *Camelops huerfanensis* (Cragin). Those from Denver consist of a right fourth premolar (pl. 116, fig. 1); a right first molar (pl. 116, figs. 2, 3); a right second molar (pl. 116, figs. 4, 5); a right third molar (pl. 116, fig. 6); all of the upper jaw. There is, besides, a lower left second molar which appears not to have belonged to this individual, but to another of about the same age. All of these teeth are those of animals mature, but yet young. The hindermost molars are but little worn; and all may be said to be in prime condition. In the table of measurements here presented the height is given merely to indicate the stage of wear. The specimen described by Cragin was a somewhat older animal. In the columns showing the fore-and-aft lengths the first number, where there are two, indicates the length at the summit; the numbers in parentheses, the length taken near the base. The first number varies with the amount of wear. The width is taken near the base of the front lobe. The numbers in parentheses in the first column are those assigned in the catalogue of the department of vertebrate paleontology in the United States National Museum.

Table of measurements of teeth of Camelops huerfanensis.

Tooth.	Height.		Length.		Width.	
	Type.	Denver.	Type.	Denver.	Type.	Denver.
Pm 4 (8248*a*)	38	43	27 (22)	24±(—)	25	26
M 1 (8248*b*)	35	50	40 (32)	41 (29)	30	30
M 2 (8248*c*)	55	70	50 (35)	49 (35)	31	30
M 3 (8248*d*)	63	62	56 (54)	41 (46)	31	29±

On comparison of the structure of the teeth of Cragin's type specimen and that from Denver, few differences are observed, and these are probably not important. The median style of the Denver teeth is more undercut than in the type specimen, and the spaces between the styles are somewhat more elevated. In the figure showing the grinding surfaces the latter appear much broader in the type than in the Denver specimen, but this is because the teeth of the type are worn down farther toward the base.

There are some lower teeth to be described.

Table of measurements of lower teeth of C. huerfanensis.

Tooth.	Height.		Length.		Width.	
	Type.	Denver.	Type.	Denver.	Type.	Denver.
M 2 (8247)	55±	60±	45 (—)	50 (32)	21	19
M 3 (8248*j*)	65±	76±	62 (—)	51 (61)	21	22

Inasmuch as the lower teeth of the type of *C. huerfanensis* are to a considerable extent hidden in the bone, some of their dimensions can not be secured. The right lower second molar from Denver is a thinner tooth than the corresponding one of the type. It is possible, of course, that this Denver tooth did not belong to the same species as the other teeth. Leidy [3] referred a lower second molar to his *Megalomeryx niobrarensis*. In its less wedgelike form it is different from the corresponding molar from Denver, and it is larger; otherwise the teeth are not greatly different. The lower left hindermost molar is represented by figure 7 of plate 116. The Denver teeth appear not to be much different from camel teeth found at Minidoka, Idaho, and described by the writer in 1913.[4] In the United States National Museum there is a lower left hindermost molar (Cat. No. 8252) of a camel which was sent from Wakonda, Turner County, South Dakota.

[3] Extinct Mamm. Fauna Dak. Neb., 1869, pl. 14, fig. 12.

[4] Proc. U. S. Nat. Mus., vol. 46, pp. 273-275.

It was found in a gravel pit at a depth of 9 feet. Figures are presented of this tooth (pl. 116, figs. 8, 9). It is characterized by its thickness, the strong development of the styles, the angulation of the inner faces of the lobes, and the unequal slopes of the front and rear portions of their faces. The crown is worn down to about one-half of its original height; the length is 64 mm.; the width of the front lobe, at the base, 28 mm. It can hardly belong to *C. huerfanensis*.

A scapula from Denver is represented by about 150 mm. of the base of that of the left side (Cat. No. 8228). The greater diameter of the glenoid cavity is 77 mm.; the shorter, 64 mm. The width of the bone from its rear border to the front of the coracoid process is 118 mm. The bone differs from that of the dromedary in having along the hinder border of the subscapular surface a prominent ridge. This fades out as it approaches the glenoid fossa.

The humerus is represented by the distal end of three bones—two of the left limb, one of the right. One of those of the left side (Cat. No. 8236) is large, measuring 91 mm. across the articular surface for the forearm. In the specimen of dromedary at hand (Cat. No. 143158, U. S. Nat. Mus.) this width is only 77 mm. The other fragment (Cat. No. 8229) of a left humerus and the one of the right (Cat. No. 8231) belonged probably to the same individual, and measure across the articular surface 81 mm. The fossa for the olecranon is, however, narrower (30 mm.) than in the dromedary (35 mm.).

Of the ulno-radius there are present the proximal end of one of the left side (Cat. No. 8233) and two distal ends of the left side. It is probable that the proximal end belonged to the smaller individual, that which possessed the distal end of the right humerus above described. Judging from the color of the bones the writer concludes that one (Cat. No. 8227) of the distal ends was a part of the same bone as the fragment (Cat. No. 8233) just described. The surface which articulated with the wrist bones is 81 mm. wide; in the dromedary it is 78 mm. wide. The other distal end of a forearm bone (Cat. No. 8232) has the same size as the one just mentioned. It is of a lighter color. The browner bone has been much gnawed by some broad-toothed rodent, probably a porcupine. The bone last mentioned brings with it all of the carpals except the pisiform. Those of the upper row have a height of about 37 mm.; those of the lower row, of about 22 mm. These carpals are followed by about 100 mm. of the anterior cannon bone. This has a width, across the proximal articular surface, of 78 mm. There is, besides, a second proximal end of a cannon bone (Cat. No. 8234) of the same size. The corresponding surface of the dromedary measures only 68 mm. from side to side. It is evident, too, that the shaft of this bone in the fossil had a considerably greater diameter than that of the dromedary, although the bones higher up in the leg were not greatly larger. The larger fragment of the humerus mentioned above (Cat. No. 8230) is too large to fit into the upper end of the ulno-radius present.

There are present the distal ends of two cannon bones. One (Cat. No. 8238) is taken to belong to a foreleg; the other (Cat. No. 8237) to a hinder leg. The former is the larger. The articular surfaces are damaged, but the distance across the end was close to 92 mm. Across one of the articular surfaces the width is 43 mm. At a distance of 75 mm. above the distal end of the bone the width of the shaft is 66 mm., the thickness 30 mm. The split between the two divisions does not reach quite to this height. One proximal phalange is present (Cat. No. 8239). The length is 102 mm.; the width of the proximal end is 42 mm.; of the distal end, 33 mm. At the middle of the length the side-to-side diameter is 22 mm.; the fore-and-aft, 22 mm. This bone is slightly longer than the hinder first phalange in the dromedary. The upper and middle diameters of both species are about the same. The lower articular surfaces of the fossil bone are abraded somewhat, but it is hardly probable that they were expanded laterally as much as in the dromedary. A right navicular (Cat. No. 8246), somewhat large for the astragalus 8244, has a fore-and-aft diameter of 50 mm.; a side-to-side diameter of 30 mm.

Of the left innominate bone there is a piece (Cat. No. 8240) a little more than 200 mm. long. The diameters of the acetabulum are 70 mm.

The cannon bone mentioned above as a supposed hinder one has each of the articular surfaces 38 mm. wide. The distance across both is 85 mm. At a height of 75 mm. from the lower end the shaft is only 50 mm. wide; the thickness is 25 mm. The split extends a short distance above this height.

There are present three calcanea. One (Cat. No. 8242) belongs on the right side. Its total length is 155 mm.; the greatest height (at surface for articulation with the fibula), 68 mm.; the greatest thickness (just at the rear of the articular surface mentioned), 60 mm. Another calcaneum belonging to the left side shows no important difference in size or form. A third one, somewhat damaged, is slightly smaller.

A right and a left astragalus in the collection differ only slightly in size. One (Cat. No. 8244), fitting pretty closely the calcaneum (Cat. No. 8242), had a length along the outer face of about 80 mm.; along the midline, a length of 60 mm. The width along the front end is 58 mm.

2. REMARKS ON CAMEL REMAINS FOUND IN SOME WIDELY DISTANT LOCALITIES, WITH DESCRIPTIONS OF TWO NEW SPECIES.

From Prof. Mark Francis, of College Station, Texas, an enthusiastic collector of vertebrate fossils, the writer has received a cervical vertebra, probably the fifth, which is of much interest. This bone, together with the distal end of a metapodial of a camel, was found by Doctor Francis in December, 1919, at Keeran Point, the eastern extremity of Victoria County. This locality is on Lavaca Bay, itself a prolongation northward of Matagorda Bay. In September there had been a violent storm in the Gulf, and the waves caused an enormous mass of the bluff to fall. Two farmers of the vicinity, L. Meyer and Edward Machac, gathered up some mastodon and elephant bones and teeth; and these they presented to the Agricultural and Mechanical College, at College Station. Later Doctor Francis visited the locality and picked up some camel remains. He informs the writer that the black surface soil is from 2 to 6 feet thick and barren of fossils. Below this is a cream-colored sand varying from 2 to 4 feet in thickness. In this were buried the bones. The writer is informed that the elevation of the surface there is about 20 feet. These facts appear to show that that bed of sand was laid down when camels were living there, and that was about the first third of the Pleistocene. The vertebra indicates a large animal, the length of the centrum being 145 mm.; in the dromedary, 160 mm. Most of the neural arch and the zygapophyses are broken off; also the right transverse process and some of the left. Three views of it are presented (pl. 122, figs. 1–3). Figure 1 shows the bone as seen from below; figure 2, from the right; figure 3, from in front. In the midline there is, in place of the conspicuous sharp ridge seen in the existing camels, a hardly perceptible elevation of the bone. The transverse processes at the anterior end of the vertebra are broken off, but they were evidently thicker and stronger than in the existing camels, and projected downward, outward, and forward, evidently somewhat beyond the end of the centrum. From the base of each process arise two ridges which pass backward. Of these the upper one expands into a broad wing and continues to the rear of the centrum. The lower one, prominent on the middle third of the lower face of the centrum, soon subsides and disappears on the hinder third. Where widest the bone must have had a breadth of about 140 mm. In the dromedary it is only 95 mm. The appearance of the lower face of this vertebra is very different from that of the dromedary.

The distal end of the metapodial resembles closely that of *Camelops huerfanensis*. The width across the articular end is 89 mm., almost exactly that of the metapodial of the species last mentioned; and to it the specimens are provisionally referred.

With these camel remains there were found jaws, teeth, and tusks of a very large specimen of *Elephas columbi*, and a tooth of a species of a bunolophodont mastodon.

From Pittbridge, Brazos County, Doctor Francis has sent the writer an upper right hindermost molar and the distal end of a hinder cannon bone which were picked up along Brazos River. The tooth is well preserved and is not essentially different from the corresponding tooth from Denver here figured (pl. 116, fig. 6). The tooth and the cannon bone are referred to *Camelops huerfanensis*.

From Christmas Lake there is present a first, apparently anterior, phalangeal bone (Cat. No. 3821; pl. 123, fig. 2), which is to be compared with that of *Camelops huerfanensis*.

Measurements of first phalanges of camels.

	Camelops. (No.3821).	*C. huerfanensis.*
Length on median plane	117	111
Fore-and-aft width of upper end, at epiphysial suture	40	41
Side-to-side width of upper articular surface	45	42
Fore-and-aft diameter at middle of length	24	25
Side-to-side width at middle of length	24	21
Width of distal articular surface	34	33
Greatest width of distal articular surface on lower side of the bone	34	32.5

It is probable that this bone belongs to *Camelops huerfanensis*.

In the United States National Museum there are some remains of a camel which was found, associated with a horse, at Keams Canyon, Arizona. The parts seen are the upper end of a tibia, the lower end of the same tibia, the external malleolus, an astragalus, a calcaneum, a navicular, and the proximal end of a cannon bone, all of the same right limb. The total length of the calcaneum is 156 mm., being close to that of *Procamelus coconinensis* from Anita, Arizona, described on page 622. Instead, however, of finding an astragalus nearly as large as that of *P. major*, figured by Leidy and Lucas (a bone only slightly too large to fit the Anita calcaneum), one finds that the bone from Keams Canyon is much smaller. On the inner face the latter is 75 mm. long; that from Florida, 92 mm. The Keams Canyon animal belongs possibly to *Camelops huerfanensis*. The bones agree in every way with corresponding bones from Denver, Colorado, referred to *C. huerfanensis*.

It is interesting to find that remains of one or more very large camels have been found at various places in the elevated regions of the West. Matthew, in his list of vertebrates found at Christmas Lake ("Silver Lake"), Oregon, and Washtucna Lake, in southwestern Washington,[5] mentions "teeth, foot bones, etc., of *?Camelops* sp. max." In the National Museum there are some bones that were collected in 1882 at Christmas Lake by Dr. I. C. Russell, among which are the head of a humerus, the distal half or more of a left humerus, one of the distal divisions of a cannon bone, and a complete first phalangeal.

The head of humerus from Christmas Lake measures from front to rear of the articular surface 93 mm.; in the dromedary this

[5] Bull. Amer. Mus. Nat. Hist., vol. 16, pp. 320, 321.

measurement is 70 mm. The distal half of the humerus from Christmas Lake (Cat. No. 3817) measures across the articular surfaces 96 mm.; in the dromedary, 77 mm. At a distance of 150 mm. above the lower end of the inner condyle the fore-and-aft diameter is 68 mm.; the side-to-side diameter, 59 mm. The fore-and-aft width of the inner condyle is 108 mm.; in the dromedary, 86 mm. The fossa for the olecranon is more deeply excavated than in the dromedary, and it is relatively narrower—33 mm.

There is in Russell's collection a complete right hinder cannon bone (U.S.N.M., Cat. No. 3824). The total length is 380 mm.; that along the outer border, 369 mm. The width across the proximal articular surface is 70 mm.; the fore-and-aft diameter at the middle of the length, ignoring the groove, 42 mm.; the side-to-side diameter, 40 mm. The width across the distal end is 90 mm.; across the divisions, 42 mm. The hinder face of the bone is occupied by a broad groove. It is doubtful whether this bone belongs to the largest camel found in that region. There is, however, another and larger right hinder cannon bone which lacks about the distal third. The fragment, measured along the outer border, is 290 mm. long. The length originally was not far from 435 mm. The width of the upper articular surface is 70 mm.; the side-to-side diameter, at about the middle of the length of the bone, 45 mm. The inner border of the hinder groove is higher than in the other bone just described. It is probably to be referred to the very large camel of the Christmas Lake region.

In a small lot of bones which were collected many years ago at Washtucna Lake, Washington, by the late Dr. George M. Sternberg, are three foot bones of a very large camel. These consist of a right astragalus, the distal end of an anterior cannon bone, a first phalange, and a second phalange. These parts may have all belonged to the same animal. On the catalogue they have the number 9717. The astragalus is a large one. The length on the outer face is 96 mm.; in the dromedary, 77 mm. The width at the lower end is 70 mm.; in the dromedary, 51 mm. The cannon bone presents about 135 mm. of the lower end. This bone is compared in the following table with the corresponding one of the dromedary *Camelus dromedarius*:

Measurements of anterior cannon bones in millimeters.

	Oregon camel.	Dromedary.
Width of distal end, ignoring the split	108	90
Width of each articular surface	49	41
Anteroposterior thickness of each division	45	42.5
Width of shaft above lower end at distance equal to width of distal end	60±	48
Thickness at same level	38	24

The first phalange (pl. 123, fig. 1) is compared with that of the dromedary.

Measurements of first anterior phalange in millimeters.

	Oregon camel.	Dromedary.
Length of bone in median plane	115	94
Fore-and-aft diameter of proximal articular surface	47	34
Side-to-side diameter of proximal articular surface	58	41
Fore-and-aft diameter at middle of length	29	21.5
Side-to-side diameter at middle of length	35.5	21
Width of articular surface at distal end	47	34

This phalange resembles much that of the dromedary and differs from that of *Camelops* in the greater antero-posterior flattening of the bone and in the extension of the articular surface for the second phalange backward on the lower face of the bone. In this respect it agrees with the phalange here made the type of *Camelus arcto-americanus.* In each of these bones the articular surface extends backward about 43 mm. The two bones hardly belonged to the same species. As will be seen on comparing the measurements they are of nearly the same length, but differ in other dimensions.

The second phalange is broad and flattened. The greatest length in the median plane is 81 mm.; the greatest width near the upper end, 51 mm.; the greatest width in the lower half, 49 mm.

It seems to the writer that the remains of the large camel from Christmas Lake and those from Washtucna Lake indicate a species different from any described species of *Camelops* and that this animal belonged to the genus *Camelus.* Following Doctor Matthew's suggestion it is named *Camelus maximus.* The first phalange from Washtucna Lake is made the special type specimen.

Type specimen.—A first phalange, No. 9717, U.S.N.M.

Type locality.—Washtucna Lake, Washington.

Type formation.—Early Pleistocene.

Diagnosis.—Size large. Width of upper end of phalange equaling one-half of the length of the bone. Lower articular surface carried back on lower surface of this bone as in *Camelus.*

CAMELUS ARCTOAMERICANUS, new species.

Plate 119, fig. 12.

Type specimen.—A first phalange, No. 7713, U.S.N.M.

Type locality.—Old Crow River, near Alaska–Yukon boundary.

Type formation.—Pleistocene.

Diagnosis.—A large camel with broad phalanges, whose upper articular surface from side to side equals less than one-half of the length of the bone, and whose lower articular surface extends well backward on lower face.

In the United States National Museum there is a first phalange of a camel which was found in 1912 by Copley Amory, close to the Alaska-Yukon boundary, at a distance of 50 miles above the mouth of Old Crow River. This locality is 100 miles north of the Arctic Circle and about 175 miles south of the Arctic Ocean. The bone is complete, except that a chip from the lower side of the anterior articular surface is broken off. The bone probably belongs to a fore limb. It is here compared with a first phalanx of *Procamelus major* from Florida, and with the anterior first phalanx of *Camelus dromedarius* (p. 607), and with the first phalange of *Camelus maximus*.

Measurements of first phalangeal bone of camels.

	C. arcto-americanus.	*Procamelus major.*
Length of bone in median plane	110	118
Fore-and-aft diameter of proximal articular surface	40	44
Side-to-side diameter of proximal articular surface	50	47
Fore-and-aft diameter at middle of length	25	27
Side-to-side diameter at middle of length	33	28
Width of articular surface at distal end	44	37

The measurements show that the phalanx of the arctic camel is larger in every way than that of the dromedary. It is more flattened, especially in the shaft, than either the dromedary or *Procamelus major*. The distal articulation is carried back on the hinder surface as it is in the dromedary. The hinder face of the shaft is flat and even somewhat excavated. It is a slenderer bone than that of *C. maximus*.

The relationships of this camel seem to be with *Camelus* rather than with *Camelops* and *Procamelus;* and to *Camelus* it is referred.

A notice of this discovery was published by Mr. J. W. Gidley in 1913[6] but no systematic name has hitherto been applied to it.

With the camel bones above described from Christmas Lake were collected three astragali of horses, one of which is small, one of medium size, and one large; also a first, a second, and a third phalange of perhaps three horses; also a symphysis of the lower jaw of a small horse; also a first and a second phalange of a large deer, possibly a species of *Sangamona;* lastly, some fragments of a tusk of a proboscidean.

3. ON A SMALL COLLECTION OF FOSSIL MAMMALS MADE IN CHELAN COUNTY, STATE OF WASHINGTON.

In the United States National Museum there is a small collection of bones and teeth which were collected probably in 1897, by a settler named Parrish, on his place in the southwest quarter of section 23,

[6] Smiths. Misc. Coll., vol. 60, no. 26, p. 1.

township 23 north, range 19 east, near Wenatchee, Chelan County, Washington. An account of this find and the fossils themselves were sent to Dr. Henry Gannett, of the United States Geological Survey, by Mr. Fred G. Plummer. The correspondence is preserved in the National Museum. Mr. Parrish was making an excavation into a ridge to reach a perpendicular vein of travertine, in the search for supposed onyx. At a depth of 16 feet from the surface he found the bones. A geological section shows that at the top there was 1 foot of recent soil. This was followed by a bed 15 feet thick composed of angular and partly rounded bowlders, somewhat cemented together by calcite. Below this was an old soil, 4 feet in thickness, and in this were found the fossils. The soil was underlain by sandstone of unknown thickness.

Many of the bones are fragmentary and indeterminable even generically but the following list has been made out.

LIST OF FOSSILS AS DETERMINED.

Megalonyx jeffersonii?
Equus niobrarensis?
Odocoileus, species indeterminable.
Sangamona? species indeterminable.
Alces? species indeterminable.
Bison, species indeterminable.
Marmota arrodens, new species.
M. flaviventer.
Thomomys fuscus.
Lepus or *Sylvilagus*, species indeterminable.

There are too few species and their identification too uncertain to justify one in fixing too exactly the age of the deposit. The presence of *Equus* and of probably *Sangamona* appears to indicate a time not later than the Sangamon interglacial.

MEGALONYX JEFFERSONII?

A tooth, a second or third molar, of a species of *Megalonyx*, probably *M. jeffersonii* (Cat. No. 2658), is in the collection. The fragment is 42 mm. long; the greater diameter is 20.5 mm.; the shorter, 14 mm. A section of the tooth resembles most that presented by Leidy.[7]

EQUUS NIOBRARENSIS?

A species of horse is represented by two lower left true molars—the first and the third (Cat. No. 10287). They are little worn. The first molar has the grinding surface 27.5 mm. long and 17 mm. wide, not including the cement. The third molar is 36 mm. long and 16 mm. wide in front. So far as the writer can see, these teeth are not distinguishable from those of the type of *Equus niobrarensis*.

[7] Smiths. Contr. Knowl., vol. 7, pl. 16, fig. 14.

ODOCOILEUS, species indeterminable.

Plate 117, fig. 1.

An indeterminable species of apparently this genus is represented by one of the distal pulleylike articular ends of a cannon bone. The diameter is 22 mm. One lateral face has been gnawed by rodents. There is present also a first phalangeal bone which fits accurately against the trochlea just mentioned (pl. 117, fig. 1). It has exactly the length of a hinder first phalange of *O. virginianus*, but it is considerably slenderer. These bones have the catalogue number 10319. The following are the comparative measurements:

Measurements of first phalanges of Odocoileus.

	O. sp. indet.	O. virginianus.
Total length	56	56
Fore-and-aft diameter at upper end	19	21
Side-to-side diameter at upper end	15	17.5
Fore-and-aft diameter at middle of length	14	14.5
Side-to-side diameter at middle of length	10.5	13.2
Greatest width of distal articular surface	12.4	14.5

SANGAMONA?, species indeterminable.

A deer larger than any existing species of *Odocoileus* and smaller than *Cervus canadensis* is indicated by a single bone, a left astragalus. The hinder half of a left astragalus (Cat. No. 9193) found at Cavetown, Maryland, and regarded as belonging to *Sangamona fugitiva*, has the same width; but the groove for the lower end of the tibia is deeper, and the inner ridge bounding this groove is thinner than in the astragalus from Washington. The side-to-side thickness of the bone taken at the middle of the length is close to 30 mm. The astragalus of a specimen of *Odocoileus virginianus* is 43 mm. long on the outer face, the width of the front end 29 mm. The length in the fossil is 46 mm.; width in front 33 mm. Here again in *O. virginianus* and likewise in *O. hemionus*, the inner ridge bounding the median groove is thinner than in the fossil. For the present this bone is referred to the genus *Sangamona*. This catalogue number is 10316.

ALCES?, species indeterminable.

In the collection there is an epiphysis from the lower end of a cannon bone of a deer which had about the size of a moose. When compared with a corresponding part of the moose some minute differences are noted. These probably indicate a distinct species, possibly *A. brevitrabilis* or *A. semipalmatus*, both of which were described by Cope from parts of antlers found at Washtuena Lake, Oregon. Or the bone may belong to *Cervalces*.

BISON, species indeterminable.

