FAUNA OF THE CAVES OF YUCATAN

By

A. S. PEARSE
Duke University

With the Collaboration of

Nathan Banks
Joseph C. Bequaert
Joseph C. Chamberlin
Ralph V. Chamberlin
B. G. Chitwood
William J. Clench
Edwin P. Creaser
Norma C. Furtos
Helen T. Gaige
Theodore H. Hubbell
Carl L. Hubbs
Libbie H. Hyman
Wilton Ivie
Remington Kellogg
Harlow B. Mills
J. Percy Moore
C. F. W. Muesebeck *et al.*
Grace E. Pickford
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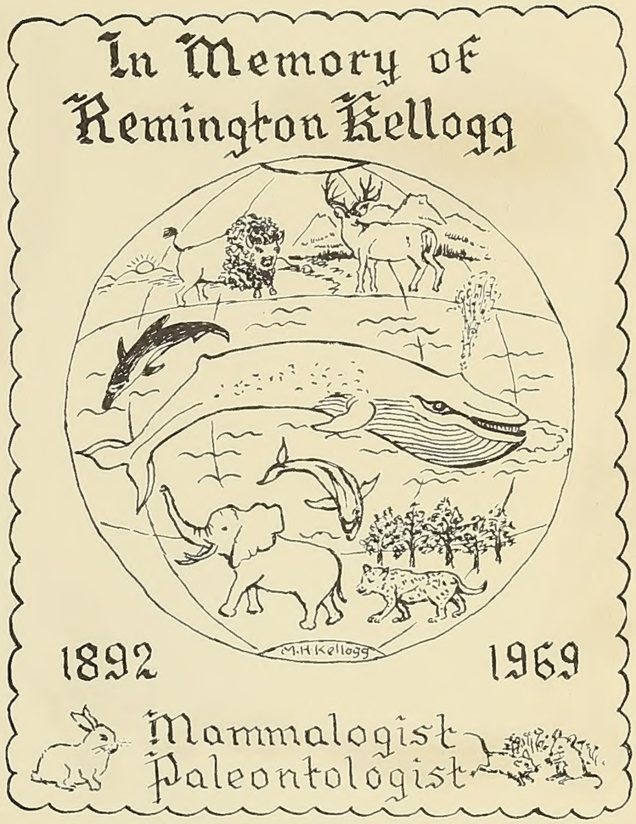

In Memory of
Remington Kellogg

1892 1969

Mammalogist
Paleontologist

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FAUNA OF THE CAVES OF YUCATAN

INTRODUCTION

A. S. Pearse
Duke University

The caves in the State of Yucatan are of particular interest because they played an important role in the development of Maya civilization. Although there are extensive brackish cienagas along the coast, the Yucatan Peninsula contains no rivers. Cenotes, aguadas, and caves therefore long furnished the only water supplies for the Maya. Yucatan is a sheet of limestone which rose from the ocean bed in rather recent times and even today has accumulated but a very thin layer of soil. The greatest elevation is along the southern border of the State of Yucatan, where the "sierra" rises to a height of about 160 m. Mercer (1896) visited the caves in this region and did some excavating. After studying potsherds and other artifacts he concluded that the remains in caves show only one type of Maya culture and are all comparatively recent. He found the remains of no extinct animals.

Today there are many evidences of previous occupation of the caves in Yucatan. These include potsherds, walls which cut off parts of caves and apparently served as defenses against human enemies or other animals, carvings, bones, excavated holes in rocks for catching water which dripped down from above, stone blinds for hunting birds, and carved steps. Maya do not live in caves now but often resort to them to bathe or to obtain water during dry seasons. Probably they never lived in caves permanently but perhaps used them as shelters during wars or other periods when such refuges were desirable. Robbers are also said to have used them as bases for their operations, but, since Maya as a rule are honorable and law-abiding, robbers are rare among them, even after long association with Christian culture. The caves are generally too humid to be comfortable for prolonged residence, but a few, such as Loltun near Oxkutzcab, are cool and to some degree dry (Table 2, p. 12).

During the summer of 1936 the writer visited twenty-seven caves distributed throughout the State of Yucatan. He was accompanied by two Maya: Heliodoro Castillo, who served most admirably as interpreter and factotum, and Coyock, who cheerfully tramped rocky trails with a heavy pack on his back. Great help was given by Dr. S. G. Morley, Director of the Chichen Itza Project of Carnegie Institution, and by Don Carlos Vales and other Yucatecans.