A species of *Bison* is indicated by one first phalange. Its proximal end is broken off. It is possible that it belongs to the preceding species. The catalogue number is 10318.

MARMOTA ARRODENS, new species.

Plate 117, figs. 3-5, 7, 9; plate 118, figs. 1, 3, 4.

Type specimen.—Lower jaw, No. 2656, U. S. N. M.

Type locality.—Chelan County, Washington.

Type formation.—Pleistocene.

Diagnosis.—Size large. Lower incisors in adults equaling in breadth about two-fifths of the length of the row of molar teeth; its outer face, behind the enamel, furnished with a prominent ridge.

In the collection here considered there is a considerable number of teeth and bones of woodchucks. There appear to be present two species. One of these, represented by a lower jaw, probably also by other bones, was an unusually large marmot. As type of this supposed species are taken the right and left rami of the lower jaw, which bear the catalogue number 2656 of the United States National Musuem. Neither of these rami is complete, the better preserved one lacking the coronoid, condylar, and angular processes (pl. 117, figs. 3, 4).

Inasmuch as the locality which furnished these bones lies within the area occupied by *Marmota flaviventer* and close to that occupied by subspecies of *M. caligata*, it is fair to make comparisons with the two species mentioned.

Measurements of teeth and lower jaws of species of Marmota.

	M. arrodens.	*M. flaviventer.*	*M. caligata.*
Distance from incisive border to border between the condylar and angular processes	64	62	64
Length of row of molars	20	20	22
Height of jaw on inside at front of last molar	16.5	15	15.5
Height of jaw between symphysis and first molar	14	12	12.5
Width of incisors at the bone	8.1	6.5	7
Thickness of incisor at bone	5	4	4

Besides the ridges and grooves of various widths usually found on the enamel of the incisors of the species of *Marmota*, there is in *M. arrodens*, about halfway between the hinder edge of the enamel and the hinder border of the tooth, a prominent ridge. In front of it is a broad groove; behind it a narrower one. On the enamel there are distinct remains of the original pale orange color.

There are various limb bones which may or may not belong with the jaw just described. They may, indeed, belong to the same individual. In the jaw the molar teeth are all worn down smooth, while in the limb bones the epiphyses are not yet ankylosed to the shafts. However, in a skeleton of *M. monax* at hand, the bones are in about the same stage and the molar teeth are worn down nearly as much as in the jaw of *M. arrodens*. The writer is inclined to believe that the limb bones belong with the jaw. They are here to be compared with a skeleton of *M. monax* (Cat. No. 20765) found near Washington, District of Columbia. These bones are illustrated alongside those of the fossil. On the plate cited the humerus of *M. arrodens* is shown by figure 5; that of *M. monax* by figure 6.

Measurements of humeri of Marmota.

	M. arrodens.	*M. monax.*
Total length	74	74.8
Side-to-side diameter of head	15.2	14
Side-to-side diameter at middle of length	7	5.8
Width across distal condyles	20	18.5

Figures 7 and 8 of plate 117 show, of the natural size, the right ulna of the fossil and that of *M. monax;* while figures 9 and 10 present views of the right radii of the same individuals, respectively. The ulna of the fossil has lost its distal epiphysis. Of the left femur supposed to belong with the bones of the fore-limb there is present only the upper half (pl. 118, fig. 1). It will be seen at once that the fossil femur is a far stouter bone than that of *M. monax* (pl. 118, fig. 2); and it was probably little, if any, longer than the other femur.

Three tibia, one of the right side of *M. monax* and both right and left of the fossil, are shown on plate 118; figures 3 and 4 are those of the fossil bones; figure 5 that of the recent skeleton. The right tibia of the fossil is 81 mm. in total length; that of *M. monax* only one-half millimeter longer. Here again the recent bone is seen to be much slenderer. In the fossil the upper half of the hinder face is much more deeply excavated than in the eastern woodchuck.

From Dr. Joseph Grinnell, of the University of California, the writer has received important materials belonging to *Marmota vancouverensis*, *M. flaviventer flaviventer* and *M. f. sierrae*. *M. vancouverensis* is a very large species, one humerus measuring in length 93 mm., the ulna 94 mm. The humerus of *M. arrodens*, 74 mm. long, is a relatively stouter bone than that of *M. vancouverensis,* especially proximally. On comparison with a humerus 82 mm. long of *M. vancouverensis,* it is found that the side-to-side diameter just above the insertion of the *latissimus* muscle is 9.5 mm.; in *M. arrodens,* 11 mm. Where the bones are narrowest below the deltoid ridge the diameters are little different, that of *M. arrodens* being slightly less. The greatest width of the lower end of the bone is 22.5 mm. in *M. vancouverensis*; in *M. arrodens*, 20 mm.

The ulna of *M. arrodens* originally had a length of 83 mm. and the humerus is 74 mm. long. In *M. vancouverensis* the ulna is only 2 or 3 mm. longer than the humerus. The bones of *M. arrodens* are stouter than the corresponding ones of *M. vancouverensis*. In an ulna of the latter 77 mm. long, the depth in front of the coronoid process is 8 mm.; in *M. arrodens*, 9 mm. In a radius of *M. vancouverensis* the least diameter at the middle of the length is 4 mm.; in *M. arrodens*, 5 mm. The ulna and radius of the latter are more bent than in the other species.

The humerus, ulna, and radius of *M. arrodens* have been compared with the same bones of *M. flaviventer flaviventer* and *M. f. sierrae*, from various localities in California, sent by Doctor Grinnell. Both forms are smaller than *M. arrodens* and considerably smaller than *M. vancouverensis*. These two forms of *M. flaviventer* differ from *M. arrodens* in the same way as does *M. vancouverensis*.

MARMOTA FLAVIVENTER (Audubon and Bachman).

Plate 118, figs. 6–8.

This species appears to be represented in the collection by the rear of a skull preserving the basioccipital, the bullae, the petrosals, and the supraoccipital; also by the remainder of possibly the same skull from just behind the orbits to the front of the maxilla (pl. 118, figs. 6, 7). These have the catalogue number 2655. The nasals are missing; also the incisor teeth and three of the molars of the right side. On comparison with skulls of *M. flaviventer* no differences are noted. The molar teeth are little worn. The interorbital portion of another skull (Cat. No. 2657) is also represented (pl. 118, fig. 8). In this there is a complete postorbital process. Two right rami of lower jaws, or rather parts of them, with some little worn teeth, may belong to these incomplete skulls.

THOMOMYS FUSCUS (C. H. Merriam).

Plate 118, figs. 9 and 10.

This species is represented by a single incisor and by the anterior half of a skull, which contains both incisors, but lacks all the molars and both nasal bones. On comparison with a skull of *M. fuscus* from that region no differences are observed. The incisors retain much of their original color.

LEPUS OR SYLVILAGUS, species indeterminable.

A single right ramus of a rabbit is in the collection. It has about the size of the corresponding part of *Sylvilagus nuttallii*.

4. DESCRIPTIONS OF THREE SUPPOSED NEW SPECIES OF RODENTS OF PLEISTOCENE AGE, ONE FROM NEBRASKA, ONE FROM OREGON, AND ONE FROM TEXAS.

Through the liberality of the American Museum of Natural History, New York, the writer has been permitted to study the collections of vertebrate remains of Pleistocene age which that institution possesses. Among the remains sent are parts of the Cope collection, made at different localities; also some specimens collected by expeditions sent out by the American Museum itself.

Of especial importance is the large collection made by Mr. Barnum Brown in the Conard fissure, in Newton County, Arkansas, in 1903 and 1904. Of interest, too, is a small collection made by Mr. Brown in a cave at Anita, Coconino County, Arizona, in 1904. In the study of the materials mentioned the writer has found what appear to be three new species of *Glires*. The following are the species:

THOMOMYS SCUDDERI, new species.

Plate 120, figs. 1–4.

Type specimen.—Skull with the incisors and molars, but lacking most of the part behind the frontals; the lower jaw with its teeth; a few vertebrae; the pelvis and some limb bones. No. 8596, American Museum of Natural History, New York; a part of the Cope collection.

Type locality.—Christmas Lake, Oregon.

Type formation.—Pleistocene.

Diagnosis.—Animal of medium size. Lower outline of rostrum straight to near the incisors. The latter grooved and incurved somewhat more than in *T. bottae leucodon*, but not projecting so far beyond the bone. Interorbital space flat, the ridges inconspicuous, and forming a lyriform figure on the frontals.

In studying these fossil remains the species that first suggested itself for comparison is that now living in the region of Christmas Lake, *Thomomys quadratus* Bailey.[8] A slight examination shows, however, that the fossil does not belong to *T. quadratus*. A comparison with materials in the United States National Museum and in the Biological Survey has led the writer to regard the remains as being somewhat closely related to *T. bottae leucodon*.

This subspecies ranges to-day from Cape Saint Lucas to Grants Pass, in southwestern Oregon. It has incisors which are slenderer than those of the fossil. A specimen in the National Museum (Mamm. Cat. No. 4783) measures, from the rear of the frontals to the incisive border, in front of the incisors, 26 mm. This is the same as in the fossil skull. The interorbital space in the former is 7 mm. wide; in the fossil, 7.5 mm. the width of the rostrum in the former is 7 mm.; in

[8] N. A. Fauna, 139, pp. 23, 114, text fig. 3.

the fossil, 8 mm. The interorbital space of the former is transversely concave; in the latter it is flat. The nasals of the fossil were considerably wider than those of *T. bottae leucodon*.

The lower jaw has the same length as that of the specimen of *T. b. leucodon*, No. 4783, mentioned above. In the latter the incisors project beyond the extreme end of the jaw 10 mm.; in the fossil they project only 7.4 mm.

The fossil skull appears to resemble still more closely that of *T. bottae nigricans*, a form inhabiting the region about San Diego, California. In this again the incisors project beyond the bone more than in the fossil, and they appear to be somewhat more strongly curved downward. The interorbital space is 7 mm. wide and transversely concave. The ridges form the same lyriform figure as in the fossil. The nasals overlap the frontals more than they did in the fossil.

The species here described is named in honor of Mr. N. P. Scudder, librarian at the United States National Museum, to whom the writer has been greatly and for a long time indebted for assembling the literature that he has required in his studies.

CYNOMYS NIOBRARIUS, new species.

Plate 122, fig. 7.

Type specimen.—A part of the skull which presents the palate and its teeth; part of the interorbital space; and the bases of the zygomatic arches (No. 2715, American Museum of Natural History, New York).

Type locality.—Niobrara River, near Grayson, Nebraska.

Type formation.—Sheridan beds of the Pleistocene.

Diagnosis.—Allied to *C. leucurus*, but appears to have differed in being larger and in having a broader and deeper groove for the anterior branch of the masseter muscle.

The label on this specimen states that it was collected by the American Museum expedition in 1897. It is a thoroughly mineralized fossil and was evidently buried in sand. The third milk molar is present on the left side. On the right side it is missing, but deep in the socket is seen the uncut third premolar. The next tooth behind on each side is probably the fourth milk molar. All three molars on each side are present.

The bases of the zygomatic arches are somewhat injured, but they show that the anterior border of the upper root approached the premaxilla as it does in *C. leucurus*, and not nearly at a right angle, as it does in *C. ludovicianus*. The lower border of the anterior root of the zygomatic arch ends abruptly opposite the first molar, as in

C. leucurus. In *C. ludovicianus* the border is prolonged backward as a distinct ridge as far as the second or third molar. In the fossil it does not descend so close to the alveolar border as it does in both of the existing species just named. The broad groove running upward and forward in front of the anterior root of the zygomatic arch is deeper and broader than in *C. leucurus*, especially anteriorly, being more like that of *C. ludovicianus*. Along the middle of the palate there is a sharp and prominent ridge, highest in front. This is present in *C. leucurus*, sometimes becoming nearly as prominent as in the fossil.

Enough of the interorbital space is left to show that the width was at least 11.5 mm. This width is very variable in *C. leucurus*.

Cynomys niobrarius was probably larger than *C. leucurus*, since the tooth row, measured on the alveolar border, is very close to 17 mm. long, and would certainly have exceeded this after the replacement of the milk molars by the premolars. The three molars occupy 11.5 mm. of the alveolar border. No specimen of *C. leucurus* showed quite so large a molar row. The species now occupying that region is the typical *C. ludovicianus*. *C. leucurus* inhabits the mountainous regions of Wyoming, Colorado, and New Mexico.[9]

CITELLUS TAYLORI, new species.

Plate 120, fig. 7.

Type specimen.—A left ramus of a lower jaw, with the premolar, the molars, and a part of the incisor. Amer. Mus. Nat. Hist., New York.

Type locality.—Probably somewhere in the vicinity of San Diego, Texas.

Type formation.—Pleistocene.

Diagnosis.—First and second molars wider than long. The anterior transverse crest of moderate height. The premolar as long as wide; the cusps of its anterior crest with a shallow notch between them.

The type of this supposed species is a part of the Cope collection in the American Museum of Natural History. It is labeled as having been collected by W. Taylor, of San Diego, Texas, who was one of Cope's collectors in that region. The jaw is further labeled as having been found in the "elephant beds." The jaw and teeth seem to resemble most those of *Citellus townsendi*—a species now living in Oregon, Wyoming, and California. The molar teeth have the same short, broad form, and the jaw itself is hardly different. The anterior crest of each tooth is, however, not so high as in that species and not so abruptly steep on its hinder face. The premolar of *C. townsendi* and of various other species examined is shorter than wide; also in

[9] Hollister, N. A. Fauna, No. 40, p. 24.

this species and others there is an infold of the enamel on the inner part of the front face of the premolar, or a deep notch between the cusps. Nothing of this is seen in the fossil. The teeth have suffered but little wear, and yet a very little more would have produced one straight loop of enamel across the front of the grinding surface of the anterior premolar.

The length of the tooth row is 10 mm. The distance from the mental foramen to the rear of the condyle is 22 mm. The height of the ramus at the second molar is 6.5 mm.

5. COLLECTION OF FOSSIL MAMMALS MADE AT ANITA, COCONINO COUNTY, ARIZONA.

From Mr. Barnum Brown, of the American Museum of Natural History, New York City, the writer has received a small collection of fossil mammals which had been made at Anita, Arizona. The greater part of these specimens had been secured by Mr. B. C. Bicknell in 1901; another part was collected by Mr. Brown himself in 1904. The portion gathered by Mr. Bicknell was the property of the Arizona School of Mines, at Tucson, and had been sent for examination in 1904 to Mr. Brown by the director, Dr. W. P. Blake. Other pressing duties prevented Mr. Brown from completing his studies of these remains. From Mr. Brown's notes it appears that the fossils were found at the Val Verde Copper Mines, at Anita, a station on the Grand Canyon branch of the Santa Fe Railroad, 40 miles north of Williams and 20 miles south of the Grand Canyon. The collecton has become the property of the United States National Museum through exchange.

The fossils were discovered in a fissure in a Carboniferous limestone. This fissure was entered in the making of some prospect holes by the workmen of the copper company. The bones appear to have been buried in a deposit of sand about 7 or 8 feet thick, lying on the bottom of the cave or fissure. They are in a fine state of preservation, but are mostly pretty badly broken up. Mr. Brown's examination of the collection resulted in the recognition of remains of horses, camels, rabbits, woodchucks, packrats, pocket gophers, and squirrels. Being engaged in other investigations he did not have the time to study the remains and he generously put them into the hands of the writer. Unfortunately other lines of work have prevented a consideration of them until recently. Most of Mr. Brown's general determinations have been confirmed. In addition, a few other forms have been recognized, among them a hyaena-like animal. In case this determination shall be confirmed an important addition will have been made to our extinct fauna. Cope believed that the genus *Borophagus* belonged to the Hyaenidae, but it is now arranged among the Canidae.

LIST OF SPECIES FOUND AT ANITA.

EQUIDAE.

Equus occidentalis? *Equus giganteus?*

TAGASSUIDAE.

Mylohyus? Species indeterminatable.

CAMELIDAE.

Procamelus coconinensis, new species. *Procamelus longurio,* new species.

BOVIDAE.

Antilocapra americana?

SCIURIDAE.

Marmota arizonae, new species. *Citellus tuitus,* new species.

CRICETIDAE.

Neotoma cinerea.

LEPORIDAE.

Lepus benjamini, new species. *Brachylagus browni,* new species.

MUSTELIDAE.

Taxidea robusta, new species.

CANIDAE.

Canis nubilus? *Canis latrans?*

HYAENIDAE.

Chasmaporthetes ossifragus, new genus, new species.

Family EQUIDAE.

An examination of the bones belonging to the genus *Equus* shows that two species are represented—one of medium size, one very large. The former is referred to *Equus occidentalis,* the latter provisionally to *Equus giganteus.*

EQUUS OCCIDENTALIS Leidy.

Plate 118, fig. 11; plate 124, fig. 1.

To this species are referred the proximal end of a left third metacarpal bone (Cat. No. 10131); an upper second premolar (Cat. No. 10132); an upper right third molar (Cat. No. 10133), and some fragments of other upper teeth; a lower hindermost molar (Cat. No. 10134); some fragments of other upper and lower teeth (Cat. No. 10135); and an incisor (Cat. No. 10136). The fragment of metacarpal is only 65 mm. long. This bone and the others here considered are compared with those of a skeleton of a horse in the National Museum (Cat. No. 174960). In this recent horse the side-to-side diameter of the upper end of the metacarpal is 55 mm.; in the fossil bone this diameter is 50 mm. The facet for the cuboid bone is considerably smaller in the fossil bone than in that of the recent horse.

The second right premolar is a nearly unworn tooth. In order to get an adequate view of the enamel, the tooth was sawn across, about 1 inch below the grinding surface. The end of the proximal section was polished and a view of it is presented (pl. 118, fig. 11); but this is the reverse of the one that would be shown on the grinding surface of a tooth of that side. The upper right hindermost molar is worn down to about 45 mm. of the root. The length of the crown along the outer border is 33 mm.; the width is 24 mm.; the fore-and-aft diameter of the protocone, 17 mm. Besides the unusual length of the protocone it is thin and flat, differing in these respects greatly from that of the tooth figured by Gidley.[10] The postprotoconal valley, too, has a deep inlet near its head. The width and thinness of the protocone is shown in two fragments of upper teeth. The hindermost lower molar had just begun to wear. The height is 85 mm.; the length at half of the height, 38 mm.; the thickness in front, 15 mm. A fragment of an upper tooth (Cat. No. 10215), somewhat worn, is 80 mm. high and considerably curved. A fragment of a little-worn lower tooth (Cat. No. 10216) is 100 mm. high. A little-worn and deeply cupped incisor (Cat. No. 10217) is 20 mm. wide. It appears to be safe to refer these teeth to *Equus occidentalis*. There are in the collection a few vertebrae and fragments of other bones of *Equus*, some of which may belong to this species. It is not at all improbable that the remains here described will prove eventually to belong to an undescribed species.

EQUUS GIGANTEUS? Gidley.

Plate 118, fig. 12; plate 124, fig. 2–3.

The larger horse of the collection is referred with doubt to Mr. J. W. Gidley's *Equus giganteus* [11] found in southwestern Texas and based on a tooth which had been referred by Cope [12] to *E. crenidens*. The reason for this identification of the Anita materials is admitted by the writer to be the evident large size of the horse. There are present an upper right hindermost molar (Cat. No. 14361 Amer. Mus. Nat. Hist.) and some fragments of teeth which appear not to belong to *Equus occidentalis*; but these fragments (Cat. No. 10137) present no special resemblance to the tooth which forms the type of *E. giganteus*. Two of the fragments are here illustrated. Figure 12 of plate 118 presents a part of the anterior fossette of an upper grinding tooth. The section shown belongs about an inch above the root of the tooth. The distance across this fossette is 16.2 mm.; in a large domestic horse the corresponding distance is 15 mm. Figure 3 of plate 124 gives a view of the postprotoconal valley of an upper tooth,

[10] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 115, fig. 10.

[11] Idem, p. 137, fig. 27.

[12] Amer. Naturalist, vol. 19, p. 1208, pl. 37, fig. 4.

possibly of the same one shown in figure 2 of plate 124. The double inlet at the head of the valley is unusual.

In the part of the collection from this place made by Mr. Barnum Brown for the American Museum of Natural History is an upper right third molar (plate 124, fig. 2). It is worn down to 25 mm. from the root. The length is 36 mm. along the outer face; the width is 30 mm. The fossettes are wide and the enamel simple. There is an inlet at the head of the postprotoconal valley. The catalogue number is 14361. It is referred to the larger of the two horses found at Anita.

Among the bones referred with reservations to this species are most of those of the left tarsus (Cat. No. 10138) in their natural relations—a condition that shows that these parts were held together by their ligaments when they reached the fissure. All of the bones of this tarsus are present, except the consolidated internal and middle cuneiforms. As illustrating the size of these parts, the distance from the rear of the calcaneum to the front of the external cuneiform, 161 mm., may be compared with that of the horse of medium size already mentioned. This comparison shows that in case all other parts were proportionately large, the extinct species was fully one-fifth higher than the recent one.

The following measurements are given of some of the individual bones of these tarsi.

Measurements of tarsal bones.

	E. giganteus.	No. 174960, U.S.N.M.
Calcaneum, greatest length	135	117
Calcaneum, greatest width across the tentaculum	54	50
Calcaneum, height at middle of talus	50	43
Astragalus, length on inner face	74	64
Navicular, width	62	56
Ectocuneiform, width	57	50

In the collection is about the upper half of a right third metatarsal (Cat. No. 10139). Unfortunately, the upper end is damaged so that the side-to-side diameter can not be determined. The fore-and-aft diameter is 50 mm.; in the recent horse, 44 mm. At a distance of 90 mm. below the upper end the side-to-side diameter of the shaft is 40 mm.; the fore-and-aft, 35 mm. In the recent horse at hand these diameters are respectively 32 mm. and 33 mm. There are present two distal ends of third metapodials (Cat. No. 10140); but the writer can not convince himself that either of them belonged to the hinder limb. Three splint bones are in the collection (Cat. No. 10141), with the distal ends missing. The diameters of the upper ends are about one-third greater than in the recent horse used for comparison. A part of the shaft of a radius (Cat. No. 10142), 185 mm. long, has a breadth of 47 mm. at about the middle of the whole bone. A nearly complete left third metacarpal (Cat. No. 10143) is present.

The following comparative measurements are given:

Measurements of third metacarpals.

	E. giganteus.	No. 174960 U. S. N. M.
Total length	268	246
Width of upper end	61	56
Side-to-side diameter at middle	40	32
Fore-and-aft diameter at middle	32	27
Side-to-side diameter at lower end	55	54

It will be seen that the fossil bone is only about one-tenth longer than the recent one. It is not at all improbable that it belonged to the smaller horse, but the metacarpal described as representing that horse is only 50 mm. wide above.

A first phalangeal bone (Cat. No. 10144) of the third digit has a length, in the median plane, of 88 mm.; that of the hinder bone of the recent horse being 77 mm. The width at the upper end is 63 mm.; that of the recent horse, 57 mm. It is not larger than corresponding bones of supposed *Equus pacificus* from Christmas Lake, Oregon. A second phalange (Cat. No. 10146) is 55 mm. wide at its lower end; that of the recent horse, 44 mm. A hoof phalange (Cat. No. 10147) is 78 mm. wide. The latter bone appears to belong to a hinder limb. In the part of this collection that was made for the American Museum of Natural History there are a second and a third phalangeal which appear to belong to a fore limb. These have that museum's catalogue number, 14362. The second phalange is 63 mm. wide at the upper end; 55 mm. wide at the lower end. The hoof phalange is 84 mm. wide. This phalange is more broadly rounded than that supposed to belong to the forefoot.

MYLOHYUS ? species indeterminable.