CONDITIONS OF LIFE IN CAVES

Types of caves.—Caves have been classified variously by speleologists. Some authorities (Adams 1886, Henderson 1932, Kyrle 1923) use method of origin as a primary basis for classification; others (Jeannel 1926) depend largely on ecological conditions and contained biota. *Solution* caves are formed by the passage of water which contains carbon dioxide through limestone; thus $Ca(CO_3)_3$ is dissolved and carried away as $CaH(CO_3)_2$. Such caves may be designated as one-cycle or two-cycle solution caves (Davis 1931). The former are those that have been excavated above ground water. On the other hand, in two-cycle caves solution occurs largely below ground-water level, where as cavities form they remain filled with slowly moving water under hydrostatic pressure; later when the land is elevated, air fills the cavities and dripstones (stalagtites and stalagmites) form. Henderson (1932), in a recent review of the caves of the world, says, "The idea long prevalent that the formation of caverns by solution above the water table must necessarily have been the principal method and solution below the water table unimportant, seems to be probably incorrect." One-cycle caves usually "form linear, branching channels such as are formed by stream erosion above ground, not interlacing channels and vaulted chambers." Two-cycle caves are usually characterized by numerous "large, vaulted chambers, connected by narrow passages, sharp angles, and a network of interlacing channels." Solution caves develop best in thick series of massive limestone. When channels for carrying away water from the surface are above ground water, they tend to cut new channels continually and descend to lower levels until down-cutting reaches base level for the region (Weller 1927). "There are large regions in the world where solution caverns are so extensive that drainage is now almost entirely underground, as in portions of southern Indiana, Kentucky, Tennessee, Yucatan, and various districts in Europe and Asia. Such regions are known to geologists as karst regions." (Henderson 1932.)

Lava caves are formed during volcanic activity. Liquid materials may be ejected from craters or lateral ducts and thus leave cavities. Bubbles of volcanic gases or steam may cause spaces when molten rock about them cools and congeals. *Erosion* caves may result from the action of streams, waves, winds, and other agents. *Fault* caves are clefts or cracks in rocks brought about by movements of the earth's crust. *Travertine* caves are small cavities enclosed by dripstone materials which grow down from cliffs. *Artificial* caves, such as mines and quarries, are works of man. Of course many caves result from a combination of causes: a cleft may be enlarged, closed, or changed in form by solution and accretion; winds may hasten erosion and corrosion may fill up spaces.

Attempts to classify European caves on an ecological basis have been quite diverse and have as yet resulted in no generally accepted system. An example of a recent effort in this direction is that of Jeannel (1926) who recognizes eleven types: (1) caves with diverse conditions and faunas; (2) clean caves, usually containing few animals; (3) dry caves, with a few or no animals; (4) caves with air currents, because there are two openings or the cave is inclined, and with few animals on account of low humidity; (5) rubbish caves with few animals; (6) grottoes with stalagtites and many animals; (7) caves with guano deposits; (8) caves with clay banks from ancient river beds, and a rich fauna; (9) narrow caves with entering rivers, in which temperatures vary with those of the streams; (10) subterranean torrents, with few or no animals; (11) subterranean rivers, which may contain many animals in quiet parts.

Regions in caves.—Caves are usually discontinuous units which often have no direct connection with other similar subterranes. Usually animal and plant life diminishes rapidly from the surface downward. The density of animal population is roughly inversely proportional to the size of a cave; small caves may contain many animals if conditions are favorable, animals in large caves are comparatively infrequent. There is usually greater variety in older caves (Eigenmann 1923). The deeper parts of a great cave are stable, dark, and humid; those near the mouth are much more variable. Though there are often no sharp lines of demarcation, a large cave usually shows three parts: (1) Twilight Region, where there is more or less light and where temperatures vary; (2) Transition Region, dark with more or less variable temperatures; and (3) Troglic Region, dark with little or no variation in temperatures.

Origin of cave faunas.—Epigean animals enter caves for shelter and to take advantage of high humidity and stable temperature. Many of them find food outside. Animals from ground waters enter caves chiefly for food, which must come directly or indirectly from the world above. In northern England Ritchie (1914) studied thirteen species of animals which had been introduced into a mine with timbers and were living at a depth of 240 m. below the surface. In the Egyptian Desert where there were no plants Kirkpatrick (1923) investigated the animals in an artificial cave which was 20 m. deep. Bats were found throughout the cave but none of the ten other species found was observed more than 6 m. from the mouth. Many animals readily take up life in caves, or continue to live after they are accidentally introduced. Recent migrants into caves are modified little or not at all, but a typical cave animal is blind, pigmentless, and otherwise adapted. Epigean animals during humid seasons, especially during prolonged cloudy periods, perhaps may become adapted for life in caves before entering them (Jeannel 1926). Some aquatic types such as schizopods, sphaeromids, cirolanids, certain amphipods, and blind brotulid and amblyopsid fishes have relatives in the ocean. They apparently came into caves from the ocean through ground waters. Some representatives of old groups (Bathynella, Anthuridae) have persisted in caves and ground waters since ancient times. Caves have been populated from soil, streams, and ground waters, as well as by surface wanderers and flying animals. Thienemann (1908) maintains that some stenothermic animals were forced to take up subterranean life by high temperatures which prevailed at times during the Glacial Epoch in Europe.

Terminology for cave animals.—The term "speleology" was first used by E. Riviere (Martel 1900). In 1852 Schiner defined troglophile animals as those which live in caves and may breed there but live outside also, and troglobite animals as exclusively cave types. Later he added trogloxene for those animals which occur in caves as accidental guests but may live indefinitely outside. This classification of cave animals has been used by others (Rocovitza 1908, Jeannel 1926, Chappuis 1927) and such words as troglobiont are in general use, but lately there has been a tendency to amplify Schiner's classification. Thienemann (1908) proposed stygobionte, stygophile, and stygoxene for Schiner's groups; Hesse (1924): eucaval, tychocaval, and xenocaval. Arndt (1923) and Mohr (1929) divide cave animals into four groups: troglobitic, troglophilic, ombrophilic or shade frequenting, and euryphotic accidental guests. Gebhart (1932) and Kolsavary (1934) use the following classification:

1. Eutroglobionts—animals confined to caves; in dark, eyes often reduced or absent.
2. Hemitroglobionts—animals often in caves but also outside; usually sensitive to humidity.
3. Pseudotroglobionts—epigean animals which frequent caves; sensitive to temperature, may hibernate in caves.
4. Tychotroglobionts—animals accidental in caves; sensitive to temperature, may hibernate in caves.

The latter author also adds

5. Troglocheimada—accidental in caves at certain seasons (during hibernation, etc.).

Wichmann (1926) accepts only one of Schiner's groups and presents the following "profile" for cave animals in the karst region in southern Europe: (1) fauna of free air, bats, flies, etc.; (2) subterranean fauna, blind, colorless, hydrophylic animals such as blind beetles; (3) cave animals (troglobionts); and (4) crevice fauna. Jeannel (1926) proposes a rather comprehensive classification of cave habitats and animals as follows:

Light Zone
1. Parietal association—on walls, varied and abundant.
2. Lapidicoles—among stones.
3. Endoges—small, in humus.
4. Muscicoles—among mosses and lichens.
5. Xenophiles and Coprophages—parasites, scavengers.
6. Troglobies—cave animals attracted into light zone.
7. Aquatics—not often in light zone.

Dark Zone
1. Guanobies—solitary or gregarious, associated with bat guano.
2. Stalagmite species—in organic debris, many and varied.
3. Lapidicoles—stone dwellers.
4. Saproxylophages—with vegetable debris.
5. Animals in clay beds—at times many.
6. In periodically inundated zones—usually no animals.
7. Terrestrial crevice animals—such as small insects and snails.
8. Aquatic—amphipods, crayfishes, planarians, etc.

Though the work of Holdhaus (1910) deals especially with soil animals, it is of interest to speleologists because it gives a significant assortment of the "Terricolfauna" into four groups: (1) stone-indifferent animals, which are often wide ranging; (2) petrophiles, which usually have limited ranges; (3) psammophiles, confined to sand; and (4) halophiles, a doubtful group perhaps limited by salt.

TYPES OF ANIMALS WHICH OCCUR IN CAVES.—Representatives of all phyla groups of freshwater and land animals are found in caves. Rather extensive lists of species of animals which live in caves have been published (Chappuis 1927, Packard 1887, Spandl 1926, Wolf 1934) so that a long account is not justified in this paper. Protozoans in caves are usually ubiquitous types, such as common rhizopods and ciliates. Sponges have been reported. Cave flatworms include rhabdocoels and triclads. About twenty species of nematodes have been recorded from caves by

Spandl (1926). A simple polychaete, a number of oligochaetes, and several leeches have been found in caves. Other cave invertebrates include rotifers, gastrotrichs, tardigrades, and bryozoans; pulmonate and prosobranch snails, and sphaerid clams among the molluscs. There are many cave crustaceans: cladocerans, numerous copepods including parasitic species, ostracods, archaic anispidaceans (Bathynella, Parabathynella), mysidaceans, a great variety of aquatic and terrestrial isopods, many amphipods, palaemonid shrimps, atyids, hippolytids, crayfishes, and galatheids. Among the arachnids are many aquatic and terrestrial mites, ticks, many spiders, pseudoscorpions, whip scorpions, and scorpions. There are many cave millipedes and a few centipedes. Insects include thysanurans, collembolans, psocids, earwigs, cockroaches, a phasmid, several acridians, beetles, lepidopterans, dipterans, and hymenopterans. Cave crickets are widely distributed and often common; cave beetles are noteworthy, the anopthalmids being a cave group with many blind species. Cave fishes include amblyopsids, silurids, cyprinids, brotulids, and symbranchid eels. Amphibians are chiefly salamanders, both aquatic and terrestrial; some with degenerate eyes. There are no troglobite reptiles, but troglophiles include lizards and snakes. Birds do not penetrate far into caves but swifts, swallows, and owls commonly nest within the entrances. Certain rodents are well established far within caves and such animals as racoons, opossums, bears, foxes, and cats often hunt more or less throughout caves, or use them as homes; but the most characteristic cave mammals are bats, which occur in great variety and at times in enormous numbers.