In the collection there is a fragment (Cat. No. 10153) of the upper end of the ankylosed lower arm bones of the right side. The olecranon process is likewise broken off. The whole fragment is only 80 mm. long, and it extends 65 mm. below the greater sigmoid cavity. The width of the radius in this cavity is 29 mm. At the lower end the fragment has a width of 26.5 mm.; a thickness of 17 mm. On the hinder face of the fragment, at a distance of 42 mm. below the front of the greater sigmoid cavity, is a foramen. A specimen of *Platygonus* from a fissure near Cumberland, Maryland, measures 160 mm. from the front of the sigmoid cavity to the lower end of the radius. The articular surface of the upper end of the radius is 35.5 mm. wide. From the articular surface to the foramen corresponding to the one mentioned above the distance is 33 mm. These measurements appear to indicate that the forearm of the fossil animal was both longer and slenderer than that of *Platygonus*. The genus *Mylohyus* appears to be indicated.

Family CAMELIDAE.

In the collection being considered the writer recognizes remains of two species of camels. Unfortunately the parts are scanty and fragmentary.

PROCAMELUS COCONINENSIS, new species.

Plate 122, figs. 4–6; plate 123, fig. 5.

Type specimen.—An upper left second molar (Cat. No. 10154).

Type locality.—Coconino Forest plateau, Arizona.

Type formation.—Early Pleistocene.

Diagnosis.—The type molar resembles that of *P. major*, but has the outer crescents much thicker at the same level.

Of a very large camel there are present the greater part of an upper molar tooth and some foot bones.

The tooth (pl. 122, figs. 4, 5) is taken to be the upper left second molar. The writer has the advantage of having for comparison the materials figured in the paper by Leidy and Lucas on some fossil remains found in the Alachua clays, at a point 10 miles south of Archer, Levy County, Florida.[13]

The tooth from Anita has lost nearly the whole of the inner crescent of the front lobe and a part of that of the hinder. It is worn down pretty well, the height of the lobes being about 20 mm. The length of the crown at the base is 36 mm.; at the grinding surface, along the midline, 38 mm. The width of the hinder lobe appears to be 33 mm.; that of the front lobe can not be determined. When comparison is made with the upper right second molar figured in the paper cited (pl. 17, fig. 4) some differences are observed. The length of the two crowns, taken at the same level, is almost exactly the same. The length of the hinder lobe in the Florida tooth is about 2 mm. less. The styles and ribs on the outer faces of the teeth are hardly different, and the minute differences might be those of individual teeth or of individual animals. There appear to be, however, important differences in the widths of the outer crescents (paracone and metacone), those of the Arizona animal being much thicker. Inasmuch as the crowns of the two teeth compared have quite exactly the same height the differences in width must be due to actual differ-

[13] Trans. Wagner Free Inst., vol. 4, pp. i–xiv; 15–61, pls. 1–19.

ences in thickness. Measuring from the pillar on the outer face of the anterior crescent to its inner wall the distance is 17 mm.; in *P. major* it is only 14 mm. One must measure from nearly the bottom of the fossette in order to get a width of 17 mm. The hinder crescent of the Arizona specimen at the worn surface is 14 mm. wide; that of *P. major* only 9 mm. It is only at the bottom of the fossette that the width is 14 mm. These differences appear to be indication of specific difference.

Of a large camel there are some fragments of limb bones. One of these is part of the distal end of a right tibia (Cat. No. 10156). An estimate shows that the width of the lower end of this bone was close to 93 mm. It lacks only 5 mm. of fitting into the right astragalus of *P. major*.[14] A complete bone is the right external malleolus (Cat. No. 10157). Its greatest diameter is 52 mm., and it fits closley against the right calcaneum. This calcaneum (Cat. No. 10158) belonged to an animal that had not reached its greatest size, inasmuch as the hinder epiphysis is missing. The length is now 146 mm. The same bone of the dromedary has a total length of 141 mm. The fossil calcaneum must have been originally about 165 mm. long. The height at the external malleolus is 75 mm.; in the dromedary, 61 mm. A right navicular (Cat. No. 10159) has its greatest diameter 56 mm.; in the dromedary this diameter is 48 mm. The fossil bone fits quite exactly on the astragalus of *P. major*.

There is in the collection a part of the shaft of a hinder cannon bone (Cat. No. 10162), the length of the fragment being 185 mm. Proximally it reaches about the middle of the shaft; distally a little beyond the top of the split. The fore-and-aft diameter of the upper end is 45 mm.; the side-to-side diameter, 40 mm. In the dromedary these diameters are, respectively, 34 mm. and 30 mm.

A fragment (Cat. No. 10175) which presents the distal articular end of one of the divisions of a cannon bone is 50 mm. wide. In the dromedary the width of the corresponding part of the anterior cannon bone is 41 mm.; the width of this part of a metapodial of *Camelops huerfanensis*, 40 mm. This bone has the size and general appearance of the same part in the large camel which the writer describes in this paper as *Camelus maximus*. When closely examined, however, differences are seen. The grooves alongside of the guiding keels are deeper in *C. maximus*. While the side-to-side widths of the articular surface is the same in the two bones, the fore-and-aft thickness in *C. maximus* is 45 mm.; in the Arizona bone it is 50 mm. This bone may belong to a very large individual of *Procamelus coconinensis* or it may represent an otherwise unknown form.

A practically complete first phalange (Cat. No. 10163), probably an anterior one, is present (pl. 122, fig. 6). The length in the median

[14] Leidy and Lucas, pl. 18, fig. 1.

plane is 106 mm.; the width across the proximal articular surface is 46 mm.; that across the distal surface, 38 mm. At the middle of the length the fore-and-aft diameter is 24 mm.; the side-to-side diameter, 27 mm. The bone resembles closely the corresponding one of *Procamelus major*.[15] The former is, however, a slightly stouter bone, as may be seen in comparing the measurements just given with those of the table on page 608. On the underside of the distal end the lower articular surface ascends a height equal to one-third the total length of the bone; in *P. major*, only 0.27 of the length. The fore-and-aft width of the upper articular surface in *P. major* equals 44 mm.; in the bone from Arizona, only 39 mm. The fore-and-aft thickness of the distal end of the bone in *P. major* is 36 mm.; in the other bone, 32 mm. These differences appear to be of specific value.

There is present in the collection a first phalange (Cat. No. 10177), which appears to belong to the hinder foot of this species (pl. 123, fig. 5). It is that of a rather young animal, inasmuch as the epiphysis is missing from the upper end. The bone is there somewhat damaged. Its original length was very close to 85 mm. The side-to-side diameter at the middle of the length is 21 mm.; the fore-and-aft, 20 mm. The width of the distal articular surface is 25 mm. The hinder face is concave both up and down and from side to side.

There is present the greater part of one second phalange, probably belonging to a front foot (Cat. No. 10165). The upper articular surface is 43 mm. wide.

PROCAMELUS LONGURIO, new species.

Plate 120, fig. 8; plate 123, figs. 3–4; plate 124, fig. 4.

Type specimen.—A right hinder cannon bone, lacking the lower split end. (Cat. No. 10166).

Type locality.—Coconino Forest plateau, Arizona.

Type formation.—Lower Pleistocene.

Diagnosis.—Animal with long and slender limbs and, as shown by a referred axis, long necked, the hinder cannon bone, on the middle third of the shaft, with rounded front and lateral faces and with a deep hinder groove (pl. 120, fig. 8.)

A smaller camel than the dromedary is indicated by an injured axis, the greater part of a hinder cannon bone, and some first phalangeals. It appears to have been a slender, long-necked, and long-legged animal. The axis (Cat. No. 10167) lacks the hinder end. In all probability this missing portion was in the deposit, but was not collected. In size the bone is intermediate between that of the llama and that of the dromedary. An estimate based on the axes of the species just mentioned indicates that the length of the centrum of

[15] Leidy and Lucas, as cited, pl. 18, fig. 2.

the fossil bone would be about 130 mm. That part present, from the front of the odontoid process to the rear of the neural arch, is 125 mm. long; and there is still no indication of the ridges that must have run forward from the postzygapophyses. The width of the bone, across the front end is 50 mm. The width, 80 mm. behind the front end, is 26 mm.; the height, 39 mm. On the part of the bone preserved there are no, or very obscure, indications of the wing-like transverse processes that are present on the axis of the llama and that of the dromedary; nor is there any beginning of the posterior enlargement of the median ridge on the lower face; likewise none of the posterior enlargement of the crest of the neural arch.

The fragment of cannon bone (pl. 124, fig. 4) is 288 mm. long. It is complete above, but does not quite reach the split at the lower end. The hinder face is occupied by a broad groove. At the upper articular surface the side-to-side diameter is 44 mm.; the greatest fore-and-aft diameter, 40 mm. At a point 125 mm. below the upper articular surface the fore-and-aft diameter is 32 mm. on the outer face; 25 mm. in the median plane. Figure 8 of plate 120 presents a section at this point. The lateral faces are convex and nearly parallel; the front face is rounded. At the lower end the fore-and-aft diameter is 22 mm.; the side-to-side diameter, 28 mm. This bone is to be compared with the corresponding one of *P. minimus*.[16] Similar parts of the two bones are preserved. The two agree in having a strong ridge running down in front of the process at the rear of the upper articular surface. In this they differ from both the dromedary and the llama. A comparison of figure 8 of plate 120 and figure 9 of plate 120 will show that the cross sections, taken 125 mm. below the upper ends, are very different. In section the bone of *P. major* resembles that of the dromedary, while that of *P. longurio* is not greatly different from the corresponding bone of the llama. Two first phalangeals (Cat. No. 10168) are present and are taken to be the anterior. One has lost the epiphysis. The other is here illustrated (pl. 123, fig. 3).

The following comparative measurements are given:

Measurements of anterior first phalangeals.

	Procamelus longurio	Dromedary.
Length of bone in its median plane	111	94
Fore and aft diameter of upper articular surface	33±	34
Side-to-side diameter of articular surface	28	41
Width of distal articular surface	22	35
Fore-and-aft diameter at middle of bone	20	21
Side-to-side diameter at middle of bone	16	21

[16] Leidy and Lucas, p. 60, pl. 16, fig. 1.

The measurements show that the proximal phalangeals of *Procamelus longurio* differ much from those of the dromedary, being at once longer and much slenderer. The shaft in the dromedary is flattened from front to rear; in the fossil, from side to side. These bones resemble more those of the llama. There is present what is taken to be the distal half or more of a hinder first phalange (pl. 123, fig. 4) of the same species (Cat. No. 10169.) Its length must have been 90 mm. or more. At what is thought to be the middle of the length the fore-and-aft diameter is 19 mm.; the side-to-side diameter, 13 mm. The width of the lower articular surface is 20 mm.; but here, as in the hinder phalangeals, the width increases somewhat backward on the lower surface. This phalange is to be compared with the phalange, probably a hinder one, figured by Leidy and Lucas,[17] and referred to *P. minimus*. The one from Arizona was evidently longer than the one from Florida, which measures 87 mm. At the middle of its length the latter has a fore-and-aft diameter of 16 mm.; a side-to-side diameter of 14 mm. The former is therefore a more compressed bone. Its distal articular surface is considerably wider and extends upward farther on the lower surface.

To this species are referred a number of fragmentary bones which are smaller than those of a dromedary and apparently too small to have belonged to *P. coconinensis*. An injured lumbar vertebra (Cat. No. 10170) had a length of about 60 mm. The anterior end of the centrum is 52 mm. wide. The excavation for the zygapophyses of the preceding vertebra is 33 mm. wide. Somewhat less than the inner half of the distal articular surface of the right humerus has the catalogue number 10171. The front to rear diameter is 67 mm. The distal end of a right radius (Cat. No. 10172) has the surface for the first row of carpals 50 mm. wide. There is present a part of the upper end of an anterior right cannon bone (Cat. No. 10173). A good deal of the inner side is gone. The width of the upper articular surface must have been about 60 mm. Two pieces of the distal end of one or two cannon bones (Cat. No. 10174) are preserved. They may belong to the same leg. One articular surface is 35 mm. wide. A second phalange (Cat. No. 10178), belonging apparently to the hinder foot, is 50 mm. long.

Family BOVIDAE.

ANTILOCAPRA AMERICANA Ord.

Apparently this species is represented by a single first phalange (Cat. No. 10179). On comparison with corresponding bones of three recent skeletons the fossil is found to resemble one more closely than the latter resembles those of the other skeletons. Rather surprising differences in proportions exist in these bones of the existing pronghorn.

[17] Work cited, pl. 18, fig. 8.

Family SCIURIDAE.

MARMOTA ARIZONAE, new species.

Plate 123, figs. 6–8.

Type specimen.—The front two-thirds of a skull (Cat. No. 10181).

Type locality.—Coconino Forest region, Arizona.

Type formation.—Early Pleistocene.

Diagnosis.—Belonging near to or within the *flaviventer* group of the genus. Snout narrower and more rounded than in *M. f. obscura*. Nasal processes of premaxillae broader than in the just mentioned subspecies. Incisors obsoletely striated.

A species of marmot belonging apparently to the group of *M. flaviventer* is represented by the anterior part of the skull of one individual and two molar teeth of another. On comparison of the skull with that of a specimen of *M. flaviventer obscura*—a female from San Miguel county, New Mexico—differences appear which, on the discovery of additional materials, may prove to be of specific or of only subspecific value. At the present day no species of marmot is known to live within the territory of Arizona; and New Mexico harbors only in its northern part the subspecies named above—*M. flaviventer obscura*.

Figures 6–8 of plate 123 present views of the specimen on which the new species is based. The incisor teeth are broken off at the bone. On the right side, three molars, little worn, are present; on the left side, only one. The nasal bones and the zygomatic arches are missing. The distance from the rear of the last molar to the front of the premaxillae is 47 mm. In the recent skull used for comparison this distance is 46 mm. The nasal process of each premaxilla is nearly as wide as the space occupied by both of the nasals. The width of the frontals at the front of the orbits is somewhat less than in the recent skull. Examined from below, the snout is narrower in the fossil. The width at the maxillo-premaxillary suture is 19 mm.; in the recent skull, 20 mm. The palate behind the incisors is more rounded from side to side. In the recent skull a ridge running back on each side from the incisor gives an effect of squareness to this region. The processes on the maxillae just in front of the rows of teeth appear to be unusually strongly developed in *M. f. obscura*. They are much less prominent in the fossil. No differences are observed in the rows of teeth or of the individual molariform teeth. The incisors of *M. f. obscura* are very distinctly striated; in the fossil they are nearly smooth.

CITELLUS TUITUS, new species.

Plate 120, figs. 5–6.

Type specimen.—The anterior half of a skull, with incisors and all the upper teeth except the third premolars (Cat. No. 14353 of the Amer. Mus. of Nat. History).

Type locality.—Coconino Forest plateau, Arizona.

Type formation.—Early Pleistocene.

Diagnosis.—Size about that of *Citellus franklini.* Rows of upper teeth converging backward. Palate narrow.

The skull which is made the type of this species presents that part which lies in front of the brain case. This part is damaged and slightly distorted. The small foremost premolars (pm^3) are missing. The other teeth are in fine condition. A part of one nasal bone is present, but displaced. Most of the left premaxilla is missing. Much of the bone is covered with a coating of calcite.

In size this animal resembled *C. franklini.* Its conspicuous character is the convergence of the rows of upper teeth backward. The following comparative measurements are presented:

Measurements of skulls of Citellus.

	C. franklini.	*C. tuitus.*
Length of upper row of teeth	10	10.8
Length of last premolar and three molars	9	9.6
Space between last two premolars	8	7
Space between hindermost molars	7	5.6
Length of suture between maxillae on palate	13.5	13.5

It will be observed that, while the rows of teeth are slightly longer in *C. tuitus* than in *C. franklini*, the palate is narrower at each end, and that the rows approach each other more rapidly in the fossil.

While the bones and teeth are colored green by the copper, there are yet traces, on the enamel of the incisors, of the original orange color.

Family CRICETIDAE.

NEOTOMA CINEREA Ord.

In the collection made by Mr. Brown for the American Museum of Natural History, in New York, there is a right ramus which is not distinguishable from that of *Neotoma cinerea.* It contains all of the grinding teeth except the hindermost. The catalogue number is 14365 of the American Museum.

LEPUS BENJAMINI, new species.

Plate 121, figs. 1–5*b*.

Type specimens.—A part of a left ramus, containing the premolars and molars, except the hindermost (Cat. No. 10183).

Type locality.—Coconino plateau, Arizona.

Type formation.—Early Pleistocene.

Diagnosis.—Differing, so far as known, from *Lepus campestris* only in having the enamel of the outer infold of the lower molariform teeth distinctly crenulated behind.

Named in honor of Dr. Marcus Benjamin, editor of the Proceedings of the the United States National Museum.

Besides the fragment of the lower jaw which is made the type of this species there is a considerable number of other parts referred to it provisionally. The principal of these are the following: A right upper incisor (Cat. No. 10184); the greater part of both maxillae (Cat. No. 10185), containing the left first true molar and the sockets of the other teeth, excepting the front premolar; an interparietal bone (Cat. No. 10186); one lumbar vertebra (Cat. No. 10187); a complete humerus (Cat. No. 10198); five fragments of innominate bones (Cat. Nos. 10189, 10190); three complete femora (Cat Nos. 10191, 10192); the upper half of a right tibia (Cat. No. 10193); a tibia lacking the upper epiphysis and a part of the distal end (Cat. No. 10194); and a distal end of another tibia (Cat. No. 10195). These bones are described below:

The type ramus is figured (pl. 121, fig. 1) as seen from the inner side. The height at the first molar is 16 mm. The anterior premolar is only slightly larger than the other teeth. In it, as in the other teeth, the enamel is thin and delicate, thickest where it forms the front wall of the main outer valley. In the anterior tooth this front wall is angulated and slightly wavy in its course. The rear part of the loop is very thin and distinctly crenulated. In the front border of this tooth there is a narrow but pretty deep inflection of the enamel. In the outer face of the front half of the tooth there is a wider inflection of the enamel, and this also is crenulated. In the other teeth the anterior part of the loop of enamel is thickened and forms a ridge across the grinding surface. The hinder part of the loop is crenulated. The writer was on the point of referring the fossil to *Lepus campestris*, but an examination of many specimens of its various subspecies resulted in finding that in none of them did the hinder element of the loop show more than feeble traces of crenulations. Other species, as *L. alleni* and *L. gaillardi*, present these constantly. These species, however, differ in other ways from the fossil species.

Figure 2 of plate 121 presents a view of two maxillae of one individual which is believed to belong to the species described. The right first molar is present. The parts resemble the corresponding ones of *L. campestris*. A complete upper right incisor appears not to differ from that of the species just named. The groove is nearer the inner border of the tooth, and it retains its cement. *L. californicus* rarely has cement in the grooves of the incisors.

The lumbar vertebra present resembles more that of a species of *Sylvilagus* than of *Lepus*. Perhaps it does not belong to the species being described. The humerus (pl. 121, fig. 5*a*) is 91 mm. long. It is somewhat more compressed than one 95 mm. long and supposed to belong to *Lepus callotis*. At the middle of the length the fore-and-aft diameter is 6.6 mm.; the side-to-side diameter, 4.1 mm. In the recent humerus mentioned the diameters are 6.1 mm. and 5 mm., respectively.

The parts of the innominate bones present (pl. 121, fig. 5*b*) resemble those of the supposed *L. callotis*, but are slightly smaller.

The largest femur present is 115 mm. long, quite exactly the length of that of *L. "callotis."* It is broader across the inner and outer processes at the upper end than in *L. "callotis,"* and narrower across the condyles. The femur figured (pl. 121, fig. 3) is 100 mm. long. The imperfect tibiae present are somewhat slenderer than those of the recent skeleton used for comparison. One is figured (pl. 121, fig. 4.)

Genus BRACHYLAGUS Miller.

Numerous bones of many parts of the skeleton of a species of *Brachylagus* are present. Usually they are more or less injured, but taken together they furnish the characters of a species apparently new. The remains appear to require some modification of the characters that have been imputed to the genus. None of the specimens retain the first upper premolar. According to Lyon [18] in the next four upper molariform teeth the infolding of the enamel extends about halfway from the inner to the outer face of the tooth, and this enamel is not crenulated. However, it is seen to be occasionally slightly crenulated. In the fossil species at hand the enamel is very distinctly crenulated, and the infold appears to extend outward slightly farther than it does in *B. idahoensis*. The first lower premolar conforms to the description of that of the type species of the genus. The hinder portions of the other lower molariform teeth are smaller than the anterior portion; that is, the teeth differ from those of *B. idahoensis* principally in the crenulated character of the infolded enamel of the upper teeth.

BRACHYLAGUS BROWNI, new species.

Plate 121, figs. 6–18.

Type specimen.—A palate containing three grinding teeth on the right side and four on the left (Cat. No. 10196 U. S. N. M.).

Type locality.—Coconino plateau, Arizona.

Type formation.—Early Pleistocene.

Diagnosis.—Size larger than that of *B. idahoensis*. Upper molariform teeth with the enamel of the inner reentrant fold distinctly crenulated.

This species, as represented by the skull, was larger than *B. idahoensis*, but the rest of the skeleton indicates an animal of nearly the same size. Perhaps the skull was that of an unusually large

[18] Smiths. Misc. Coll., Quart. Issue, vol. 50, p. 412.

individual. The front half (Cat. No. 10197) is here figured (pl. 121, figs. 7–9). It has been impracticable to remove all of the calcite and sand, but the form of the skull is shown. From the rear of the hinder tooth to the front of the snout is 28 mm.; in a specimen of the living species from Nevada this distance is only 23 mm. The nasal bones, the incisors, and some of the other teeth are missing from the specimen figured. Figure 10 of plate 121 presents a view of a palate and maxillae (Cat. No. 10198) from which the teeth have fallen. The first premolar, to judge from the size of the socket, was larger than the corresponding tooth of *B. idahoensis.* Figure 6 of the same plate presents a view of the type—a palate (Cat. No. 10196) in which many of the teeth are retained. Another figure (pl. 121, fig. 12) gives a view of the left zygomatic arch and palate, as seen from below (Cat. No. 10199.). Some matrix yet clings to the bone. There are present several rami of lower jaws. Figure 13 of plate 121 represents one of these (Cat. No. 10200) lacking the angular process. From the rear of the condyle to the front of the jaw is 44 mm.; in a specimen of *B. idahoensis* this distance is 39 mm. Another right ramus (Cat. No. 10201) (pl. 121, fig. 11) presents a view of the incisor and of all the other teeth except the hindermost molar. Figure 14 of plate 121 is that of a right humerus (Cat. No. 10202) 45 mm. long; but the animal had perhaps not reached its full size. The bone is slightly shorter than the humerus of *B. idahoensis* from Nevada. One-half of a right innominate bone (Cat. No. 10203) is shown as seen from below in figure 15 of plate 121. The total length is 49 mm.; that of the specimen of *B. idahoensis* is 46 mm. Figure 16 of plate 121 presents a front view of a right femur (Cat. No. 10204); figures 17 and 18 of the same plate show parts of two tibiae, one (Cat. No. 10206) lacking the epiphysis; the other (Cat. No. 10207) the distal half of the bone.

TAXIDEA ROBUSTA, new species.

Plate 119, figs. 3–5.

Type specimen.—A left ulna.

Type locality.—Coconino Forest region.

Type formation.—Early Pleistocene.

Diagnosis.—Ulna stouter than in *T. taxus.* Inner face with a ridge from coronoid process to distal end. Pubic bone at rear of obturator foramen thicker and wider than in *T. taxus.*

In the collection there is a single ulna (Cat. No. 10208), that of the left side, which appears to have belonged to a species of *Taxidea* distinct from *T. taxus.* This bone has lost all that part above the middle of the greater sigmoid cavity, and also the head and styloid process.