Adaptations of cave animals.—A typical cave animal is blind but provided with unusually effective tactile and olfactory organs; without pigment, so that the body appears pale and pellucid; small; stenothermic; and hydrophylic. Aquatic animals in caves live in quiet stability which is somewhat like that in the deep sea, yet cave animals are quite different from those in the abyssal regions of the ocean. Deep-sea crustaceans and those from the marine twilight zone are commonly red, fishes are often black, and both are frequently luminescent. Cave animals are usually pigmentless and are not known ever to be luminescent. In some respects, such as tendency to degeneration in eyes and the development of attenuated tactile organs, certain abyssal marine species resemble those in caves but the two types are on the whole quite differently adapted. Eigenmann (1909) and his students (Banta 1907, etc.) have stressed the point that animals do not become established in caves by accident, but are adapted for life in caves before they get there. Among cave fishes the amblyopsids and brotulids are often completely blind. These types of fishes have relatives in the sea which live in crevices in rocks alongshore and many of these have degenerate eyes. Silurids outside caves commonly have long tactile and gustatory barbels on their heads and depend little on sight for feeding. Small wonder that they are often found in caves. Bats are nocturnal and feed largely without using organs of vision; some of them have degenerate eyes. They are quite at home in caves. Eigenmann (1909) said, "Cave existence reduced to its simplest terms is the securing of food and the meeting of mates in absolute darkness." Some cave ants and mites are blind; so are certain epigean species that never enter caves.

Recent migrants into caves may be little modified. Some highly adapted cave animals (*Caecidotea*) are often found outside, others never leave subterranean habitats. Species that live both inside and outside caves may be specially and characteristically modified. The ears of rats and mice that live far within caves are consistently larger than those of the same species outside; the antennae of *Cambarus bartoni* (Fabricius) in Indiana caves are 11.9 per cent longer than those of representatives of the same species which live in streams above ground (Banta 1907). The eyes of rats and mice captured within caves have been observed to become sore when the animals were taken outside, though epigean members of the same species lived without trouble under the same conditions.

Evolution of cave animals.—There has been much discussion among evolutionists as to how adaptations of cave animals have arisen. Some have held that such characteristics as depigmentation and eye degeneration have been caused by the cumulative effects of environment on successive generations (Eigenmann 1909); others have maintained that mutations or other genetic changes, rather than environment, caused evolution toward characteristic cave types because similar changes often occur in the epigean world (Loeb 1913). Unquestionably animals of particular species may become adjusted to conditions above or below the surface of the earth. This is ecological segregation, and, once an isolated race is established, environment may permit (not necessarily cause) the genetic complex inherent in such animals to form a new species (Pearse 1934).

Pigmentation.—Lack of pigment is quite characteristic of troglobites and some cave species do not develop pigment if kept in light. Negative phototropism and degenerate eyes are commonly associated with depigmentation in cave animals. In groups which have closely related forms that live within and without caves there is often a graded series which shows progressive degeneration in pigmentation and eyes. This is true of fishes in the families Amblyopsidae and Brotulidae; spiders in the family Theridiidae; isopods in the family Asellidae; and so forth. Systematists often dispute over the classification of such closely related forms, chiefly because there is doubt whether pigmentless forms with more or less degenerate eyes should be separated from pigmented epigean forms. Miller (1933) maintains that it is not correct to separate the genus *Caecidotea* from *Asellus*, because species of the former show various degrees of depigmentation and eyelessness. Cave beetles belonging to the genus *Anopthalmus* show a graded series between species without trace of optic lobes or eyes and those in the epigean genus *Trechus*. Cope (1872) proposed to separate cave crayfishes from the genus *Cambarus*, but his genus *Orconectes* has never been accepted by carcinologists. Pigmentation and eyes in cave spiders are quite variable (Fage 1931) and perhaps indicate how long various forms have lived in caves. Annandale and Gravely (1913) have described a nocturnal snake which is found in Malaya. When living in caves this species is largely white, but when it lives in the forest has a characteristic pigmented pattern. In caves pigmentless animals, aquatic or terrestrial, are often encountered. When a stone is overturned one expects to find a white thysanuran, isopod, millipede, crayfish, or shrimp. But lack of pigmentation is not confined to subterranean animals;

many cave animals are pigmented and differ little or not at all from epigean forms. Furthermore, pigmentless animals often appear in springs, rivers, and lakes above ground. Species generally tend to spread, actively or passively, as far as possible beyond their usual ranges. Animals from above continually invade caves; some are only ephemeral visitors but others remain as troglophiles indefinitely. In a similar way subterranean animals are continually spreading into dark nooks and crevices above ground, and there have access to greater food resources. Probably these never become reëstablished as epigean forms. In discussing Mayfield's Cave, Indiana, Banta (1907) states, "The permanent and true cave species form but a small part of the entire cave fauna, while visitors, strays, and temporary residents form about 77 per cent of life of the cave."

Sense organs and reactions.—Perhaps the most striking characteristic of cave animals is eye degeneration which is associated with compensatory development of tactile organs. Yet many cave animals have apparently normal, functional eyes and some even have unusually large eyes. Banta (1907) brought mice and rats out of caves and observed that the eyes of these rodents became sore. The rat (*Neatoma pennsylvanica* Stone) from Mammoth Cave "seemed to go blind for a few days after being brought into the light and kept there. Its eyes, however, got better a few days later, although they hardly regained their original luster and seemed not to protrude so much as before." Some troglobite animals, such as the amphipods *Eucrongonyx mucronatus* Forbes (Williams 1932) in America and several species of the genus *Niphargus* in Europe (Spandl 1926), were probably blind before they became distributed in underground waters. As Packard (1887) long ago pointed out the eyes of some species of arthropods vary according to conditions; outside, the eyes may be functional but in caves they are degenerate. Eigenmann (1909) and his students made careful and extensive studies of the eyes of cave fishes and salamanders. Eigenmann observed that degeneration of eyes began at earlier and earlier stages in embryology until the whole course of development was profoundly affected. He believed that darkness affected the genetic character of cave animals, and that "functional adaptations are transmissible." Hyperdevelopment of tactile, gustatory, olfactory, and auditory organs and general slenderness of body correlated with eye degeneration is characteristic of cave animals, but also occurs in various epigean species (Chopard 1929, etc.). For example, species of silurid fishes that never occur in caves commonly have long barbels, which bear gustatory sense organs and receive tactile stimuli, protruding from the head. They do not depend on sight in their feeding activities (Parker 1922) and commonly feed at night. It is not strange that some silurids are found in caves. Cave animals agree in being negatively phototropic. Even some which have lost their eyes are sensitive to light. Eigenmann (1909) has shown that blind troglobite amblyopsid fishes avoid light. Buchanan (1935) studied the behavior of an eyeless cave flatworm *Spalloplana percaeca* (Packard). He found that it did not orient to light but writhed violently when illuminated, and soon died in strong light. In general the reactions of this troglobite resembled those of surface-dwelling turbellarians. The sense organs and behavior of cave animals do not differ in character from those of related epigean types, but in general dependence on optic sensation grows less and that on tactile, gustatory, olfactory, and auditory organs increases with adaptation to cave life. An interesting case of adaptive autotomy and stridulation in a chilopod (*Scutigera*) in a Malayan cave is reported by Annandale and Gravely (1913). This centipede readily casts off its legs and such detached appendages make a squeaking noise for some time by means of specially adapted structures, but those attached to the body could never be induced to stridulate. Apparently the cast leg is adapted to attract the attention of a predacious enemy while its former owner escapes.

Ecological factors in caves.—Each cave has an individuality of its own which is the result of many factors. Its character depends on its mode of origin, location, age, size, and many other things. In his studies of Hungarian caves Gebhardt (1932) presents the following synopsis of ecological factors in caves:

1. Physiographic factors: latitude, altitude, water, size of animals in water and air.
2. Edaphic factors: stones, drips, bacteria, temperature.
3. Climatic factors: prevailing temperatures, humidities.
4. Hydrologic factors: ground water, flowing water, standing water.
5. Photic factors: especially limit plants.
6. Biotic factors: animals, including man; fungi.

Banta (1907) well says, "Cave animals are most abundant under the following three conditions: (1) a considerable degree of moisture; (2) the presence of decaying organic matter; and (3) the occurrence of loose stones and other debris which serve as places of refuge."