When compared with the corresponding bone of *T. taxus* (pl. 119, figs. 1, 2) the fossil is seen to be stouter. When measured halfway between the articular surface for the head of the radius and that for its distal end the diameters are found to be 8.5 mm. and 6.2 mm. In a humerus of *T. taxus* at hand, slightly shorter, the diameters are 8 mm. and 5.2 mm. The height through the coronoid process is 15.5 mm.; in *T. taxus*, 13.6 mm. In the fossil there is a deep groove in the outer face which starts beneath the greater sigmoid cavity and runs down the bone. Beyond the middle of the length of the ulna this groove becomes shallow. In *T. taxus* it continues on distinctly to near the lower articular surface for the radius. On the inner face of the fossil bone a ridge starts at the coronoid process and continues to near the lower end of the ulna. At the middle of the length of the bone it approaches the hinder border; then retires from it, and ends below in a sharp crest. In *T. taxus* the ridge is practically missing in the middle third of the length.

Besides the ulna there is a part of the right innominate bone (Cat. No. 10209.). This (pl. 119, fig. 5) consists of the pubic bar which bounds the obturator foramen below and the part of the schium that bounds it behind. When this is compared with the corresponding parts of *Taxidea taxus berlandieri*, from Matamoras, Mexico (No. 1389 U.S.N.M.), they are found to be very different. The fossil bone is narrower, but much thicker. The pubic bar where narrowest is 5.4 mm. wide and 2.8 mm. thick; in *T. taxus*, 6 mm. wide and 2.2 mm. thick. The pubic symphysis is of about the same length in the two species, 10 mm.; in the fossil it is 7 mm. thick; in *T. taxus*, 3.3 mm. The bar bounding the obturator foramen behind makes a greater angle with the pubic bar than it does in *T. taxus*. At the rear end of the obturator foramen the bone is 7 mm. wide and 5 mm. thick; in *T. taxus*, 5.5 mm. wide and 3 mm. thick.

CANIS NUBILUS?

Three left rami of lower jaws (Cat. No. 10210); the lower half of a right humerus (Cat. No. 10211); the lower fourth of a smaller one (Cat. No. 10212); a complete right radius (Cat. No. 10211); the distal half of another of the left side (Cat. No. 10213); an axis (Cat. No. 10214); the distal ends of two right tibiae and apparently the corresponding astragali (Cat. Nos. 10218, 10219) are referred with doubt to *Canis nubilus*. The humerus and the radii evidently belonged to one individual, and it seems probable that the best of the three jaws was a part of the same skeleton. The animal belonged evidently to a large and apparently slender-limbed form. The radius is longer by as much as an inch than in some gray wolves. At the same time the bones are slenderer than in those specimens. One wolf (No. 1308 of the United States National Museum), collected in 1853, at Fort Kearney, Nebraska, regarded as *C. nubilus*, has, however, a radius only slightly longer.

Measurements of radii of wolves.

	C. nubilus?	C. nubilus.
Total length	202	204
Greatest width of head	21	23
Width at middle of length	15.5	16
Thickness at middle of length	10	11.6
Thickness 30 mm. above lower end	10.5	13.5
Greatest diameter at lower end	28.6	30.6

The thickening of the bone in the distal half is especially noticeable. The humerus of the wolf No. 1308 is 205 mm. long. The length of the fossil can not be determined. It is assumed to have been closely the same.

Measurements of humeri of wolves.

	C. nubilus?	C. nubilus.
Total length	205	205
Fore-and-aft diameter 102 mm. above lower end	17.5	21
Side-to-side diameter 102 mm. above lower end	13.5	16
Width of lower articular surface	22	25
Width across condyles at lower end	38	41.5

The best preserved ramus of the lower jaw, in comparison with that of *C. nubilus*, is lower and thinner. The teeth differ apparently only in being thinner. The canine, as shown by a part of the socket present, was slender.

Another fragment of a left ramus is similarly low, but is thicker. The fourth premolar is as thick as in *C. nubilus*. A third left ramus had early lost the carnassial tooth by disease. The socket is filled with bone and the jaw is swollen in that region. The fourth molar is longer and thicker than in *C. nubilus*. A complete axis is of a size corresponding to the other bones. It appears probable that all of these parts belong to *C. nubilus* or to a species very close to it.

In the American Museum of Natural History there is a fragment of a left ramus of a lower jaw (Cat. No. 14360) which contains the last two molars. It probably belongs to the same species as the others. An atlas in the same collection is to be similarly referred.

In addition to these bones there are some of a smaller individual, a cervical vertebra, apparently the seventh, and a dorsal vertebra, about the fifth (Cat. No. 10220); the distal ends of two tibiae and the corresponding astragali (Cat. Nos. 10218, 10219).

CANIS LATRANS Say.

Canis latrans, or a species close to it, is represented by a part of a right tibia (Cat. No. 10221) and an upper left canine (Cat. No. 10222). The fragment of tibia is 113 mm. long, and lacks a little of the upper end and several millimeters of the lower. On comparison with the same part of a specimen of *C. latrans* from Nebraska no differences are observed. The enamel of the canine tooth has been weathered somewhat, but the tooth appears not to have differed from the same tooth of a coyote from Fort Kearney, Nebraska.

Family HYAENIDAE.

In the Anita collection there are two bones (Cat. No. 10223) which the writer regards as having belonged to one specimen of some carnivorous animal; these are parts of the left ramus of one or two lower jaws. The principal fragment is that which bore the last premolar and the first molar, together with the lower border of the jaw, extending back to the condyle and the angle (pl. 124, figs. 5, 6). This was at first regarded with some doubt as having belonged to a large species of *Felis*. Unfortunately the crowns of the teeth are gone, but the roots remain; also a slight part of the grinding surface of the rear of the fourth premolar. In front of the fourth premolar there is preserved a small patch of the hinder wall of the socket for the hinder root of the third premolar. This root seems to have been about as large as the anterior root of the fourth premolar.

The other fragment mentioned belonged to a left ramus, and presents the hinder wall of the socket for the canine, and for three roots of premolars (pl. 124, figs. 5, 6, upper end). As to these premolars, it was at first a question whether the second root belonged to the first premolar present or to the second. An examination of the wall of bone between two premolars of a dog or large felid shows that both of its faces are quite uniformly concave. On the other hand, the wall that separates two roots of a premolar has its two faces nearly flat; while in the middle of each face there is a more or less distinct ridge. Each ridge fits into a slight groove on the corresponding face of the root. Now in the fragment under consideration the bone which separates the two roots present indicates distinctly that they belong to one tooth; while the bony septum next behind shows as conclusively that it separated two different teeth. We find, therefore, that the premolar succeeding the canine had two roots. We must now determine whether either or both of the fragments belonged probably to a felid or to some other group. The anterior fragment will be first considered.

(*a*) The diastema between the canine and the first premolar present measures only 10 mm. In a lion jaw at hand this measures 31 mm.; in a tiger, 26 mm. However, in a few cats, as the puma, this is short; in the puma, only about 10 mm. (*b*) In the cats there are usually two or more mental foramina; one, large or small, beneath the anterior premolar (pm. 3), the others in front of it. (*c*) In the fossil bone there is a large foramen below the hinder root of the anterior premolar, but no traces of others or of their backwardly directed canals. It is possible, however, that these were lower down than in the part of bone preserved. (*d*) In no felid that the writer has found does the symphysis on its upper surface, extend backward beyond the front of premolar 3. In the fossil fragment the curvature of the surface indicates that the upper face of the symphysis reached back at least as far as the middle of the anterior premolar. It appears improbable, therefore, that this fragment was that of a jaw of any of the Felidae.

Now as to the larger fragment of the jaw: (*a*) In the cats the lower border of the ramus is nearly straight from the symphysis to the angle, so that, when placed on a level surface, the angle touches the surface or nearly so. The upper and inner border of the jaw along the tooth row then slopes slightly downward. When the fossil ramus is placed on a level surface the inner upper border of the bone slopes slightly upward in front. Unless the jaw below the anterior teeth maintained the great depth which it has behind, 51 mm., the angle of the jaw must have been raised above the supposed level surface. (*b*) In the cats the surface for the insertion of the masseter muscle is nearly always deeply excavated, and the bone at the lower edge of this surface stands out as a sort of shelf. In the fossil the masseter surface is less deeply excavated. (*c*) In the cats, so far as observed, the depth of the jaw at the middle of the molar is considerably less than the length of the sockets of the last premolar and the molar taken together. In the fossil the two dimensions are equal. The characters just discussed, it seems to the writer, make it very improbable that the jaw belongs to *Felis* or any closely related genus.

The general appearance of the fragments, the similar fossilization, the filling of sediment in the canals and other openings, the size of the small fragment relative to the larger one, and the improbability that either of them belonged to a felid, make it probable that they were parts of the same jaw.

If this is the case, it appears that the jaw must be referred to the Hyaenidae, for there are three premolars, all two-rooted, the hindermost large, and a large molar, doubtless a shearing tooth. The diastema is short, as in the hyaenas. In *Crocuta* the symphysis comes back even with the middle of premolar 2, as it does in the fossil. There is a large single mental foramen in the position of that of the fossil. The lower border of the ramus rises from beneath the molar to the angle; and this was probably the case with the fossil jaw. The masseter excavation is comparatively shallow, as it is in the fossil. On the outer face of the jaw, beneath the molar and the last premolar, the surface is somewhat concave in the hyaenas; in the cats it is convex; in the fossil it is concave. The inferior dental foramina and canal in the cats are large; in the hyaenas they are much smaller.

Those of the fossil jaw appear to have been about as large as in the hyaenas.

There are some features in the jaw which are different from those of both the felids and the existing hyaenas. The jaw is deeper still than in the hyaenas and it is considerably thickened along that part of the lower border preserved. The angular process is strongly developed, round, rather thin, and without the concavity seen on the inner face of the angle of the hyaenas. While it seems that the animal must be referred to the Hyaenidae, it seems quite as necessary to put it in a new genus. The name of this makes allusion to the Grand Canyon, whose beginning this animal may have witnessed.

CHASMAPORTHETES, new genus.

Type species.—*Chasmaporthetes ossifragus*, new species.

Diagnosis.—Differs from the existing genera in having apparently thinner premolars and molars, a deeper and thicker lower jaw, with a broad and rounded angle.

CHASMAPORTHETES OSSIFRAGUS, new species.

Plate 124, figs. 5, 6.

Type specimen.—The rear of the left ramus of a lower jaw, with roots of teeth, but with the crowns shattered. (Cat. No. 10223.)

Type locality.—Coconino Forest region, Arizona.

Type formation.—Early Pleistocene.

Diagnosis.—Fourth premolar and first molar of nearly the same length; the molar apparently thicker. Jaw deeper and thicker than in existing species. Referred second molar two-rooted and its socket nearly two-thirds as long as that of the molar. Symphysis extending back to at least the middle of the second premolar.

The following measurements in millimeters are added to the description:

Measurements of jaws and teeth of hyaenas.

	Chasmaporthetes.	Hyaena.
Width of canine	11±	10.5
Length of diastema	10	10.2
Second premolar, length of socket	18	13.5
Third premolar, length of socket	19	17.2
Third premolar, width of front root	7	9
Fourth premolar, length of socket	25	17.5
Fourth premolar, width of roots	8	9
First molar, length of socket	27	17
Width of its front root	8	8
Width of its hinder root	6	6
Depth of jaw at middle of last molar	49	37
Thickness of jaw below last molar	17	11
Length of premolar-molar series	90±	70

It will be seen that the fossil animal was apparently a somewhat larger one than that with which it is here compared. If this is taken into account, some differences are not so great as they appear to be. The second premolar of the fossil would be relatively of about the same length as that of the living species; the fourth premolar somewhat longer, the first molar considerably longer. On the other hand, the roots of the teeth, probably the crowns also, would be relatively thinner.

In size of jaw and length of teeth the fossil species resembles more *Crocuta crocuta*. The crowns of the teeth appear to have been thinner than in either of the living species. Although the teeth of *Crocuta* are larger than those of *Hyaena* the jaw is but little longer.

Besides the parts described above, there is a root of a large canine which resembles closely the root of an upper canine of a hyaena, also a left mandibular condyle which differs little from that of *Hyaena hyaena*. It is possible that it belongs to the mandible forming the type of the species here described, but contact between the two fragments can not be established.

Having described the species found at Anita it appears proper to consider what may be learned from that assemblage. By far the larger number of the species are such as are generally recognized as belonging to the Pleistocene. While horses and true dogs (*Canis*) may yet be found to occur in Pliocene deposits, it is not yet proved that they do so occur. The preservation of the bones and teeth in a limestone cave itself indicates that they belong to the Pleistocene; yet among these Pleistocene animals are found remains of two camels which it seems necessary to refer to the genus *Procamelus*. Members of this genus have not usually been recognized as having existed at a later time than the early Pliocene. In 1916[19] Dr. E. H. Sellards referred to the apparent admixture of Pliocene and Pleistocene species that had been observed in the Dunnellon (Alachua) formation in Florida. Among the fossils were three species of *Procamelus*—*P. major*, *P. minor*, and *P. minimus*. The two species of the same genus found at Anita are so closely related to two of those from Florida, *P. major* and *P. minimus*, that it was at first thought that they were the same. The writer has briefly discussed this Florida case[20] also the finding of similar mixtures of Tertiary and Pleistocene fossils in Idaho and in Oregon. In these western localities, as well as in Florida, there have occurred, it has been supposed, either in the deposits or in the collections, accidental minglings of fossils of two distinct formations. At Anita, however, there can have happened nothing of the sort,

[19] Eighth Ann. Rep. Fla. Geol. Surv., p. 94.
[20] Amer. Journ. Sci., ser. 4, vol. 47, p. 373.

and it appears therefore that *Procamelus* is definitely brought up into the Pleistocene. It is too early to say that the same thing will happen for the rhinoceroses, but it may be expected. The explanation given by the author in the article cited above is that the mentioned deposits in Florida, Idaho, and Oregon belong to the time of the first glacial, or Nebraskan, stage of the Pleistocene. The collection made at Anita, Arizona, appears to give testimony for this view.

6. ON SOME ADDITIONAL FOOT BONES OF *THINOBADISTES SEGNIS* FROM FLORIDA.

Plate 119, figs. 6–11.

In 1919,[21] the writer described a new genus and species of ground sloth (*Thinobadistes segnis*). This species was based on a left astragalus which had been found in "Mixon's bone bed," near Williston, Levy County, Florida, in 1887. Since that description was written, seven other foot bones which had been found at the same time and place, have come to light in the United States National Museum. In all probability these belonged to the same individual as the astragalus.

The rediscovered bones are the navicular, the third, the fourth, and the fifth metatarsals of the right hinder foot, the second phalange of the right hinder foot, the proximal end of the ungual phalange of the same digit, and the right second metacarpal.

The right second metacarpal (Cat. No. 2509*a*; pl. 119, p. 6) has about the size of that of *Mylodon robustus*.[22] The total length of the bone is 78 mm.; the height at the distal trochlear ridge, 46 mm. Owen's description of this bone in *Mylodon* [23] applies well to the one in hand. The navicular (Cat. No. 2509*b*; pl. 119, fig. 7) conforms to the description given in Owen's article cited. Its side-to-side dimension is 68 mm.; its width, somewhat more than 41 mm., being thus somewhat smaller than that of *Mylodon robustus*.[24] Compared with the same bone of *Mylodon sodalis*, it is considerably smaller, thinner, narrower, and has the surface for articulation with the cuboid at right angles with the surface for the astragalus, while in *M. sodalis* it is oblique to that surface. The third metatarsal (Cat. No. 2509*c*; pl. 119, fig. 8) is much like that of *Mylodon robustus*, but it appears to be somewhat larger. Its greatest axial length is 70 mm. It differs from the corresponding bone of *Mylodon robustus* in having a facet on the inner side of the proximal end for the second metatarsal. It is near the lower border of the bone and looks downward. This facet is about 18 mm. long and 11 mm. wide. Below it the surface of the bone is rough, as though the base of the second metatarsal had been closely bound to the third.

[21] Proc. U. S. Nat. Mus., vol. 56, p. 104, pl. 27.

[22] Owen, Monogr. Mylodon, pls. 15, 16.

[23] Idem, p. 91.

[24] Idem, p. 175.

In general terms the description of the fourth metatarsal of *Mylodon robustus* applies to the corresponding one of *Thinobadistes* (Cat. No. 2509*d*, pl. 119, fig. 9). However, the latter is narrower at its distal end and gradually widens upward. It has a total length of 102 mm.; the height of the distal end is 46 mm. The fifth metatarsal (Cat. No. 2509*e*; pl. 119, fig. 9) has a length of 127 mm., very close to that of *Mylodon robustus*. The greatest width of the proximal end is 56 mm. A comparison with Owen's figure will show that the distal half of this bone is differently shaped in the two animals. In *M. robustus* the outer border is nearly straight; in the Florida animal the border is sigmoid. The distal end of the fifth metatarsal reaches nearly to the distal end of the fourth; in *M. robustus* it falls considerably short of reaching that point. The proximal end of the outer border of this metatarsal is thick, and rounded; and it forms part of a smooth surface which continues around to the underside of the bone. This surface was probably covered by a pad of thickened skin and bore much of the weight of the animal.

The second phalanx in the collection appears to belong to the median digit of the right hind foot (pl. 119, fig. 10). The total length is 50 mm.; that taken along the axis of the bone 38 mm. The height of the hinder end, taken in the median plane, is 33 mm.; the width of this end, 35 mm.; the width of the distal articulation, about 25 mm. The base of an ungual phalanx (pl. 119, fig. 11) is taken to be that of the hinder third digit, and it fits closely to the end of the second phalanx just described. The height of the hinder end of the bone is 45 mm.; the width, 38.5 mm. On the sides of the base of the phalanx are indications of the presence of the sheath for the horny claw; but, as represented in Owen's figure of the hinder median claw, this sheath was deficient on the middle of the upper surface.

It will be a matter of great interest to discover additional remains of this animal, especially remains of the skull and teeth. In the hinder foot the digits resemble much those of *Mylodon*; but the astragalus, especially on the underside, is much like that of *Megatherium*. The size of the animal was about that of *Mylodon robustus*, but considerably smaller than *Mylodon sodalis* from Christmas Lake.

EXPLANATION OF PLATES.

Plate 116.

Figs. 1–7. *Camelops huerfanensis*. Upper teeth. $\times .7 \pm$:

1. Right fourth premolar, grinding surface.
2. Right first molar, outer face.
3. Same tooth, grinding surface.
4. Right second molar, outer face.
5. Same tooth, grinding surface.
6. Right third molar, outer face.
7. Lower left hindermost molar.

FIGS. 8–9. *Camelops*, species indeterminable. Lower left third molar. ×.66:

8. View of inner face.
9. View of grinding surface.

PLATE 117.

All the figures are of approximately the natural size.

FIG. 1. *Odocoileus*, species indeterminable. Distal end of cannon bone and first phalange.

2. *Marmota monax.* Left side of lower jaw.

FIGS. 3–5. *Marmota arrodens.* ×1:

3. Right side of mandible, with incisor. Type.
4. Left ramus, with incisor.
5. Right humerus, front view.

FIG. 6. *Marmota monax.* Right humerus, front view.

7. *Marmota arrodens.* Right ulna.
8. *Marmota monax.* Right ulna.
9. *Marmota arrodens.* Right radius.
10. *Marmota monax.* Right radius.

PLATE 118.

All the figures are of approximately the natural size.

FIG. 1. *Marmota arrodens.* Upper end of left femur, rear view.

2. *Marmota monax.* Upper end of femur, rear view.

FIGS. 3, 4. *Marmota arrodens.* Tibiae:

3. Left tibia.
4. Right tibia.

FIG. 5. *Marmota monax.* Right tibia.

FIGS. 6–8. *Marmota flaviventer.* Skull:

6. Skull seen from above.
7. Same skull seen from below.
8. Frontal bone of another skull.

FIGS. 9, 10. *Thomomys fuscus.* Front of skull.

9. Seen from below.
10. Seen from right side.

FIG. 11. *Equus occidentalis?* Upper right second premolar.

12. *Equus giganteus?* Part of an anterior fossette of upper left tooth.

PLATE 119.

FIGS. 1–2. *Taxidea taxus.* Left ulna. × 1.

1. Inner face.
2. Outer face.

FIGS. 3–5. *Taxidea robusta.*

3. Inner face of left ulna. × 1.
4. Outer face of left ulna. × 1.
5. Part of right ischium and pubis, showing upper face. × .5.

FIGS. 6–11. *Thinobadistes segnis.* Foot bones. × .5:

6. Right second metacarpal, seen from below.
7. Right navicular, seen from behind.
8. Right third metatarsal bone, seen from left side.
9. Right fourth and fifth metatarsal bones, seen from below.
10. Second phalange of right hinder median digit, from above.
11. Base of ungual phalange of hinder third digit, from behind.

FIG. 12. *Camelus arctoamericanus.* Anterior first phalanx, seen from rear. × .7.

PLATE 120.

FIGS. 1–4. *Thomomys scudderi.* Skull. Type:

1. Skull seen from left side. × 1.
2. Right ramus of lower jaw seen from right side. × 1.
3. Skull showing palate. × 2.
4. Lower jaw seen from above. × 2.

FIGS. 5–6. *Citellus tuitus.* Skull. Type. × 2:

5. Palate, showing teeth.
6. Left side of skull.

FIG. 7. *Citellus taylori.* Type. × 1. Left ramus of lower jaw seen from left side.

FIG. 8. *Procamelus longurio.* Type. × 1. Section of the right hinder cannon bone.

FIG. 9. *Procamelus major* Leidy. Section of the right hinder cannon bone.

PLATE 121.

All the figures are of approximately the natural size.

FIGS. 1–5. *Lepus benjamini:*

1. Lower jaw. Type. Inner face of left ramus.
2. Referred maxilla.
3. Right femur, front view.
4. Right tibia, front view.
5a. Left humerus, front view.
5b. Right innominate bone.

FIGS. 6–18. *Brachylagus browni:*

6. Palate, with teeth. Type.
7. Referred skull, showing right side. The bone encrusted with calcite.
8. Same skull, seen from above.
9. Same skull, seen from below.
10. Palate of another skull, showing tooth sockets.
11. A right mandible with most of the teeth.
12. A left maxilla showing zygomatic arch.
13. A right ramus of the lower jaw.
14. A right humerus seen from radial side.
15. Right innominate bone.
16. Right femur seen from in front.
17. Right tibia, lacking the epiphyses.
18. Upper half of left tibia.

PLATE 122.

FIGS. 1–3. *Camelops huerfanensis?* A cervical vertebrae. ×. .5±:

1. Seen from below.
2. Seen from the right side.
3. Seen from in front—
   (*aa*) Span of the front and lower parts of the transverse processes.
   (*bb*) Span of the lower plate of the transverse processes.

FIGS. 4–6. *Procamelus coconinensis.* Tooth and first phalange:

4. An upper left second(?) molar. Type. × 1.
5. Same tooth, presenting outer face. × 1.
6. Anterior first phalange. × .7.

FIG. 7. *Cynomys niobrarius.* Palate presenting the teeth. Type. × 1.

PLATE 123.

FIG. 1. *Camelus maximus.* An anterior first phalange. Type. × .72.
FIG. 2. *Procamelus huerfanensis.* Front first phalange. × .75.
FIGS. 3–4. *Procamelus longurio.* First phalangeals. × .73.
 3. Anterior first phalange, seen from front.
 4. Hinder first phalange, seen from front.
FIG. 5. *Procamelus coconinensis.* Hinder first phalange. × .73.
FIGS. 6–8. *Marmota arizonae.* Skull. Type. × 1:
 6. Skull seen from below.
 7. Same skull seen from above.
 8. Same skull seen from the right side.

PLATE 124.