Temperature.—Cave animals are generally stenothermic. Even bats which move freely in and out of caves do not fly out when temperatures are unfavorable. Some alpine caves always maintain low temperatures and may contain ice the year round; most caves in the tropics never approach freezing temperatures. Caves offer animals thermal stability. Temperatures may vary more or less near the mouths of caves, especially if there are strong air currents, but in the deeper parts of caves diurnal and seasonal changes are negligible. High humidity helps to maintain temperatures constant, for aqueous vapor serves as an insulating blanket which prevents rapid changes. As has been mentioned, Thienemann (1908) believes that high temperatures above ground, rather than light, have in the past been potent in causing certain animals to take up subterranean life. It is of course true that temperatures below the surface of the earth are progressively more constant at deeper levels. In soils in temperate regions daily changes are slight below 2 m. and annual changes seldom reach 25 m.

Humidity.—Humidity in caves is usually high, but varies greatly. Cave animals are generally stenohydric, and require high humidities though some (bats) appear to be rather indifferent to moisture and are stenothermic. Spiders, according to Fage (1931), are good examples of animals which are in caves primarily because they require rather high, unvarying humidities. Centipedes, millipedes, terrestrial isopods, most insects, and other small arthropods probably are limited similarly.

Reproduction.—Troglobites breed in the complete darkness far within caves. This is true even of mammals such as rodents (*Peromyscus, Neotoma*), racoons

(*Brassiscus*), and bats (Bailey 1928). Of course small troglobites which have little power of locomotion or limited range necessarily propagate in darkness, high humidity, and unvarying temperature. Those which depend directly upon the outside world for food (bats) may show definite seasonal periodicity in their reproductive activities, but such animals as spiders commonly breed at all seasons unless the caves in which they live are subject to striking variations in humidity. Birds which nest at certain seasons within the mouths of caves contribute guano. Animals which breed in caves show no distinguishing secondary sex characters which may serve for sex recognition through visual stimulation.

FOODS OF CAVE ANIMALS.—All food of cave animals must come originally from outside. Large rodents, such as porcupines, rats, and mice, go outside frequently for green food. Bats also fly out and some species carry in fruits. Foxes go out to feed on berries, nuts, and animals. Bat guano is an important food resource for cave animals. Guano deposits from gregarious species are often enormous and have been exploited commercially in New Mexico, Cuba, southern Europe, and other localities. Bailey (1928) states that hundreds of thousands of tons have been removed from Carlsbad Cavern. Racoons and foxes in caves feed on bats, mice, birds, insects, fruits, and centipedes (Bailey 1928). Bats feed largely on insects and fruits. Cave crickets subsist on the remains of insects in bat feces, dead animals, and molds. Flies, beetles, millipedes, and snails commonly feed on feces and other organic remains. Doubtless fungi which grow on such materials are important materials in the dietaries of scavengers. In some instances winds and flowing water transport food into caves.

CAVES OF YUCATAN

CHARACTER OF CAVES IN YUCATAN.—Most of the caves visited in Yucatan (Table 1) were of the two-cycle solution type. This was indicated by their irregular, reticulate form, presence of high-vaulted chambers, absence of evidences of streams or large pools, and irregular floors. Some caves (Chac Mol, Oxolodt, etc.) were evidently produced by faults, while the great sheet of limestone which constitutes the Peninsula of Yucatan was being elevated. The caves varied in extent from well-lighted spaces under overhanging sides of sink holes (Chacaljas) to great grottoes which had a horizontal extent of as much as 2 km. (Loltun). In the north (near and between Merida, Tizamin, and Kaua) all the natural caves visited (Xtoloc Cenote Cave is artificial) are connected with ground water at depths of 6 to 20 m. None of the pools is large. Those in Hoctun (Fig. 4), San Isidro (Fig. 7), and San Bulha (Fig. 8) Caves are most extensive; those in the two caves studied at Tizamin are minute pools in narrow crevices. The caves visited south of Merida and Kaua seldom had accessible direct connections with ground water, though they often contained small drip pools.

CONDITIONS IN CAVES.—General conditions within the caves visited, as indicated by temperature and humidity, are shown in Table 2. Temperatures, determined by maximum and minimum thermometers in water and air, ranged between 22° and 27.2° C, 21.9° and 27.9° C respectively; humidities, 90.2 per cent

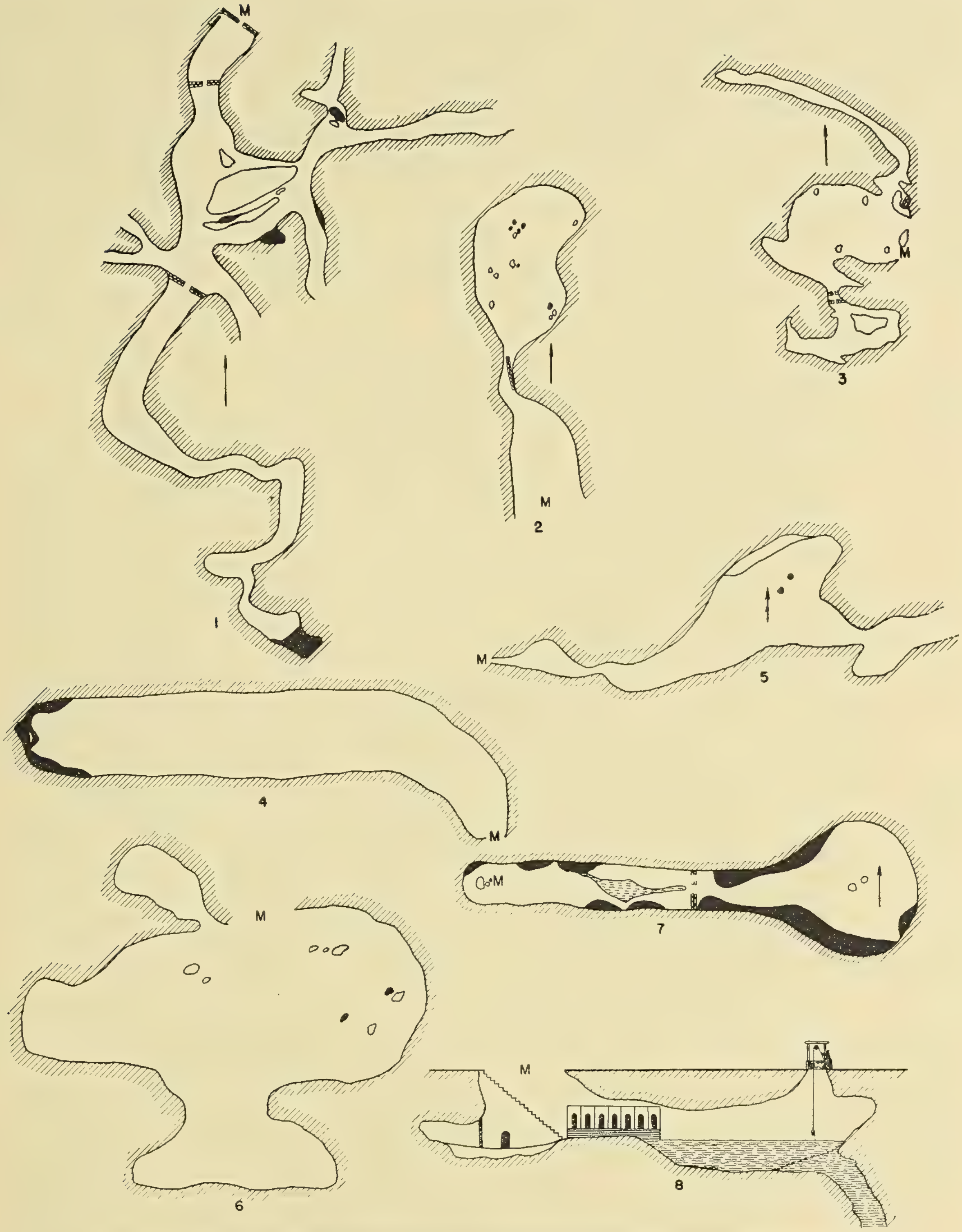
TABLE 1

Characters of Caves Visited in Yucatan, 1936, Arranged from North to South

Locality and Name of Cave	Length (meters)	Depth (meters)	Height of Roof (meters)	Type	Entrance	Remains
Tizamin Muruztun	105	12	1–3	BCRSY	N	M
Tizamin Xconsacab	20	10	1–3	CKRSY	E	....
Motul San Bulha (Cenote)	80	8	6	KLQSZ	W	M
Merida Luchil (Tixcacal)	24	7	4	KQS	EN	....
Merida San Bulha	17	6	4	CKSVZ	W	....
Merida San Isidro	70	6	6	KLQSZY–Z	EN	DMP
Hoctun Hoctun	165	10	2–4	KLQY	QW	M
Libre Union Yunchen (Cenote)	16	13	12	CKSTVZ	EN	....
Chichen Itza Balaam Canche	260+	20	1–10	KQRSTUVY	CN	DGMP
Chichen Itza Chac Mol (Tohil)	35	20	2–8	CFKY	CEN	P
Chichen Itza Xtoloc Cenote	90	0(H)	2–4	ALY	HN	P
Kaua Kaua	275+	20	1–10	CKRSUVY	CEN	OP
Kaua Oxolodt	15	20	5–8	CFKVY	EN	P
Calcehtok Chacaljas	5	16	2	FZ	W	....
Calcehtok Sazich	70	15	20	CFZ	W	....
Calcehtok Spukil	125	13	7–10	BCKTSVY	W	DMP
Calcehtok Xkyc	35	45	1–10	CFRST	EN	MP
Oxkutzcab Ebizt	97	32	1–10	BCKSTUVY	W	DGMPX
Oxkutzcab Gongora	95+	23	1–9	BCSTUVY	N	DGP
Oxkutzcab Loltun	2000	33	8–15	KRSTUVY	W(3)	DMX
Oxkutzcab Puz	80+	16	1–5	BCKSTUVY	W	DMPX
Oxkutzcab San Roque Road 1	45+	25+	1–4	BCFKSY	W	M
Oxkutzcab San Roque Road 2	35	16+	2–6	QSTVZ	W	DMX
Oxkutzcab Ziz	90+	33	1–11	BCFKSTUVY	W	DM
Tekax Chakxix	40+	10	1–4	QSTY	W	DM
Tekax Cinquo de Mayas	70	5	1–6	QSTVY	W	DMP
Tekax Sabacha	185	30	10–20	CKRSTVY	DW	DMP
Tekax Xmahit	320	16	12	KQSTVY	EN	M