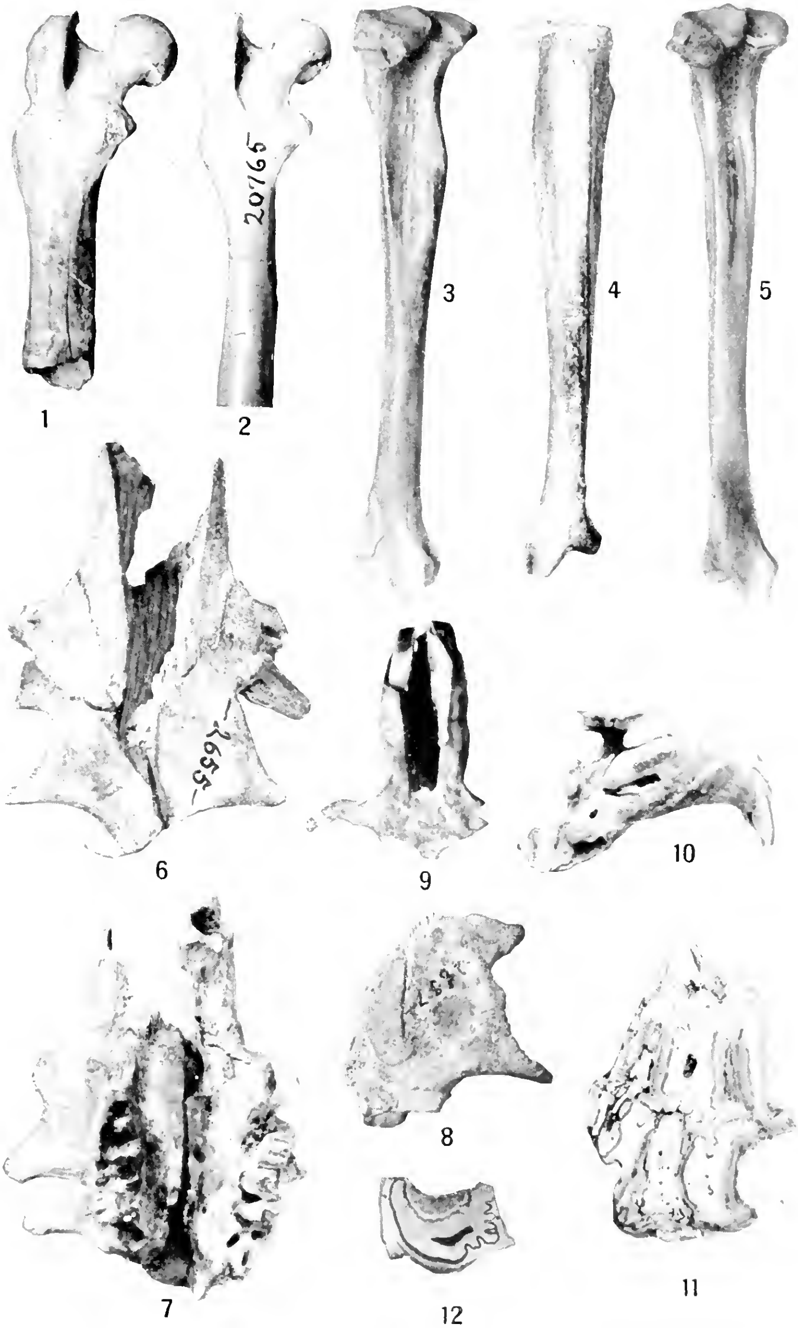
FIG. 1. *Equus occidentalis?* Right hindermost molar. Polished section. × 1.
FIGS. 2–3. *Equus giganteus?* × 1.
 2. Right hindermost molar. Grinding face.
 3. Part of a right upper molar. × 1.
FIG. 4. *Procamelus longurio.* Right hinder cannon bone. Type. × .5.
FIGS. 5–6. *Chasmaporthetes ossifragus* Parts of left ramus of lower jaw. Type. × 1.
 5. Seen from outside.
 6. Seen from above—
  (*a*) Rear of socket for canine.
  (*b*) Front root of second premolar.
  (*c*) Hinder root of second premolar.
  (*d*) Socket for front root of third premolar.
  (*e*) Part of socket for hinder root third premolar.
  (*f*) Front root of fourth premolar.
  (*g*) Hinder root of fourth premolar.
  (*h*) Front root of first molar.
  (*i*) Rear root of first molar.

TEETH OF CAMELS FROM COLORADO AND SOUTH DAKOTA.

FOR EXPLANATION OF PLATE SEE PAGES 639 640.

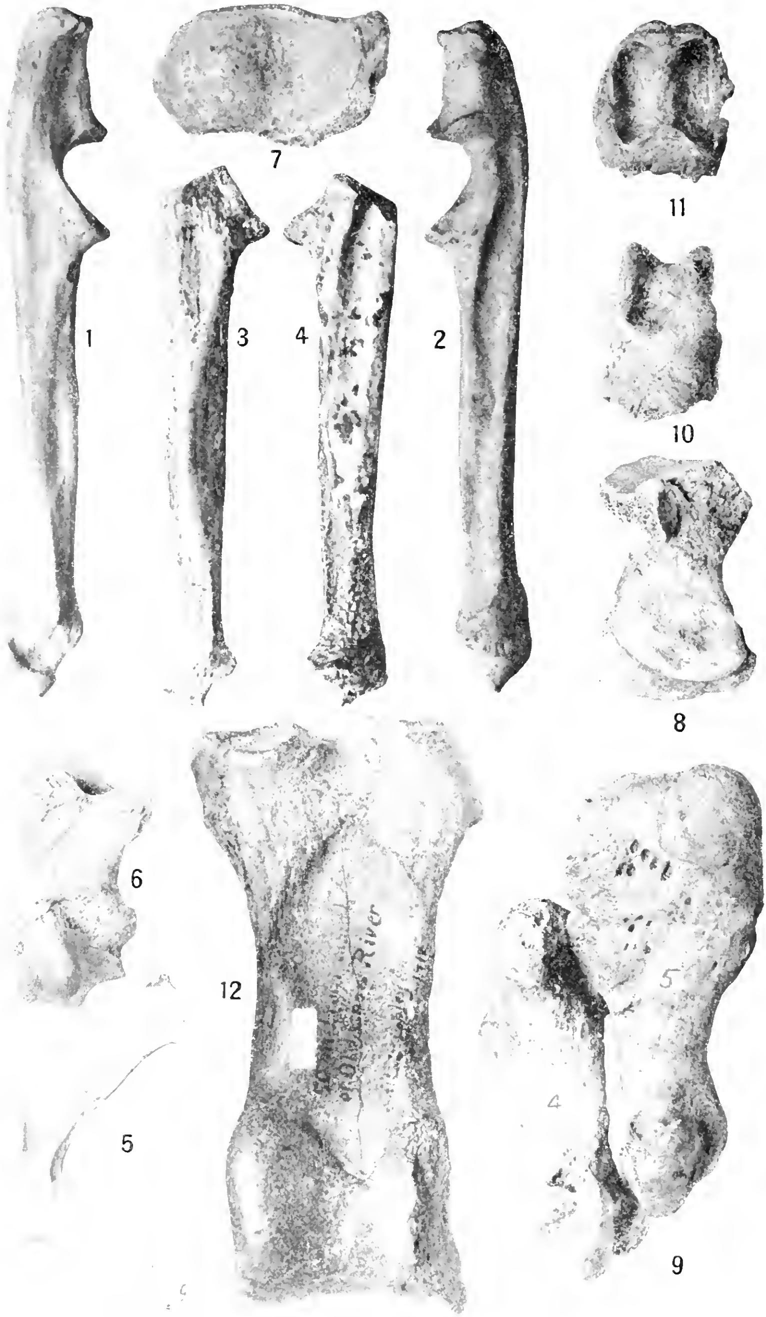
Bones of Deer and of Woodchucks.

For explanation of plate see page 640.



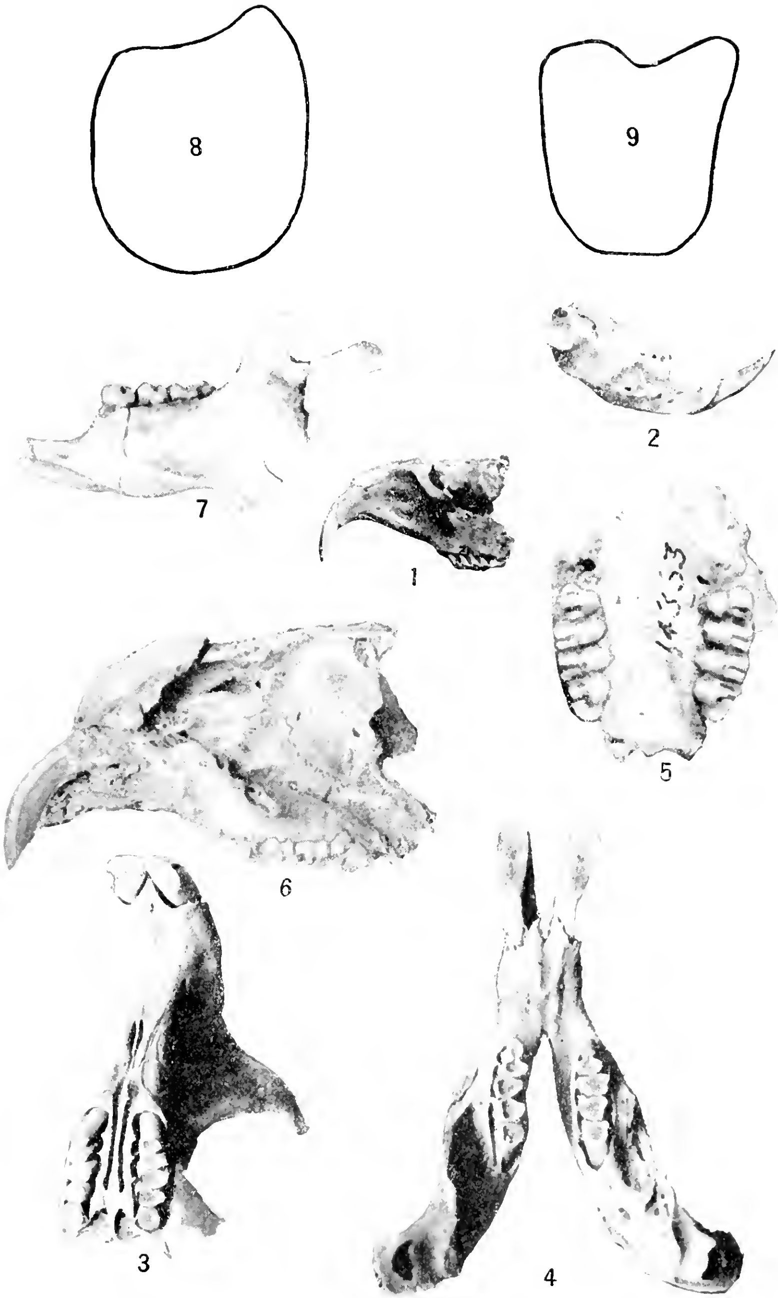
BONES OF RODENTS AND OF A HORSE.

FOR EXPLANATION OF PLATE SEE PAGE 640.



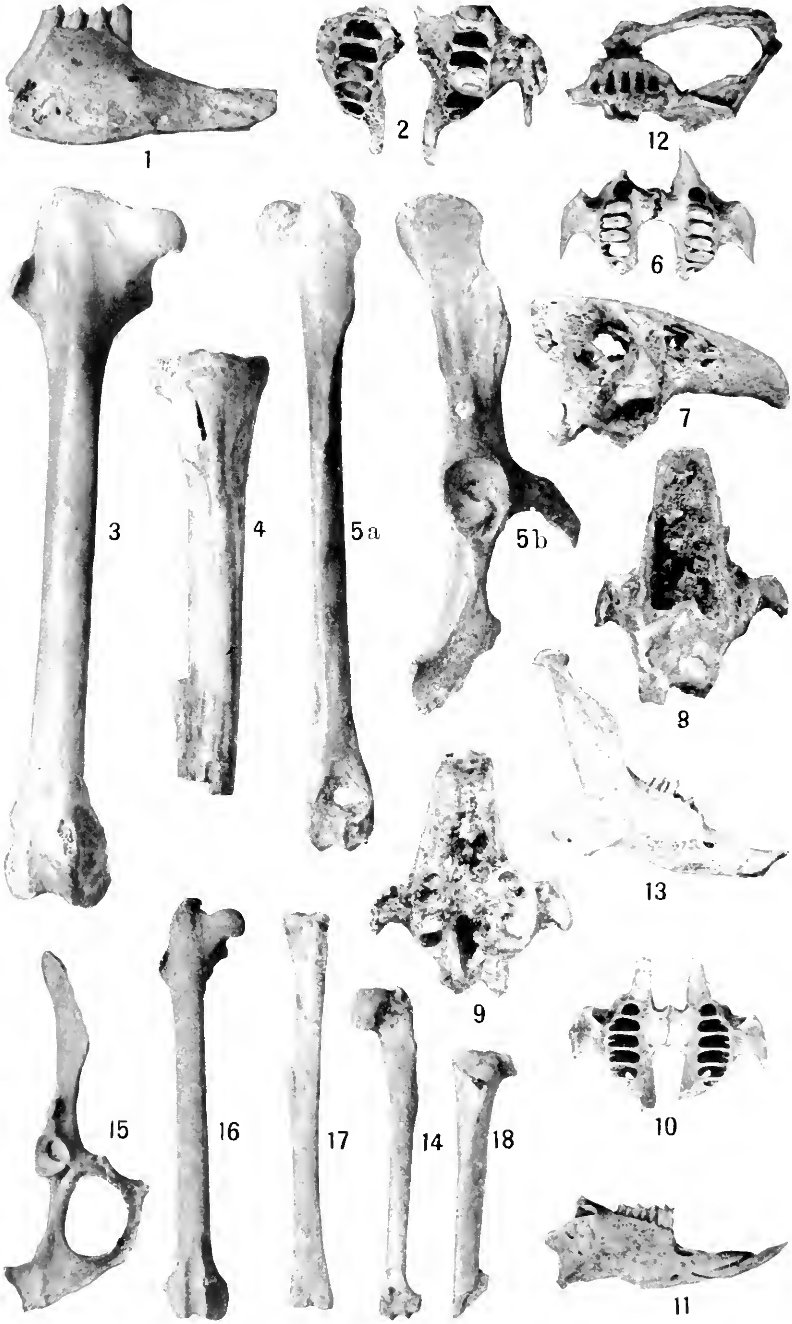
BONES, MOSTLY FOSSIL, OF A CAMEL, BADGERS, AND GROUND-SLOTH.

FOR EXPLANATION OF PLATE SEE PAGE 640.



SKULLS OF RODENTS AND SECTIONS OF CANNON BONES OF CAMELS.

FOR EXPLANATION OF PLATE SEE PAGE 641.



Bones of Rabbits.

For explanation of plate see page 611

SKULL OF PRAIRIE DOG AND BONES AND TEETH OF CAMELS.

FOR EXPLANATION OF PLATE SEE PAGE 641.

SKULL OF WOODCHUCK AND BONES OF CAMELS.

FOR EXPLANATION OF PLATE SEE PAGE 642.

TEETH OF HORSE, BONE OF CAMEL, AND JAW OF HYAENA.

FOR EXPLANATION OF PLATE SEE PAGE 642

DESCRIPTION OF DEEP-SEA FISHES FROM THE COAST OF HAWAII, KILLED BY A LAVA FLOW FROM MAUNA LOA.

By David Starr Jordan,
Of Stanford University, California.

In November, 1919, I received from a former student, Mr. Carl Schurz Carlsmith, a resident of Hilo, Hawaii, a small collection of fishes killed on the southwest of the island of Hawaii by a lava flow from an eruption of Mauna Loa.

The circumstances under which these were taken are related by Mr. Carlsmith as follows:

At the end of September, 1919, a lava flow started in the district of Kau on the island of Hawaii, and flowed to the sea through the land of Alika, which name was given to the flow to distinguish it from others. The lava was of a very fluid variety, and upon reaching the sea it built a tunnel for itself upon the floor of the ocean. The offshore water at this point is very deep, and within a hundred feet or more of the shore reaches a depth of at least 200 fathoms. On visiting the place in a native canoe on the night of October 1, I found that the subterranean tunnel was bursting at various points with heavy detonations and sending up thick clouds of steam. These clouds of steam were noticed by me as far as 2 miles from the point where the flow entered the ocean. A large number of fish, eels, and other sea life were killed by the heat and explosions, and many curious forms were found floating on the water. Some few days later, probably October 6, Tom Reinhardt, a boatman, was on his way from the flow to Hilo, and at a point, estimated by him to be 3 or 4 miles offshore, saw the water in ebullition and found a large number of boiled fish. He is a Part-Hawaiian and has spent his life on the water close to the shore. None of these fish were known to him and the specimens which are submitted herewith were taken by him floating on the top of the water and brought to the native fish inspector of Hilo. The latter did not recognize any of the forms, and I was requested to find anything definite referring to the names, habitat, and other points of interest.

The specimens were all sun-dried when received by me, but their characters are easily made out. They are of special interest as representing an offshore fauna, beyond the reach of nets, but protected from the dredge by the extreme roughness of the lava-strewn sea-bottom. Seven species, five of them representing each a genus new to science, are included in the collection, these having escaped the shore explorations of Jordan and Evermann in 1901, and the deep-sea work of the Bureau of Fisheries steamer *Albatross*, directed by Charles H. Gilbert in 1902.

The types of the new species are presented to the United States National Museum. A partial series is in the Bernice Pauahi Bishop Museum of Honolulu, the gift of Mr. Reinhardt.

Family MURAENESOCIDAE.

RHECHIAS, new genus.

This genus *Rhechias* seems to agree in nearly all respects with *Neoconger* Girard, differing, however, in the hook-like armature of the side of the upper jaw.

('σηχός, thorn.)

Type of the genus.—*Rhechias armiger*, new species.

RHECHIAS ARMIGER, new species.

Type.—Cat. No. 84097, U.S.N.M., about 5½ inches long, much shriveled, depth about two-fifths length of head. Head pointed, as

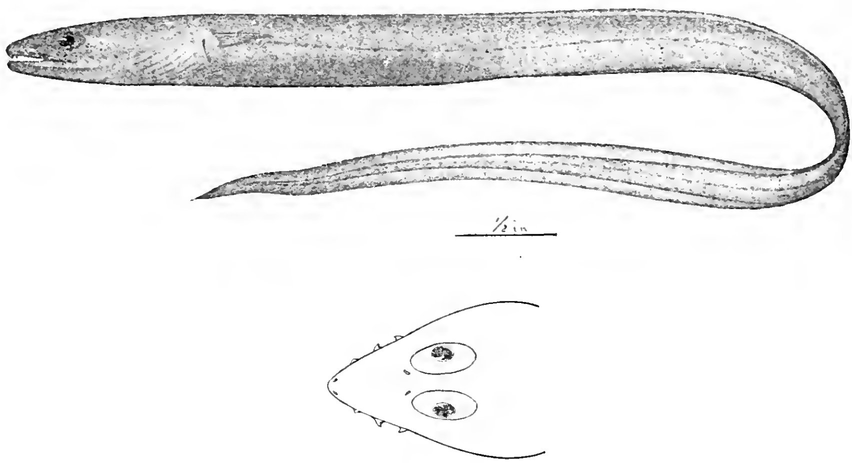


FIG. 1.—RHECHIAS ARMIGER, NEW SPECIES.

broad as deep, triangular as seen from above. Body slender, not much compressed, tapering to a very long and slender tail, which is considerably longer than rest of body. Eye moderate, near middle of cranium, about half snout, and 6½ in head, from tip of snout to gill opening; gill opening lateral, vertical, its depth more than half eye; interorbital space very narrow. Preorbital on each side with three sharp stiff, hooked spines like bramble thorns, the first two turned backward, the last forward; tongue not free; lower jaw a shade shorter than upper, each with a narrow band of sharp, close-set, irregular teeth, relatively large and larger in front, where in the upper jaw they form a patch of small canines: a row of minute teeth on the palatines.

Posterior nostril an oblique slit just before eye; anterior nostril a round pore without barbel at tip of snout. Branchiostegals, 9; pectorals narrow, pointed, about as long as from tip of snout to front of pupil. Dorsal fin very low, beginning well beyond tip of pectoral, and in front of vent, as a mere fold of skin, growing higher on the tail, where for a distance the height is almost equal to length of eye; anal quite similar; tail ending in a filamentous point. Color dusky, dotted with black, especially along the lateral line; the pectorals pale, the dorsal and anal slightly darker along the edge.

Family MYCTOPHIDAE.

NYCTIMASTER, new genus.

Closely allied to *Lampanyctus* Bonaparte, having the same general form, subacute snout, and elongate pectorals, but differing in not having the scales of the lateral line enlarged. *Lampanyctus crocodilus* (Risso), the type of the genus, has these scales much larger than the others, being deeper than long. *Nannabrachium* Günther

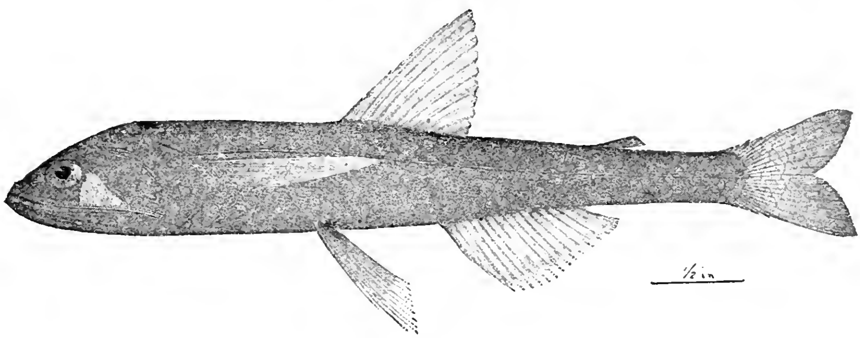


FIG. 2.—NYCTIMASTER REINHARDTI, NEW SPECIES.

agrees with *Lampanyctus* in this regard, but has the pectoral fins very short.

Most of the species thus far referred to *Lampanyctus* belong apparently to *Nyctimaster*.

(νύξ, night; μαστήρ, searcher.)

Type of the genus.—*Lampanyctus jordani* Gilbert, from northern Japan.

NYCTIMASTER REINHARDTI, new species.

Three examples badly shriveled, each about 4 inches long. The type is Cat. No. 84095, U.S.N.M. Head about $3\frac{1}{2}$ in length; depth $1\frac{2}{3}$ in head; dorsal rays about 12, anal about 16; scales 4–38–6. Body subterete, rather elongate, little compressed; head rather pointed, the mouth very large, the long premaxillary $1\frac{1}{3}$ in head, reaching far beyond eye, the posterior border of eye in front of its middle; eye rather large, about as long as snout, about 5 in head. Lower jaw slightly the longer; jaws nearly straight; the upper with a slight sigmoid curve, but with no distinct angle anteriorly. Premaxillary very narrow, reaching angle of preopercle; each jaw with a band of small, sharp, even teeth; two patches of similar teeth on vomer; palate with two broad bands of similar teeth, the outer much the broader; no canines. Preorbital very narrow; propercle very oblique; cheeks longer than deep; opercle rather short, oblique; scales large, smooth, caducous, lateral line well developed; its scales not enlarged; some photophores on its course and on belly, but these are mostly destroyed, hence not shown in the drawing. A moderate photophore in front of eye and a large triangular luminous patch just below and behind eye. Pectoral placed rather high, narrow, long, as long as head, the lower rays short. Ventrals nearly reaching front of anal, more than half head. Dorsal inserted in front of middle of body, just behind ventrals, the first rays high, two-thirds head, adipose fin small (shriveled); anal similar to dorsal, but lower, inserted under its last rays. Caudal broken, apparently lunate. Color uniform jet black, the fins whitish, especially the pectoral.

This species must be placed in the genus *Lampanyctus* Bonaparte, as at present defined, differing from most of the other species in the sharper snout and slenderer body. But the type of *Lampanyctus*, *L. crocodilus* (Risso), has the scales along the lateral line considerably enlarged. Further material is necessary to decide how many of the species now placed in *Lampanyctus* and having the lateral scales not deepened should be assigned to *Nyctimaster*. The genus *Nannobrachium*, also with enlarged lateral scales, differs in having the pectorals very small.

Family STERNOPTYCHIDAE.

POLYIPNUS NUTTINGI Gilbert.

A very small example, 1¼ inches long. Black area along the back continuous to base of caudal and not extending down behind the scapular region. Scales mostly lost. Spine at front of dorsal relatively high, the anterior spine much lower. This specimen diverges somewhat from the account given by Gilbert, being very young and badly shriveled. The species is, however, probably the same.

Family SERRANIDAE.

RHYACANTHIAS, new genus.

Subfamily *Anthiinæ*, allied to *Leptanthias* Tañaka, from Japan. Body much elongated; caudal lobes extremely attenuate in the adult; lateral line not angulated; head closely scaled; vertical fins scaleless; teeth small, no true canines, the base of the lower jaw with an elevated angular lobe with stronger teeth; dorsal and anal rays rather few. (D. IX, 7; A. III, 7.)

Type of the genus.—Rhyacanthias carlsmithi, new species.

RHYACANTHIAS CARLSMITHI, new species.

Type.—Cat. No. 84099, U.S.N.M., 7 inches long, besides the caudal fin, which is 1½ inches. Head, 3¾ in length to base of caudal; depth, 3¾; dorsal rays, IX.7; anal, III.7; pectoral, 15; scales, 5–53–13.

Body compressed, lanceolate, little elevated. Head moderate, the occipital region little elevated. Interorbital space broad, with two low ridges. Eye very large, 3¼ in head, the snout three-fifth its length; mouth moderate, the broad maxillary reaching middle of eye, 2⅓ in head, its tip four times width of the very narrow preorbital lower jaw, slightly projecting, with an emarginate, toothed symphyseal knob.

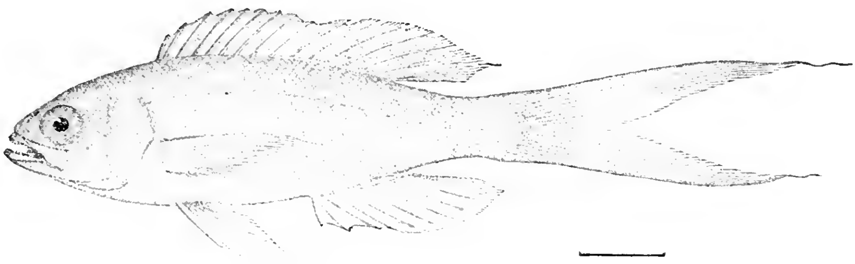


FIG. 3.—RHYACANTHIAS CARLSMITHI, NEW SPECIES.

Teeth small, even, no true canines, but those on the symphyseal knob and a corresponding patch on a knob in front of each premaxillary somewhat enlarged; a notch between these knobs; base of lower jaw with a prominent angular basal elevation, which also bears larger teeth; teeth on tip of lower jaw extended; vomer and palatines with narrow bands of small teeth, a small patch on tongue and apparently (not certainly) on pterygoids also. Propercle with a right angle, somewhat produced, the vertical and horizontal limbs entire, or nearly so. Cheek region quadrate. Interopercle prominent. Opercle moderate, with two small flat spines, besides a soft point. Gill rakers rather slender and numerous.

Head everywhere closely beset with moderate, ciliated scales, these covering forehead, preorbital, suborbital, maxillary, mandible, preopercle, including both limbs, cheeks, opercle, and interopercle. Scales on mandible smaller and smoother. Scales of body rather small, ciliated, the soft dorsal and anal nearly naked, scaled only along a basal sheath. Lateral line running high, descending in a broad, even curve under soft dorsal, not at all angulated; tubes simple, covering most of the length of each scale; caudal and pectorals with small scales basally. Dorsal and anal (dried down and not easily studied, the soft rays not certainly counted) dorsal spines slender, the third not elevated, about half head; last ray pointed, a little elevated, about three-fourths head; base of soft dorsal about as long as that of spinous. Anal spines strong, graduated, the third longest, 3 in head; last soft ray $1\frac{1}{2}$ in head; caudal very deeply forked, slightly scaly at base, its lobes subequal, attenuate, more than twice length of head, one of its upper rays ending in a very long and slender thread, the other rays with short filaments. Filament of lower lobe shorter than upper; pectoral narrow, unsymmetrical, pointed, the rays all branched, the upper rays filamentous, a little longer than head; ventrals close together, just behind pectorals, reaching past vent, the tip slightly filamentous, as long as head.

Color uniform whitish when received, probably rosy silvery in life, with no markings or shades anywhere.

This species is a typical anthiine form, but it does not seem to fit into any recognized genus. The body is more elongate than in any other, the caudal lobes more attenuate, the lateral line not angulated,

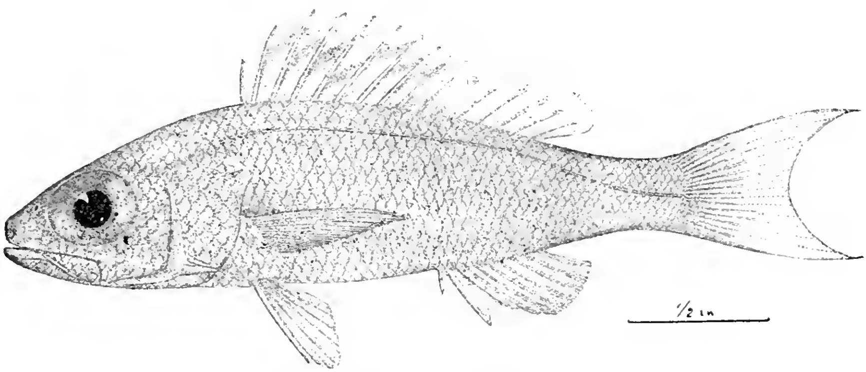


FIG. 4.—RHYACANTHIAS CARLSMITHI (YOUNG).

and the head closely scaled, while the vertical fins are naked. The absence of true canines and the presence of a strong toothed angle at the base of the mandible will serve to characterize the new genus *Rhyacanthias* (ῥύαξ, volcano) as also the very small number of soft rays in the dorsal, much fewer than those of the nearest ally, the Japanese genus *Leptanthias* Tanaka.

RHYACANTHIAS, species.

Another specimen of the same genus, I suppose to be the young of this species, although at first I took it to be distinct. Its length (Cat. No. 24101, U.S.N.M.) is $3\frac{2}{3}$ inches.

Head, $2\frac{3}{4}$ in length; depth, $3\frac{1}{2}$. Body elongate, the back moderately elevated, the anterior profile even; head moderate, snout short, rather abruptly truncate, about half the large eye, which is 3 in head. Mouth moderate, the jaws equal, the upper $2\frac{1}{2}$ in head, maxillary extending to below middle of eye; teeth small, unequal, some of them on front and on base of jaw somewhat enlarged, a moderate elevated angle at base of lower jaw, with slightly larger teeth; tip of lower jaw with small exserted teeth, fitting into a notch in the upper. Preorbital very narrow; cheeks rather longer than deep, preopercle with two limbs, the anterior entire, the posterior rather finely and sharply serrate, with a slender sharp spine at the angle in one example, broken in the others and probably lost with age; replaced in the largest example by rather stronger serrations; lower limb of preopercle with a few small sharp forward directed serrations. Opercle with two sharp spines. Dorsal fin rather high, slightly notched, its rays apparently IX, 7 to 9, the soft part very short, anal rays III, 7. None of the dorsal spines elevated, the third longest, $2\frac{1}{4}$ in head, rather higher than the soft rays. Caudal broken in all specimens, evidently forked. Anal lower than dorsal, its second spine longest, all shorter than the soft rays. Pectoral narrow, unsymmetrical, $1\frac{1}{2}$ in head; no filamentous rays on any fin in this young specimen. Scales rather large ctenoid, 3–47–10, as nearly as can be counted. Scales on opercles rather larger and more ctenoid, in about five rows, four rows of rather large scales on cheeks; both jaws, snout, and all the opercles covered with scales smaller than those on cheeks and opercles; scales on sides of head rougher and rather larger than in the type; a scaly sheath at base of dorsal; the fin otherwise scaleless.

Lateral line complete, concurrent with the back, nowhere angulated, its pores covering most of the scale.

Color plain, probably red in life. Spinous dorsal with six oblique black cross shades, running upward and backward, three dusky shades downward and backward on soft dorsal, the edge black, other fins pale. Scales on back with some black dots; scales on opercle dusky at base.

There are also three other examples, $2\frac{1}{2}$ to 4 inches in length, which I refer to the same species, though not without some doubt. They are more slender, and the back is quite dark in color, made so by a multitude of dark punctulations; the upper fins and caudal also dusky, scales on opercle with a dusky area at base. Teeth very small, but unequal, certainly none of them canine-like, although the lower jaw is angulated at base. Though these three look unlike the other young example, and unlike the type, it is probable that all belong to *Rhyacanthias carlsmithi*.

Family GRAMMICOLEPIDAE.

VESPOSUS, new genus.

Closely allied to *Grammicolepis* Poey, with the same peculiar type of scales, but distinguished by the well-developed ventral fins and by the much stronger armed bucklers along bases of dorsal and anal fins.

Type of the genus.—*Vesposus egregius*, new species.

VESPOSUS EGREGIUS, new species.

Type.—(Cat. No. 84098 U.S.N.M.); length, 13½ inches; head, $3\frac{3}{4}$ in length; depth, $1\frac{9}{10}$; dorsal rays, X–I–34; anal, III–38; ventral, I, 6; pectoral, 15; caudal, 15; scales, about 118; dorsal scutes, 38; anal scutes, 36.

Body broad, ovate or pear-shaped in outline, strongly compressed, its thickness less than one-tenth its length. Head rather small, a little longer than deep, the anterior profile even, nearly straight to the elevated nape, which forms an even curve with the back, followed by a very weak even curve to base of caudal peduncle. Anal

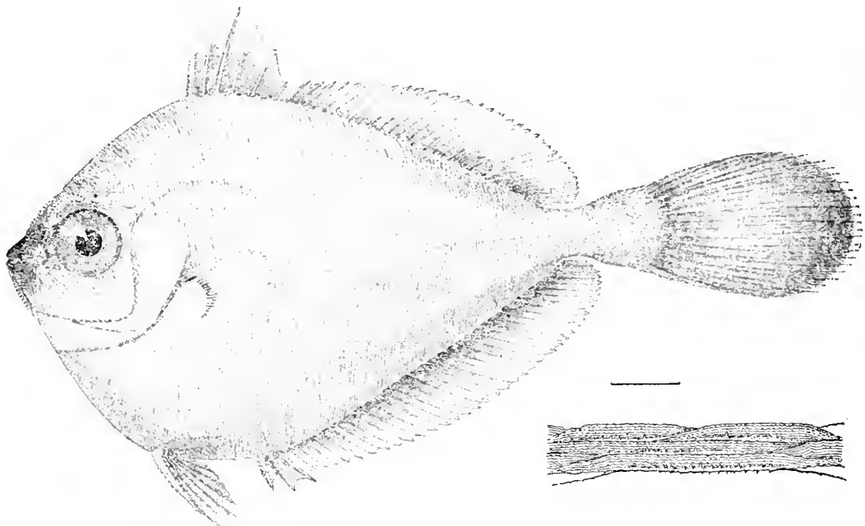


FIG. 5.—VESPOSUS EGREGIUS, NEW SPECIES.

beginning behind middle of spinous dorsal and ending just behind it; base of anal nearly straight, ascending obliquely.

Eye very large, $2\frac{2}{3}$ in head, longer than the short blunt snout; top of head very short, the groove for the protractile premaxillary lying between very rough, rugose supraocular bones; preorbital very short, broad, rugose, with rough radiating ridges; maxillary slipping under it; length of upper jaw about 6 in head; mouth very small, very oblique, the jaws equal, the mandible not quite reaching front of eye, 3 in head, its angles very rough with small serrations, as are all prominent bones about head. Preopercle with two ridges, both finely and evenly serrate, the anterior ridge roughest, the teeth coarser below; posterior limb vertical, the anterior horizontal, the two forming a rounded angle; region of cheeks rectangular, nearly twice as long as deep. Opercle rather short, without spine. Teeth very small, even, apparently in a narrow band (characters of teeth, gill rakers, and branchiostegals, not to be ascertained without dissection). Gill membranes free from the isthmus, but broadly united across it, and covered with small rough scales.

Scales of body unique, each developed as a long thin vertical strip, of the color and texture of the material of a wasps' nest; the edges parallel, each scale many times as deep as long; with three or four parallel vertical ridges roughened with small prickles, and each with a vertical series of larger prickles turned backward, along its base, apparently not on the scale itself, but on the basal skin. Similar scales on cheeks, opercles, and gill membranes; scales on caudal peduncle gradually assuming by degrees a normal form, small, rounded, and rough at base, the edges entire. A very narrow lateral line curved upward on anterior half of body, straight and nearly horizontal behind; fins scaleless, mandible scaly; snout, nostrils, and upper jaw with some naked skin. A row of stout, hooked, immovable thorn-like spines along base of dorsal and anal, these subequal in size. Dorsal fin with the spines rather low and weak, the second a little elevated, about as long as eye (broken in the type); soft rays low slowly rising posteriorly where the longest is about $2\frac{1}{2}$ in head. Anal with three stiff curved spines, the first two serrated, the second nearly 4 in head. Soft anal longer than soft dorsal, separated from the spinous part by a short notch (whether actually connected or not can not be now determined), the last rays about equal to the last of dorsal. Rays of pectoral dorsal and anal not branched.

Caudal peduncle rather slender, compressed, longer than deep, its length two-thirds that of head, its least depth about one-third; broadened at base of caudal fin, which is narrow, rounded, its middle rays longest, a shade longer than head; pectoral short, rounded, $2\frac{1}{3}$ in head; ventrals inserted just before them; longer than pectoral $1\frac{2}{3}$ in head: ventral spine and outer rays of caudal strongly serrate, as is the first spine of the dorsal and the first two of the anal.

Shoulder girdle slender, apparently normal, so far as can be ascertained without dissection.

Color uniform slaty gray, the tip of caudal and edges of vertical fins blackish.

The type is in fair condition except for having been dried in the sun.

This extraordinary fish is plainly allied to the *Zeidae*, although very properly placed in a different family, *Grammicolepidae*. The only other species of this family known, *Grammicolepis brachiusculus*

Poey, is known from a single specimen obtained from deep water off Habana. In the new genus, *Vesposus*, the form of the body and fins is essentially the same, as is also the aquamation. The genus is apparently distinguished by the strong, hooked spines along the bases of dorsal and anal, and by the much larger ventral fins. Other apparent points of difference seem to be of specific value only. The name, *vesposus*, waspy, alludes to the dry scales, suggesting the material of a wasp's nest.

Family CHAETODONTIDAE.

LOA, new genus.

Allied to *Chaetodon* Linnaeus, but with the anterior dorsal spines thickened at base, the third and fourth greatly elevated and all higher and stronger than in *Chaetodon*.

Type of the genus.—Loa excelsa, new species.

LOA EXCELSA Jordan, new species.

Type.—Cat. No. 84094, U.S.N.M., 2 inches in length; head, $2\frac{1}{2}$ in body; depth, $1\frac{1}{6}$; dorsal rays, XI, 23; anal III, 18; scales, 12–50–15.

Form and appearance of a *Chaetodon*, the body greatly compressed and elevated, snout short, sharply exerted, the profile behind nearly straight to front of dorsal, the cranium above eye slightly convex. Eye as long as snout, $3\frac{1}{2}$ in head; mouth very small, with slender teeth; bones of head entire; preorbital moderate, entire, sheathing the maxillary; bones of head generally all covered with small scales; lateral line strongly arched, ceasing at root of caudal peduncle. Dorsal spines very strong, unequal; the third longest and strongest, one-third longer than head; the second and third thickened at base, longer than third, $1\frac{1}{5}$ in head. Soft rays of dorsal and anal high, but not produced, the first of dorsal slightly longer than last spine; the posterior outline of both fins almost vertical, the last rays rapidly shortened; soft dorsal and anal closely scaled at base, the margin naked; some scales on bases of dorsal spines, especially the last five, caudal very short, rounded, $1\frac{1}{2}$ in head. Pectorals long, nearly as long as head, reaching sixth soft ray of anal; ventrals large as long as head, inserted just before pectorals.

Color gray, perhaps yellow in life; with broad dark black-edged cross bands, snout dusky, paler behind in front of eye; a broad black band dark-edged from front of dorsal across eye to suborbital region, next a pale area, broadened below, having the form of an inverted V, from second dorsal spine to ventral spine, then a broad dusky bar, covering space from third to seventh dorsal spine, this bordered before and behind by a narrow sharp black streak; a clear white or yellow band as wide as eye from last dorsal spines to anal spines; a dark streak behind this, then a broad dusky space covering most of soft dorsal and anal; a narrow black streak again behind this; then a narrow white band bounded again by a black streak extending on dorsal and anal, the tips of the rays broadly white; a white bar, then a dark one across base of caudal, which is otherwise dusky. Middle of soft dorsal above with a jet-black ocellus larger than eye,

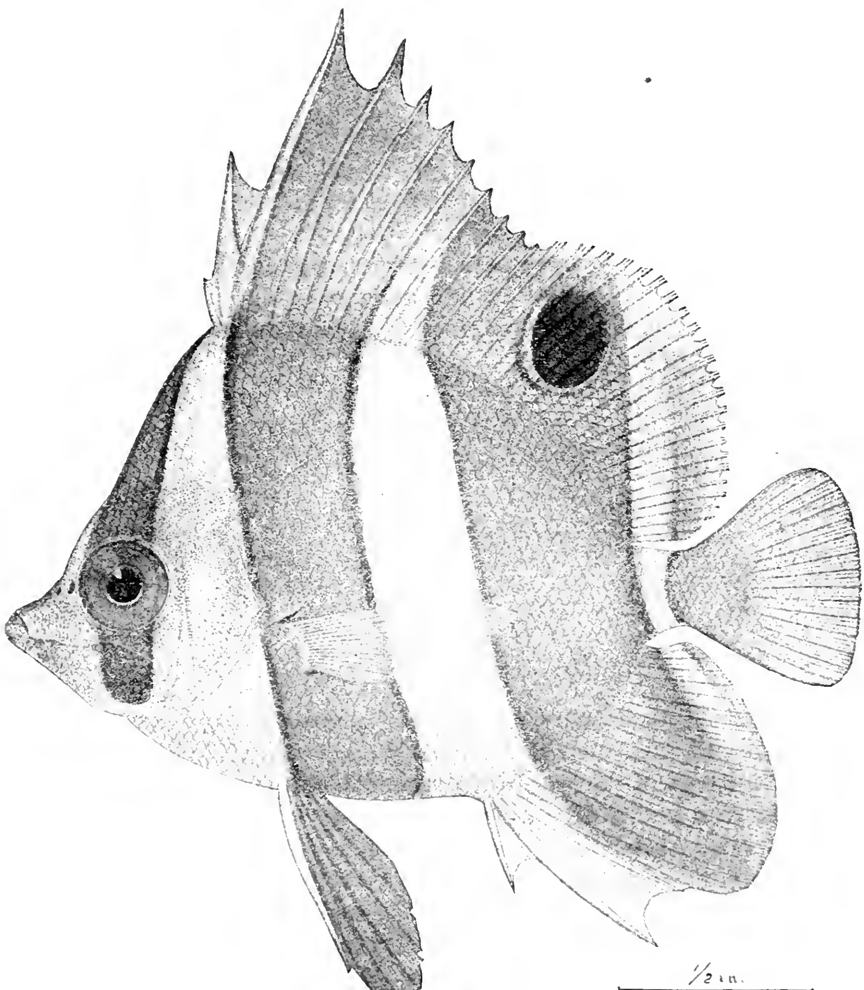


FIG. 6.—LOA EXCELSA, NEW SPECIES.

ringed with white; pectorals pale, dusky at base; ventral black, with the soft rays all black; the spine white; markings of body extended more or less on the fins.

In general coloration and more or less in form this elegant fish resembles a common butterfly-fish or Kihikihi of Hawaii, *Chaetodon lunula.* The ocellus on the fin may disappear with age. From this as from all other species of *Chaetodon* the present species differs generically in the extraordinary development of the spinous dorsal, which characterizes the genus *Loa*, named for the great volcano, the eruption of which brought this strange fish to light.

Family PERISTEDIIDAE.

PERISTEDION ENGYCEROS Gunther.

Peristethus engyceros GÜNTHER, Proc. Zool. Soc. London, 1871, p. 663; "Sandwich Islands"; Fische der Südsee, p. 168.

A large example, 13½ inches long, in good condition, except being dried in the sun. It is apparently identical with *Peristethus engyceros*, described by Günther, from "dried fragments from the Sandwich Islands."

A second specimen of the same species, 6 inches long, identical with this in color and details, I find among the duplicates from the Albatross collection of 1902, described by Dr. C. H. Gilbert.[1]

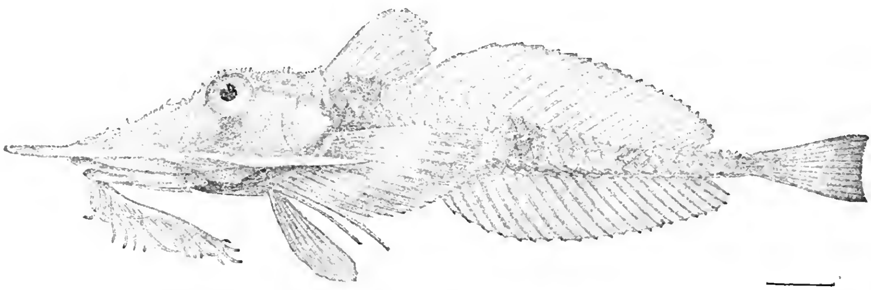


FIG. 7.—PERISTEDION ENGYCEROS GÜNTHER.

In most respects these two specimens agree with Doctor Gilbert's description and with such of the duplicates on which it is based, as have become part of the Stanford University collections. The differences, however, indicate two distinct species, the second of which I propose to call *Peristedion gilberti*, taking as a type, Cat. No. 84102, U.S.N.M., obtained by the *Albatross* off Oahu or Maui.

In *Peristedion engyceros* the prolongations of the snout are not quite parallel, but diverge visibly, being nearly half farther apart at tip than at base; the interorbital space is broader than the vertical diameter of the eye; the preopercular spine is $1\frac{1}{5}$ in the length of the prolonged spines: The dorsal rays are VII–22: anal, 22: pectoral, 13+2, reaching to the seventh lateral scute, $1\frac{2}{5}$ in head with the spines. Ventrals nearly reaching front of anal; pectoral considerably beyond.

Body with four broad blackish cross bars, one under spinous dorsal; two under soft dorsal and one near base of caudal, the first broadest;

[1] Deep Sea Fishes of the Hawaiian Islands, 1905, p. 639.

no spots or reticulations; a dark area below eye; both dorsals narrowly but sharply edged with black; caudal blackish at base and tip; pectoral black with a narrow white edge, the middle paler, lower parts pale.

PERISTEDION GILBERTI, new species.

Peristedion engyceros GILBERT, Deep Sea Fishes of the Hawaiian Islands, 1905, p. 639, Coasts of Oahu, Maui, Kauai, and Laysan Islands, 178 to 305 fathoms.

The specimens examined by Dr. C. H. Gilbert, with the one exception noted above, belong to a distinct though closely related species. Comparing these with *Peristedion engyceros* I note the following differences:

Prolongations on snout, rigidly parallel, a little longer than in *P. engyceros;* the preopercular spine $1\frac{2}{5}$ in their length; interorbital width a little less than vertical diameter of eye; ventrals barely

FIG. 8.—PROLONGATION ON SNOUT OF (*a*) PERISTEDION ENGYXEROS GÜNTHER CONTRASTED WITH THAT OF (*b*) P. GILBERTI, NEW SPECIES.

reaching front of anal; pectorals also a little shorter, reaching to fifth or sixth lateral plate.

No dark bars anywhere on body or fins. In the largest example the body and fins are all pale, alike, no doubt pink in life. All the other examples have the upper parts marked with small olive spots regularly arranged, these giving place on the head to symmetrical fine olive streaks. In some, the pectoral and caudal are more or less specked with olive, in others quite plain. (Cat. No. 84102, U.S.N.M.)

The following is Doctor Gilbert's description of *Peristedion engyceros*, (not of Günther):

Length of head, measured from front of premaxillaries to opercular margin, 2.5 in length from front of premaxillaries to base of caudal; depth, 5.75; greatest width of head, 3.65. D. vii, 20 (rarely 21); A. 20; P. 14×2.

The species differs strikingly from *P. hians* in the shape of the rostral processes, which are very slender, parallel, of nearly equal width throughout; the distance between them equals their length and is about half length of snout without them; width of the snout opposite anterior nostril equal to its length; interorbital space deeply concave, with a median groove, which widens posteriorly; a small postocular spine, a much stronger spine at end of occipital ridges, and small spines at end of paroccipital opercular crests; upper orbital rim spinulose along its entire length; in the young are usually two preorbital spines which disappear in adults; behind snout the lateral margins of head are expanded to form a thin knife edge, which leads to the long preopercular spine, the anterior limit of the expanded edge marked by a projecting spine, to the base of which runs a vertical ridge from front of eye and an oblique ridge from middle of lower orbital margin; all the plates of the head minutely prickly; on median portion of snout six or eight stronger hooked spines, distributed on the rostral ridges; interorbital width 0.65 diameter of eye, which is contained 4.4 times in head; premaxillaries protruding beyond mandible for a distance equal to 0.2 length of head; length of maxillary contained 2.3 times in head and equal to the greatest external width at angles of mouth; the large barbel, when laid back, extending to base of ventral fins; along its anterior margin it bears a series of smaller barbels, mostly arranged in pairs, seven barbels, similar to these smaller ones, occurring on each side of symphysis, on lower lip and adjacent portions of mandible; the most posterior of these, on the mandible, is always paired; mouth toothless; gill rakers 5×16 or 17, the terminal ones represented by papillae, spinous dorsal joined to soft dorsal at extreme base; pectorals long, reaching fifteenth plate along lateral line, length of upper ray equaling distance from tip of snout to front of pupil; upper free ray contained 2.25 times in head.

Dorsal series of plates with strong backwardly hooked spines, which decrease in size posteriorly, almost disappearing on caudal peduncle, behind these two movable spines along base of upper caudal lobe; the upper lateral series of plates accompanies the lateral line, which opens externally in three pores for each plate, one above and two below the spine; behind the short anterior arch the spines are strong. Nine to 12 spines in front of middle of caudal peduncle bear at the base of the anterior side a short, strong, straight spine, directed obliquely forward; spines of ventral row of plates obsolescent, perceptible to the touch, but scarcely visible along course of anal fin; only two or three of the anterior plates of the series have well-developed spines. Dorsal series containing 29 to 30 plates, including 2 on base of caudal; 34 or 35 in upper lateral, 23 or 24 in lower lateral series, and 26 or 27 in ventral series, including 2 on base of caudal.

A specimen in life was pink, with a yellowish tinge, the tips of rostral processes, the fins and long barbels deeper pink or almost scarlet, the tips of fins and ends of barbels white; breast and belly white; upper parts of head and body marked with fine olive dots and lines, those on head arranged regularly and symmetrically; some specimens appear nearly or wholly plain, without spots and lines, pectorals whitish, streaked or spotted with olive, anal marked with three indistinct narrow yellowish vertical bars; other fins unmarked.

A NEW SPECIES OF RAY FROM THE TEXAS COAST, AND REPORT OF THE OCCURRENCE OF A TOP MINNOW NEW TO THE FAUNA OF EASTERN TEXAS.

By Asa C. Chandler,

Of the Department of Biology, Rice Institute, Houston, Texas.

In a collection of fishes received from Mr. Ira P. Cox at the Houston city market there was contained a specimen of ray which proved to be a new species. Two specimens were collected off the Galveston jetties in the Gulf of Mexico at a depth of between 5 and 10 fathoms, on November 17, 1920. The larger one, unfortunately, was not preserved, but the smaller one, a female, was sent to the Rice Institute with some other fishes. Examination showed that this species did not conform to any of those described by Jordan and Evermann, and no species to which it conforms could be found in the literature since the publication of Jordan and Evermann's work in 1896. My hearty thanks are due to Prof. C. H. Gilbert, of Stanford University, for assistance in looking up this literature.

The ray in question apparently occupies a position intermediate between *R. eglanteria* of the Atlantic coast of the United States and *R. ackleyi* of the Yucatan banks, but differs from both these species in color and minor structural characteristics.

RAIA TEXANA, new species.

TEXAS RAY.

Disk, including ventrals, about as long as broad, 12¾ inches in width in the type specimen, the total length 20½ inches; widest region of disk very slightly behind middle. Posterior edge of pectorals convex, the anterior edge concave.

Snout somewhat produced, its angle acute but bluntly rounded at tip. A broad, rhomboid, translucent, unpigmented space at either side of snout, the width between pigmented areas at sides equal to distance from tip of snout to eye; interorbital space concave, not quite 3 in this distance. Long diameter of eye 2½ in interorbital space. Spiracles larger than eyes and directly behind them. Mouth opposite a point just behind middle of eye. Nostrils small, their distance from corners of mouth about half the width of the mouth and in line with the corners of the mouth. Teeth in 50 rows in each jaw; the lateral teeth flat, the cusps becoming higher and sharper towards the median line.

Entire under surface of head except just behind mouth covered with small spines, these very dense and forming a heavy shagreen towards tip of snout. Small spines on most of under surface of trunk, but sparse on abdomen behind pectoral girdle, and absent on under surfaces of pectoral and pelvic fins, tail, and ring around vent. Very fine spines on upper surface of rostral cartilage, head, anterior parts of pectoral fins, anterior part of trunk, and anterior third of tail. Upper surface of pectorals with very minute sparse spines, except distally, where they are smooth; pelvics smooth. A median series of larger spines along middle line of back and tail, these large between shoulders, small on middle of back, and larger again on rump and tail. Two lateral rows of irregularly alternating large and small curved spines on tail, and a J shaped row of larger spines bordering orbit anteriorly and medially, these extending back to middle of spiracle.

Tail 10 inches in length from vent to tip, without lateral cutaneous folds. Dorsal fins of moderate size, separated by a space somewhat less than the length of either one; dorsal row of spines continued between them.

Color uniform rich brown above, except translucent area at sides of snout. A single conspicuous, eye-like black spot, with well-marked pale yellow border, on pectoral fins, slightly behind broadest point and somewhat nearer middle line of body than edge of pectoral fin. Under surface plain white.

Type.—Cat. No. 84162, U.S.N.M.

Locality.—Off Galveston jetties, Gulf of Mexico.

While dredging with a small net in a weedy pool in the coast prairie at Hardin, Liberty County, Texas, a single small specimen of top minnow (*Zygonectes henshalli*), 4 cm. in length, was obtained on January 8, 1921. This specimen conforms in every detail with the species as described by Jordan from the San Sebastian River in Southern Florida. The species has not hitherto been recorded outside of Florida, but its occurrence in the coast prairie of eastern Texas would indicate its existence along the entire Gulf coast from Florida to Texas. This specimen has been deposited in the United States National Museum.

NEW NEARCTIC SPIDER MITES OF THE FAMILY TETRANYCHIDAE.

By H. E. Ewing,

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

Interest in the taxonomy of the spider mites (Tetranychidae) in the United States has been increased during the last few years for several reasons: First, because of the realization of their great economic importance; second, because of the danger of introducing many of the most injurious exotic species; and, third, because of the difficulty found in determining correctly the most common of our species. Following the earlier work of Banks and the later work of the present writer, McGregor undertook a systematic review of the American species, and examined more critically than had been done before those characters which alone are of real specific value. As a result of his investigations several mooted questions in regard to synonymy have been cleared up. Yet the task of revision has in no way been completed, for one is constantly finding new characters and new differences which change previous judgments in regard to many points. New species also exist within our borders, and foreign ones are constantly being brought to our shores. Hence the present writer has again taken up the difficult task of taxonomic investigation of the different species, and as a result of this work here offers the description of eight new species.

Genus OLIGONYCHUS Berlese.

The genus *Oligonychus* Berlese (1886) is based upon a species represented as having the tarsi each provided, in addition to the tenent hairs, with a simple claw and a deflexed plumose, claw-like structure. This type of tarsal armature must be very rare in the spider mites, for recent workers have dropped the genus *Oligonychus* because they knew of no species having the tarsal appendages of the type shown by Berlese. During the last year the writer has observed two species with a deflexed, plumose, claw-like appendage to each trasus. These species also show other characters which allies them with the type species of *Oligonychus*. They are here described.

OLIGONYCHUS AMERICANUS, new species.

Plate 125, fig. 1.

A small species. Preserved specimens yellowish and not showing maculations. Mandibular plate broad, being about two-fifths as broad as long, not emarginate in front but with a deep V-shaped notch behind. Palpal thumb not swollen and not exceeding palpal claw; terminal finger moderate, about one-third as broad as thumb. Legs moderate; anterior pair exceeding the palpi by half their length; posterior pair extending beyond the tip of abdomen by the full length of tarsi and one-half the length of their tibiae. Simple claw of each tarsus almost as long as width of tarsus, with basal half but slightly and distal half strongly curved; deflexed claw about half as long and half as thick as simple claw, and with at least three hair-like barbs on its outer side. Length, 0.32 mm.; width, 0.19 mm.

Type locality.—Experimental Farm, Saskatchewan, Canada.

Type slide.—Cat. No. 24026, U.S.N.M.

Described from specimens on a single type slide. This species differs from *O. minimus* Targioni-Tozzetti in having the deflexed claw pectinate on the outside and from the following new species, to be described, in being much smaller, more slender, and in its habits. The species occurs on leaves of spruce and does considerable injury.

OLIGONYCHUS MAJOR, new species.

Plate 125, fig. 2.

Preserved specimens yellowish, or yellowish brown; body clothed with conspicuous minutely pectinate, curved setae. Mandibular plate about one-half as broad as long, not emarginate in front, but with a deep V-shaped notch behind. Thumb of palpus not surpassing claw; apical finger medium in thickness, slightly over one-third the width of thumb. Legs medium; anterior pair extending beyond tips of palpi by over one-half their length; posterior pair extending beyond the tip of abdomen by length of tarsi only. Simple tarsal claw scarcely as long as width of tarsus; slightly curved near its base, but strongly curved toward its tip; deflexed claw about one-half as stout and two-thirds as long as simple claw and with three to five prongs on outer side. Tenent hairs exceeding simple claw by almost one-half their length and terminated with distinct knobs. Length, 0.35 mm.; width, 0.21 mm.

Type locality.—Yarrow Experiment Station, Rockville, Maryland.

Type slide.—Cat. No. 24027, U.S.N.M.

Described from specimens on type slide. This species is very similar to *O. americanus*, but is much larger and of a different shape, and occurs on a host not closely related to the host of the latter. This species infests the avocado.

Genus BRYOBIA Koch.

Two species of this genus, *B. pratensis* Garman and *B. pallida* Garman, have been described in the past as new from the United States. The description of *B. pallida* was soon recognized as being based on immature individuals of *B. pratensis;* but for many years in this country the name, *B. pratensis*, has been held valid, being the scientific designation of our common brown mite, or so-called clover mite. Prior to the year 1911 the present writer sent a specimen of *B. pratensis* to Dr. A. C. Oudemans, the noted Dutch acarologist, for comparison with European forms. As a result of his comparisons he decided that our *B. pratensis* was only a synonym of *B. cristata* Dugès. This is the synonymy which he gives in a printed article published in the same year.

In 1914 Ivar Trägårdh, a Swedish authority, published the results of his extended taxonomic study of the genus *Bryobia*. In his English summary he gives the following pertinent statement in regard to synonymy in the genus:

> All the different species described by Koch, G. Canestrini, F. Fanzago, Berlese, Thomas, and Garman under the name of *praetiosa*, *speciosa*, *nobilis*, *gloriosa*, *ribis*, and *pratensis*, must be referred to *praetiosa* Koch, being mere variations and different instars of that species.

Trägårdh for the first time ascertained the variations due to growth in the old species of Koch, as well as the individual variations found in the adults of the same species; and as a result of this has not only given us his very valuable list of synonyms, but has shown to what extent one can depend upon such variable characters as must be used in specific diagnosis. For the present it appears it is better to confine all descriptions of new species to adult, egg-bearing females. The variations, which are very great in the genus, must be worked out later for the different species.

There has accumulated in the United States National Museum a large number (many hundreds) of *Bryobia* specimens from almost all parts of the United States. A survey of this material shows, after eliminating variations due to growth by confining examinations exclusively to adult females, and after making all due allowances for individual variations noted by Trägårdh, that one can recognize at least three forms here. One of these, the common brown mite, *B. praetiosa*, is distributed over most of the country and appears to be the only species found east of the Mississippi River. Beisdes this form there occurs in the west another and in the southwest a third. The differences between these are, in the writer's opinion, of specific importance, as is indicated in the following key to three forms of *Bryobia:*

a.[1] Mandibular plate emarginate in front; cephalothoracic plate much broader than long.

b.[1] Inner tubercles of cephalothoracic plate, as seen in egg-bearing females, united for about half their length, and bearing squamous setae almost as large as those of the outer tubercles .... **B. praetiosa** Koch.

b.[2] Inner tubercles, as seen in adult females, united for at least three-fourths their length, and tipped with squamous setae much smaller than those of the outer tubercles, cephalothoracic plate less than one-third as long as cephalothorax .... **B. brevicornis**, new species.

a.[2] Mandibular plate not emarginate in front; cephalothoracic plate, as seen in egg-bearing females, about as long from base to tips of inner tubercles as it is broad, and fully equal in length to one-half the length of cephalothorax **B. longicornis**, new species,

Descriptions of these two new *Bryobias* are here given:

BRYOBIA BREVICORNIS, new species.

Plate 125, fig. 3.

Adults brownish red and similar in markings to *B. praetiosa.* Body about three-fourths as broad as long. Cephalothorax over twice as broad as long; two eyes on each side above second pair of legs, both with cornea; anterior eye about three-fourths the diameter of posterior one. Cephalothoracic plate showing much variation, but always, in the case of egg-bearing females, much broader than long; inner tubercles projecting much in front of lateral ones, united from three-fourths to their entire length, and bearing scales decidedly smaller than those on outer tubercles. Mandibular plate about twice as long as broad and conspicuously notched. Abdomen widest somewhat behind the shoulder region and evenly rounded behind. Front legs equal to the body in length; tarsi provided with two claws (onychial claws), each bearing a pair of tenent hairs, which arise from near the base; and a few hair-like elements, which spring from below the bases of claws. Tarsi of the other legs without tenent hairs and with the hair-like elements below the claws developed into a comb. Length of adult females, 0.69 mm.; width, 0.52 mm.

Type locality.—Tempe, Arizona.

Type slide.—Cat. No. 23756, U.S.N.M.

Described from egg-bearing females on type slide. Three other slides are also in the Museum collection. The specimens were collected by Wildermuth from alfalfa.

BRYOBIA LONGICORNIS, new species.

Plate 125, fig. 4.

In general appearance similar to *praestiosa* and *brevicornis,* but somewhat larger. Cephalothorax over twice as broad as long; two eyes on each side, the larger posterior pair either without cornea, or with a very thin and indistinct cornea. Cephalothoracic plate very large, and, as seen in egg-bearing females, about as long from base to tips of inner tubercles as broad, and fully equal in length to one-half the length of cephalothorax; inner tubercles but slightly surpassing the outer, separated from the latter by emarginations which extend almost to the base of the plate, and bearing scales considerably smaller than those of the outer tubercles. (There is much variation in the size of these inner tubercles, and the tubercle on one side may be decidedly larger than its fellow on the other side, also the emarginations may entirely separate the outer tubercles from the inner.) Mandibular plate about three-fifths as broad as long and broadest at the base, narrowly rounded in front, and without frontal emargination except in rare instances. Abdomen usually broadest somewhat back of the shoulders and broadly rounded behind. Anterior legs distinctly longer than the body and provided at their tips with the usual armature. The much shorter remaining pairs are also provided with the usual tarsal appendages. Length of egg-bearing females, 0.81 mm.; width, 0.53 mm.

Type locality.—Ashland, Nebraska.

Type slide.—Cat. No. 23767, U.S.N.M.

Described from egg-bearing females on type slide. This species differs from *praetiosa* and *brevicornis* in a number of details, the most important difference being in the great size of the cephalothoracic plate and in its shape. The specimens on the type slide were taken on Dutchman's breeches (*Bikukulla cucullana* (Linnaeus)).

Genus RAPHIGNATHUS Dugès.

In this genus the integument is reticulate. The individuals are stout, with short legs and large tarsal claws. About a dozen species are known, three of which have been described from this country.

RAPHIGNATHUS VIRIDIS, new species.

Plate 125, fig. 5.

Preserved specimens green throughout; body circular in outline. Cephalothorax slightly smaller than abdomen and separated from the latter by an evenly curved groove. Palpi large, surpassing the beak by one-third their length; palpal thumb small but with setae as long as the palpal claw. Abdomen broader than long, with integument reticulate, as it is on the cephalothorax, but not pitted in either case. Dorsal setae straight, simple, and stout, longest on the posterior margin of abdomen, where they extend to the tips of the tarsi of posterior legs. Legs stout; anterior pair considerably longer than the others and extending beyond the tips of palpi by the full length of their tarsi; posterior legs quite short, extending beyond the margin of the body by the full length of their tarsi and one-half the length of the tibiae.

Tarsal claws stout, as in other species of the genus; empodial hairs very fine, a single pair surpassing the tarsal claws. Length, 0.36 mm.; width, 0.26 mm.

Type locality.—Parker, Illinois.

Type slide.—Cat. No. 24028, U.S.N.M.

Described from a single specimen, the type. This species is distinguished at once from the three other described species in having the dorsal setae setiform and not clavate. Specimens were collected in moss by L. M. Smith.

Genus SYNCALIGUS Berlese.

This genus, formerly known as *Caligonus*, has recently been divided by Berlese into three. For the two new genera the names, *Homocaligus* and *Caligonella*, have been suggested. The wisdom of making this division may well be questioned, hence the genus name is here used in its former broader sense.

SYNCALIGUS TRIDENTIFER, new species.

Plate 125, fig. 6.

Preserved specimens yellow. A well-armed species. Cephalothorax with four pairs of large, simple, slightly curved setae; a frontal pair, a pair just inside and in front of the eyes, and two pairs behind and lateral to the eyes. The single pair of eyes is situated above second pair of legs, but inward from lateral margins of body. Chelicerae exceedingly sharp and needle-like, but with two chelae each. Palpi stout, each with strongly curved claw at tip. At the base of palpal claw on the inside is a small clawlike chitinous projection of penultimate segment. Palpal thumb cylindrical and not reaching tip of claw; terminal seta or finger ending in three prongs, two being somewhat lateral in position; other setae of thumb conspicuous. Abdomen with nine pairs of dorsal setae arranged as follows: Five pairs forming two longitudinal rows, two pairs on shoulders, one pair above last pair of legs and not far from margin of body, and a lateral, subterminal pair. Legs medium to stout; anterior pair extending beyond the palpi by the full length of their tarsi and a third the length of their tibiae; posterior pair extending beyond the tip of abdomen by over one-half their length. Tarsal claws large and stout, those of leg one about one-half as long as tarsus; empodial hairs fine, two of them slightly exceeding the claws. Length, 0.49 mm.; width, 0.27 mm.

Type locality.—St. Paul, Minnesota.

Type slide.—Cat. No. 24029, U.S.N.M.

Described from a single specimen selected as the type. This species is closely related to *S. mali* (Ewing), a very serious pest on apple trees in Oregon. It is probably a vegetable feeder, although found under a log, where it probably was hibernating, as specimens were taken November 8.

SYNCALIGUS QUERCUS, new species.

Plate 125, fig. 7.

A small, yellowish species. Beak prominent; chelicerae very sharp and needlelike, but each with two arms. Palpi rather short and stout; claw rather strongly hooked toward the distal end; thumb cylindrical, but slightly surpassing the claw and without three cleft distal spine or finger. Abdomen with a few rather long, curved setae. Legs moderate; claws large; empodium with very fine hairs none of which appear to extend beyond the claws. Length, 0.20 mm.; width, 0.12 mm.

Type locality.—Piermont, New York.

Type.—Cat. No. 23778, U.S.N.M.

Two slides are in the United States National Museum collections, both with the same date. This species can be distinguished from *S. mali* (Ewing) and *S. tridentifer*, new species, by the absence of the three-prolonged spine on palpal thumb. It is distinguished from *S. cardinalis* (Ewing) by having the palpal claw almost as long as the thumb, while in *S. cardinalis* the claw is so reduced as to be almost esvtigial. Specimens were taken from leaves of oak by N. Banks (?).

TETRANYCHINA TRITICI, new species.

Plate 125, figs. 8 and 9.

A medium-sized reddish brown, or sometimes greenish, species with long front legs. Cephalothorax very broad and separated from the abdomen by a distinct but not conspicuous groove. Two eyes, or corneas, on each side of cephalothorax, near lateral border; corneas of equal size and situated approximate; ocular pigment deep carmine. Cephalothorax provided above with apparently four pairs of pectinate setae; one pair on the front margin, one just in front of eyes, one pair median to eyes and one pair near the middle of cephalothorax. A pair of tracheal horns is located at the front margin of cephalothorax. They are situated below the front setae and are about one-half as long as the latter. Mouth parts conspicuous; mandibular plate over twice as long as broad and not notched in front; palpal thumb exceeding claw, not swollen, and bearing at its tip several small setae. Abdomen evenly rounded behind, broadest at the shoulders, and sparsely clothed with short, indistinctly pectinate setae. Legs long, particularly the first pair, which is longer than the body; last pair next in length, then third pair, while the second pair is the shortest. Tarsus and tibia of leg 1 about equal; tarsus provided with a long pair of tactile setae near its tip. Tarsal claw single, but provided with a double comb of knobbed hairlike appendages, each comb consisting of about 10 filaments. Tenent hairs as usual. Length (about), 0.5 mm.; width (about), 0.3 mm.

Type locality.—Idaho.

Type slide.—Cat. No. 24030, U.S.N.M.

Described from individuals on type slide. This species is at once separated from our other two species of *Tetranychina*, *T. harti* Ewing (= *T. macdonoughi* McGregor), and *T. apicalis* Banks, and also from *T. superba* (Canestrini), by the absence of seta-bearing tubercles on the back. According to Mr. Wakeland, who sent in the specimens of this species, it causes very serious injury to wheat.

EXPLANATION OF PLATE 125.

(Drawings were made by the writer.)

FIG. 1. *Oligonychus americanus*, new species. End of tarsus IV (camera lucida drawing with oil immersion lens).

FIG. 2. *Oligonychus major*, new species. Tarsal claw (camera lucida drawing with oil immersion lens).

FIG. 3. *Bryobia brevicornis*, new species. Dorsal view of cephalothorax (drawing from egg-bearing female).

FIG. 4. *Bryobia longicornis*, new species. Dorsal view of cephalothorax (drawing from egg-bearing female).

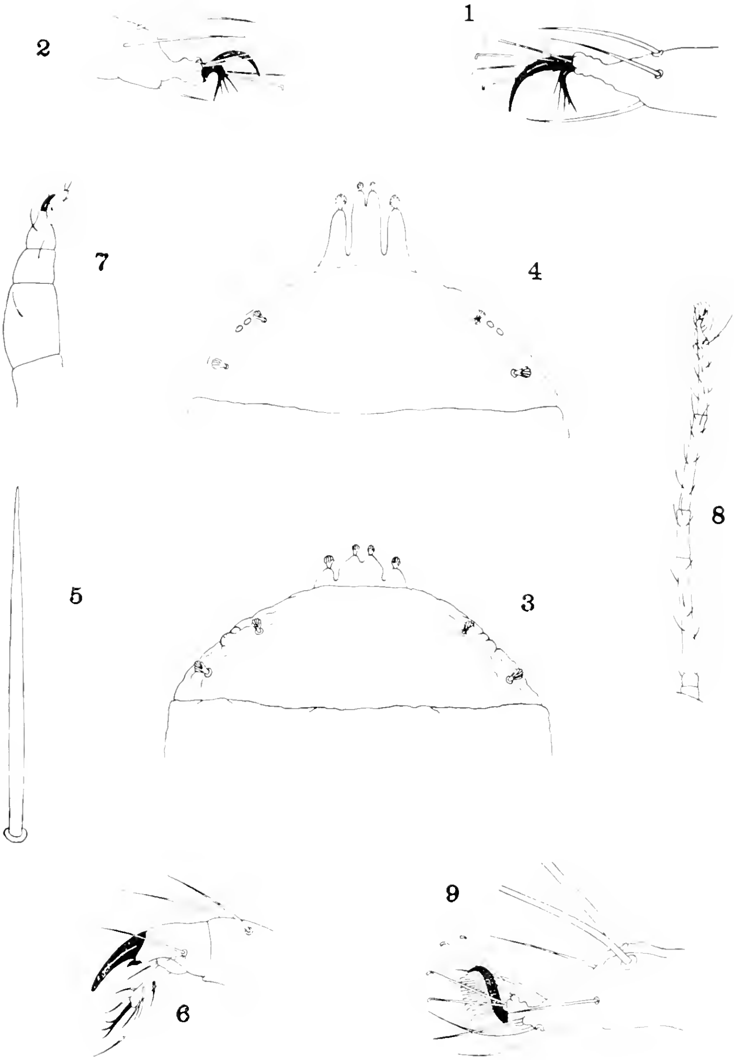
FIG. 5. *Raphignathus viridis*, new species. Seta from dorsum of abdomen.

FIG. 6. *Syncaligus tridentifer*, new species. Last three segments of left palpus from below (1½-inch eyepiece and one-sixth ocular used).

FIG. 7. *Syncaligus quercus*, new species. Right palpus from below (drawn with camera).

FIG. 8. *Tetranychina tritici*, new species. Right front leg from above (camera drawing).

FIG. 9. *Tetranychina tritici*, new species. Tip of tarsus of first leg on right side (camera lucida drawing with oil immersion lens).



NEW NEARTIC SPIDER MITES.

FOR EXPLANATION OF PLATE SEE PAGE 666

LUDWIGITES FROM IDAHO AND KOREA.

By Earl V. Shannon,
Assistant Curator, Department of Geology, United States National Museum.

INTRODUCTION.

The ferric magnesian borate, ludwigite, which was described by Tschermak in 1874 as a new species from Hungary, was regarded as a rare mineral for 40 years. Within the past few years, however, ludwigite and closely related members of the ludwigite group have been described from six localities in the United States. Recently ludwigites from two additional localities have been received at the United States National Museum. These have been analyzed in the Museum laboratory and are described in some detail below.

LUDWIGITE FROM LEMHI COUNTY, IDAHO.

The specimen of ludwigite from Lemhi County, Idaho (catalogue number 94,145), is labeled "Copper ore, Bruce Estate." No further information accompanies the specimen. Umpleby [1] mentions that a group of claims known as the Bruce Estate extends along the mountain slope near its summit for 2 miles south from Dry Gulch in the Texas district. Lead-silver ore is reported from several claims, but the most interesting feature is a big low-grade copper deposit found in association with large quantities of magnetite. The deposit occurs on the side of a big dike, which is called "syenite" by the miners, but which is probably quartz-diorite, as an abundance of the latter and none of the former was noted in the bowlders in the gulches below.

Description and associated minerals.—The hand specimen is about half light gray and half black in color. The light gray portion is seen in thin section under the microscope to consist of a fabric of idiomorphic crystals of colorless diopside, with interstitial areas of calcite partly replaced by ludwigite, chalcopyrite, and bornite. The ludwigite forms irregular masses and prismatic needles, which are, for the most part, opaque, but which are transparent when very thin. The borate and the ore minerals are intergrown in a manner suggesting contemporaneous deposition. The darker colored portion of the

[1] Umpleby, J. B., U. S. Geol. Survey Bull. 528, p. 89, 1913.

specimen appears to the unaided eye to be made up of pure ludwigite containing irregular masses of bornite. Under the microscope the ludwigite is seen to contain disseminated crystals and ragged grains of diopside. In the replacement of the calcite-diopside rock by ludwigite and sulphides the calcite has been selectively replaced before the diopside was attacked, and residual diopside crystals showing sharp idiomorphic boundaries occur embedded in a mass of ludwigite and bornite. In an advanced stage of the replacement the diopside has been attacked and the crystal outlines destroyed.

Physical properties.—To the unaided eye the Idaho lugwigite is black in color, with a very fine felted structure, in which the fibrous structure is too fine to be detected by the unaided eye, but is manifested by a faint silky luster, which might easily be overlooked, and the material might readily be mistaken for magnetite. The hardness is above 5, as the mineral scratches apatite with ease, but is itself scratched by orthoclase. The streak is moderately dark greenish-brown. The material is not notably attracted by an ordinary magnet of the horseshoe type.

Optical properties.—The ludwigite is transparent in very thin fragments and is intensely pleochroic in tones of brown parallel to the elongation and grass green perpendicular to it. The birefringence is moderate, while the indices of refraction are high. The extinction is parallel to the elongation of the prisms.

Pyrognostics and chemical properties.—This ludwigite yields a small amount of water in the closed tube, all of which is probably extraneous. It is soluble slowly but completely in sulphuric, nitric, and hydrochloric acids. When moistened with sulphuric acid it gives the green flame of boron.

Composition.—The material for analysis was hand selected and was contaminated by small grains of included impurities. The purest pieces of the felted aggregate were selected, ground in an agate mortar, and a small amount of magnetite extracted with a magnet. The remaining material upon analysis yielded the following results:

Analysis of Ludwigite from Lemhi County, Idaho.

Silica (SiO_2)	0.90
Ferric oxide (Fe_2O_3)	35.90
Alumina (Al_2O_3)	2.08
Ferrous oxide (FeO)	5.14
Magnesia (MgO)	36.42
Lime (CaO)	Trace.
Manganous oxide (MnO)	Trace.
Copper oxide (CuO)	2.87
Boric anhydride (B_2O_3)	14.59
Water (H_2O) −105° C	.03
Water (H_2O) +105° C	2.28
Sulphur (S)	.22
Total	100.43

Since several of the constituents which are present in minor amounts are obviously present as impurities, it is difficult to decide which of these should be included as essential to the ludwigite. The copper and sulphur are certainly extraneous, a part of the former and all of the latter being present as bornite. The presence of the bornite introduces some error into the analysis, as it itself contains ferrous iron, and the hydrogen sulphide formed by the action of hydrochloric acid upon it would naturally reduce some ferric iron to the ferrous state. The copper in excess of bornite is probably present as thin staining films of chrysocolla or malachite. These impurities are, however, present in too minor amounts to affect the broader ratios of the ludwigite. The constituents which are probably essential to the mineral yield the following ratios:

Ratios of Ludwigite from Lemhi County, Idaho.

Constituent.	Per cent.	Ratios.			
FeO	5.14	0.0715	.9745	9.75	1.08×4
MgO	36.42	.9030			
Fe_2O_3	35.90	.2247	2247	2.25	1.00×1
Al_2O_3	2.08	.0204	.2288	2.29	1.02×1
B_2O_3	14.59	.2084			
	94.13				

The general formula derived from these ratios is, then—

$$4(Mg, Fe)O.\quad Fe_2O_3.\quad B_2O_3.$$

Following Schaller this composition may be interpreted as an isomorphous mixture of magnesioludwigite and ferroludwigite in the molecular proportions of approximately 7 parts of the former to 3 of the latter; or the material is, by weight, 68 per cent magnesioludwigite and 32 per cent ferroludwigite. The essential constituents given above are below recalculated to 100 per cent and compared with the percentages calculated for a mixture of this composition.

		Found.	Calculated.
MgO		38.69	37.26
FeO		5.46	5.38
Fe_2O_3		38.14	39.88
Al_2O_3	2.21	17.71	17.48
B_2O_3	15.50		
Total		100.00	100.00

The material is thus higher in the magnesioludwigite molecule than any ludwigite yet analyzed except the end member itself.

LUDWIGITE FROM KOREA.

Introduction.—The United States National Museum has received from Mr. J. Morgan Clements several specimens labeled ilvaite from Heoth 1 Kol Mine, Korea. (Cat. No. 93729 U.S.N.M.) Since the mineral was obviously the same which Koto had called ilvaite[2] and Higgins had [3] had described as a new species under the name "collbranite," its investigation was deemed necessary. Analysis has shown the material in each of the several specimens to be ludwigite.[4]

Occurrence.—The occurrence of the ludwigite has been well described by both Koto and Higgins in the papers cited, although both authors erred in their identification of the mineral. The deposit, which is mined for gold and copper, occurs as irregular masses of lime-silicate minerals at the contact of granite with limestone. The lime-silicate hornfels in irregularly impregnated with ludwigite, bornite, and chalcopyrite, mingled with some chalcopyrite and a little galena and magnetite. The less metamorphosed limestone contains a little diopside and a uniaxial variety of serpentine, while the more intensely altered phase consists of about equal volumes of calcite and contact-metamorphic minerals. This is impregnated with auriferous sulphides in addition to the ludwigite and diopside, the ludwigite-bearing limestone being the ore body of the Hol Gol Mine. Local bodies of diopside rock and of garnetite occur in the ore-bearing zone. Muscovite is mentioned by Koto as occurring in the ore while, according to Higgins, phlogopite is very abundant, masses of pure phlogopite many tons in weight being encountered at times. It is evident from the descriptions that the ludwigite is common and present in large amount in the mine.

Description of associated minerals.—The specimens examined by the writer are all very similar in appearance, all consisting of sheaves and rosettes of shining black needles of ludwigite embedded in a white or grayish-white granular groundmass. The aggregates of the ludwigite may reach a centimeter in maximum diameter and are rather uniformly disseminated in their matrix. When examined under the microscope in thin section this matrix is seen to consist in the main of calcite in large twinned grains with disseminated irregular grains of colorless diopside. All of the grains of calcite when at the position of extinction between crossed nicols, show numerous minute flakes of a mineral resembling talc as though some magnesia in the original limestone had separated out in this form during metamorphism. Small masses and grains of bornite are visible in one specimen. None of these are included in the thin sections studied and no other ore minerals were seen. The ludwigite is included in the calcite and does not encroach upon the

[2] Koto, B., Geology and Ore Deposits of the Hol-Gol Gold Mine, Journal College Science, Imperial Univ. Tokyo, vol. 27, art. 12, 1910.

[3] Higgins, D. F., Geology and Ore Deposits of the Collbran Contact, Suan Mining Concession, Korea. Economic Geology, vol. 13, p. 19, 1918.

[4] The analysis has already been published with a short note identifying collbranite with ludwigite. Shannon, E. V., Amer. Mineral, vol. 6, p. 87, 1921.

diopside. Koto[5] concludes that the ludwigite was first deposited, followed by the diopside, after which the deposition of the sulphides and recrystallization of the calcite took place.

Physical properties.—The ludwigite is entirely black in color in the hand specimen and consists of radiating or divergent aggregates of prismatic fibers. The luster is silky. The hardness is about 5.2–5.5. The streak is greenish to brownish-black and is distinctly darker than that of the Idaho ludwigite. A peculiar property of this ludwigite is its magnetism. When powdered to 60 mesh all of the particles can be picked up with a common horseshoe magnet. When powdered very finely and examined under the microscope no magnetite inclusions were found in the mineral and no magnetite was visible on polished surfaces, so that the magnetic property must belong to the borate itself. This is further discussed below.

Optical properties.—Under the microscope very thin needles are transparent, but are very deeply colored, distinctly more so than the Idaho material described above. They are markedly pleochroic, the color parallel to the elongation being brown and that perpendicular to it green, the absorption being greatest in the former direction. Owing to the deep color of the mineral the birefringence is greatly obscured and the optical character could not be determined. The indices of refraction are higher than the range of immersion media at hand.

Pyrognostics and chemical properties.—The mineral yields water (extraneous) in the closed tube. It is slowly soluble in hydrochloric, nitric, and sulphuric acids, and gives the usual reactions for boron and iron.

Chemical composition.—The ludwigite was separated from the accompanying gangue material by the use of heavy solutions. The relatively pure material thus obtained was analyzed with the following results:

Analysis of ludwigite from Korea.

Silica (SiO_2)	0.40
Ferric oxide (Fe_2O_3)	32.49
Alumina (Al_2O_3)	2.32
Boric anhydride (B_2O_3)	16.80
Ferrous oxide (FeO)	10.40
Lime (CaO)	1.86
Manganous oxide (MnO)	.36
Magnesia (MgO)	34.54
Water (H_2O) above 110° C	1.42
Total	100.59

Of the above constituents the silica, water, and lime are quite probably extraneous, the silica and lime being doubtless derived

[5] Koto, Journ. Coll. Sci. Tokyo, 1910, p. 23.

from the included gangue and the water being adsorbed. The remaining constituents yield ratios as follows:

Ratios of ludwigite from Korea.

Fe_2O_3	0.2034	0.2261	0.93×1
Al_2O_3	.0227		
B_2O_3	.2400	.2400	.99×1
Mg_3O	.8566	.8566	1.04×3.4
Fe	.1448	.1499	1.04× .6
MnO	.0051		

These ratios place the Korean ludwigite as a member of the ferroludwigite-magnesioludwigite series having three parts ferroludwigite to 2 parts of magnesioludwigite.

PREVIOUSLY DESCRIBED LUDWIGITES.

LUDWIGITE (FERROLUDWIGITE) Hungary.

The original ludwigite described by Tschermak[6] was from Morawicza in the Banat, Hungary. Here it occurs embedded in a crystalline limestone with irregularly distributed masses of magnetite. The magnetite occurs intimately intermixed with the ludwigite. The material is fibrous and blackish-green to black in color. The formula derived by Tschermak from the analysis is $3MgO.B_2O_3FeO.Fe_2O_3$. Whitfield later analyzed material from this locality and, considering the water essential, arrived at the formula $3RO.R_2O_3$ with R = Mg,-Fe,H_2 and R_2 = B and Fe.[7] Schaller[8] later confirmed the results and formula of Tschermak.

PINAKIOLITE, SWEDEN.

Pinakiolite as described by Flink[9] occurs at Langban, Wermland, Sweden, in bands in granular dolomite with hausmannite, etc. The formula deduced from the analysis is analogous to that of ludwigite, $3MgO.B_2O_3.MnO.Mn_2O_3$.

LUDWIGITE, MONTANA.

Ludwigite was found by Calkins[10] to occur abundantly with magnetite and forsterite in a contact-metamorphic deposit in limestone at the Redemption iron mine in the Philipsburg district in Montana. This material has been analyzed by Schaller[11] who found it to contain more magnesia and less ferrous iron than the original Hungarian ludwigite. He assigned to the Montana material the formula $3MgO.B_2O_3.(Mg,Fe)O.Fe_2O_3$ and predicted the existence

[6] Tschermak, G., Min. Mitth., vol. 59, 1874.

[7] Whitfield, Amer. Journ. Sci., vol. 34, p. 284, 1887.

[8] Schaller, W. T., U. S. Geol. Survey, Bull. 490, p. 30, 1911.

[9] Flink, G., Zs. Kryst., vol. 18, p. 361, 1890.

[10] Calkins, F. C., Geology and Ore Deposits of the Philipsburg quadrangle, Montana. U. S. Geol. Survey, Prof. Paper 78, p. 162, 1913.

[11] Schaller, W. T., U. S. Geol. Survey Bull. 490, p 28.

of a magnesia member free from ferrous iron, this molecule being in excess in the Montana material and having the formula

$$3MgO.B_2O_3.MgO.Fe_2O_3.$$

MAGNESIOLUDWIGITE, UTAH.

Magnesioludwigite, the magnesia end-member of the ludwigite group predicted by Schaller from his work on the Montana ludwigite, was found by Butler in nearly pure form in the Mountain Lake mine in Utah [12]. The material is ivy-green in color and it occurs in a contact metamorphosed limestone with ordinary ludwigite, magnetite, etc.

LUDWIGITE, UTAH.

Ludwigites which are apparently ordinary in composition and contain ferrous iron have been found in several localities in the Cottonwood-American Fork area in Utah [13]. The mineral occurs in large amounts mixed with magnetite and lime silicates in contact metamorphosed limestones. The material from these occurrences has not been analyzed.

VONSENITE, CALIFORNIA.

Vonsenite, described by Eakle [14] from Riverside County, California is a member of the ludwigite group which is much higher in iron than other members of the group, even the pure ferroludwigite end member as is shown by the following comparison:

	Vonsenite.	Ferroludwigite, theory.
B_2O_3	14.12	16.6
Fe_2O_3	34.82	37.9
MgO	10.71	28.5
FeO	39.75	17.0
	99.40	100.0

The material occurs with magnetite in contact zones in limestone.

GENERAL DISCUSSION.

The above descriptions include all known occurrences of the minerals of the ludwigite group. The compositions of those which have been analyzed may be expressed by the following formulas:

Ludwigite (ferroludwigite), Hungary. .... $3MgO.B_2O_3.FeO.Fe_2O_3$.
Magnesioludwigite, Utah.......... .... $3MgO.B_2O_3.MgO.Fe_2O_3$.
Pinakiolite, Sweden.................................. $3MgO.B_2O_3.MnO.Mn_2O_3$.
Vonsenite, California................................ $3(Fe,Mg)O.B_2O_3.FeO.Fe_2O_3$.
Ludwigite, Montana.................................. $3MgO.B_2O_3.(Mg,Fe)O.Fe_2O_3$.
Ludwigite, Idaho...................................... $3MgO.B_2O_3.(Mg,Fe)O.Fe_2O_3$.
Ludwigite, Korea...................................... $3MgO.B_2O_3.(Fe,Mg)O.Fe_2O_3$.

[12] Butler, B. S., and Schaller, W. T., Magnesioludwigite, a new mineral. Wash. Acad. Sci. Journ., vol. 7, No. 2, pp. 29–31, 1917.

[13] Butler, B. S., Ore Deposits of Utah. Prof. Paper U. S. Geological Survey, no. 111, p. 243, 1920.

[14] Eakle, Arthur S., Vonsenite, a preliminary note on a new mineral. Amer. Mineral., vol. 5, p. 141, 1920.

The above type of formula was adopted by Tschermak and continued by Flink and Schaller. It is supported by the ratios of the three end members thus far found. The ratio of B_2O_3 to Fe_2O_3 seems invariably constant. It is possible to interchange the ratios of the bivalent bases, however, and the minerals can almost equally well be expressed by any of the following formula types: $3RO.B_2O_3.RO.Fe_2O_3$; $2RO.B_2O_3.2RO.Fe_2O_3$; $RO.B_2O_3.3RO.Fe_2O_3$.

The general formula for the group is thus $4(Mg,Fe,Mn)O.(B,Al)_2O_3.(Fe,Mn,Al)_2O_3$.

The formula as written by Tschermak for the original ludwigite (ferroludwigite) assumes 1 molecule of trimagnesium borate, $3MgO,B_2O_3$, plus 1 molecule of ferrous ferrate, $FeO.Fe_2O_3$; while Schaller deduces for magnesioludwigite 1 molecule of trimagnesium borate plus 1 of magnesian ferrate, $MgO.Fe_2O_3$. Pinakiolite, which is the best evidence in support of the above type of formula, is written 1 molecule of trimagnesium borate plus 1 of manganous manganate. Vonsenite, as written by Eakle, obviously does not agree with this series. An interesting hypothesis is developed from the observation that the ludwigite from Korea, described above, is decidely magnetic. It is to be remembered that the molecule ferrous ferrate is the magnetite molecule, and it is quite conceivable that this compound might preserve its magnetic properties even when united chemically with the borate molecule in a ludwigite. Assuming, for the sake of discussion, that in ludwigites which are markedly magnetic the ferrous iron is present as ferrous ferrate, while in those which are not notably magnetic the ferrous iron is present as borate, the following formulas may be written for the several occurrences:

Hungarian ludwigite; not sensibly magnetic: $3(Mg,Fe)O.B_2O_3.MgO.Fe_2O_3$.

Idaho ludwigite; not sensibly magnetic: $3(Mg,Fe)O.B_2O_3.MgO.Fe_2O_3$.

Vonsenite; not sensibly magnetic. Very close to $3FeO.B_2O_3.MgO.Fe_2O_3$.

Montana ludwigite; moderately magnetic: $3MgO.B_2O_3.(Mg,Fe)O.Fe_2O_3$.

Korean ludwigite; decidedly magnetic: $3MgO.B_2O_3.(Fe,Mg)O.Fe_2O_3$.

Of course, the term magnetic as here used is relative only, as all ludwigites are attracted to a sufficiently powerful electromagnet, as are all iron-bearing materials. The magnetism as stated above is in terms of an ordinary horseshoe magnet. While not put forward as a definite conclusion, this evidence is recommended as worthy of consideration. These interpretations may, in part, explain the anomalous variation in optical properties observed in ludwigites which should otherwise fall in a uniform series between ferro- and magnesioludwigite.[15]

A second point with reference to the composition of ludwigite which deserves mention is the water content, which is often reported in analyses and which is not released at a temperature much above 110° C. The results are collected below:

Mineral.	Locality.	Analyst.	Water below 110°.	Water above 110°.
Ludwigite	Hungary	Whitfield		3.62
Pinakiolite	Sweden	Flink		.47
Ludwigite	Montana	Schaller	1.13	1.24
Do	Hungary	do	.51	.82
Do	Idaho	Shannon	.03	2.28
Do	Korea	do		1.42

Schaller, after some consideration, decided to regard the water as extraneous. Whitfield, on the other hand, considered the water found by him in the Hungarian material as essential and basic. On the whole, the former seems the more reasonable view, especially since emphasis has been placed upon the fact that adsorbed water, properly so-called, may be held tenaciously up to the point of fusion.[6] Those ludwigites which show the largest content of water are distinctly fibrous in structure and thus possess the maximum of surface area.

Magnesia and ferrous iron seem entirely isomorphous in ludwigites as known. Boric anhydride and ferric iron are apparently always definite and constant in their ratio to each other although both may be susceptible of replacement to a slight extent by alumina. Examples intermediate between pinakiolite and ludwigites proper have not yet been found.

With regard to the occurrence of the ludwigites, one fact is obvious and important. Members of the group in every known occurrence are contact metamorphic minerals in limestone. The boron emanations in the contact zone seem to form ludwigite in the event that the supply of silica is deficient, whereas tourmaline forms under the same conditions where the supply of silica is ample. Ludwigite is not known in association with free quartz. The evidence seems to indicate that ludwigites are probably rather common products of contact metamorphism in limestone. The minerals may have largely been overlooked, as the black varieties closely resemble black tourmaline, or magnetite, while light-colored varieties may closely simulate amphiboles, etc., which are frequent in lime-silicate contact

[15] Larsen, Esper S., Mineral Tables, in press.
[16] U. S. Geol. Survey, Bull. 700, pp. 64–69, 1919.

zones. Under the microscope ludwigite resembles ilvaite to a remarkable degree, as shown by the misidentification of the Korean material by no less an authority than Koto. Acicular black minerals in contact altered limestones should be critically examined, as ludwigite is more rationally to be expected in such associations than is tourmaline. Ludwigite may simulate tourmaline in megascopic appearance and boron reaction, magnetite in appearance and magnetic properties, and ilvaite in appearance, solubility in acids, and quantitative optical properties.

INDEX.