Key to Letters Used in Table 1

A—Artificial cave.
B—Branched cave.
C—Floor with broken contour.
D—Drip pots, stones hollowed out to catch water.
E—Well-like entrance.
F—Fault cave.
G—Bones of wild animals.
H—Mouth is at side of cenote, 5 m. above water and 15 m. below surface of land.
K—Water in pools.
L—Linear cave.
M—Masonry walls.
N—Narrow entrance.
O—Mural decorations.
P—Pottery.
Q—Level or gradually sloping floor.
R—Reticulate cave.
S—Two-cycle solution cave.
T—Stalagtites and stalagmites.
U—Calcareous crystals on walls.
V—Vaulted chambers with high ceilings.
W—Wide entrance.
X—Bones of domesticated animals.
Y—Dark in interior.
Z—Light throughout.



FIGS. 1-8—SKETCH MAPS OF EIGHT REPRESENTATIVE CAVES IN YUCATAN
(M indicates mouth of cave; dark areas, water.)

1: Balaam Canche Cave.
2: Ebizt Cave, Oxkutzcab.
3: Puz Cave, Oxkutzcab.
4: Hoctun Cave, Hoctun.
5: Gongora Cave, Oxkutzcab.
6: Second cave on San Roque Road, Oxkutzcab.
7: San Isidro Cave, Merida.
8: Section of San Bulha Cave (or Cenote), Motul.

to 100 per cent. Temperatures were lower and humidities were usually higher in the deeper parts of caves than near their mouths.

Fauna of caves.—Only about one animal in ten of those collected in caves (Table 3) is to be looked upon as troglobite; a fifth of the animals were troglophile; and about seven-tenths were trogloxene. About a twentieth of the animals were inhabitants of ground waters. Rough estimates of food habits indicate about the following percentages: phytophagous, 12; predaceous, 25; parasites, 25; scavengers, 25; and coprophagous, 12. Such vegetarians and carnivores as bats and mice got most of their food outside caves.

TABLE 2

Temperatures and Humidities in Caves of Yucatan, 1936

Name of Cave and Location	Date	Temperature° C		Humidity (per cent)
		Water	Air	
Balaam Canche; Outer Pool	June 10	23.5	23.7	99.5
Balaam Canche; Outer Pool	11	23.5	23.7	100.0
Balaam Canche; Inner Pool	12	25.4	27.4	100.0
Kaua, Kaua; near mouth	16	....	26.6	94.3
Kaua, Kaua; Inner Pool	17	24.5	25.7	96.0
Oxolodt, Kaua; Inner Pool	18	25.2	26.1	98.6
Xtoloc Cenote, Chichen Itza	24	....	25.1	96.5
Chac Mol, Tohil; Inner Pool	27	24.7	24.0	99.0
San Isidro, Merida; Inner Pool	July 3	27.0	27.0	99.6
Luchil, Tixcacal; near mouth	6	27.0	27.3	99.2
Hoctun, Hoctun; Inner Pool	7	27.2	27.9	99.6
San Bulha Cenote, Motul	9	26.7	26.7	95.5
Yunchen, Libre Union; below mouth	11	25.3	26.2	....
San Bulha, Merida	13	27.2	26.6	95.2
Gongora, Oxkutzcab; Inner Pool	16	27.2	27.3	99.6
Ebizt, Oxkutzcab; Inner Pool	18	23.9	24.0	95.0
Puz, Oxkutzcab; Upper Cave	20	24.4	25.0	94.2
Puz, Oxkutzcab; Cave	21	....	25.9	99.6
No. 1, San Roque Rd., Oxkutzcab; Inner Chamber	22	24.5	25.0	95.5
No. 2, San Roque Rd., Oxkutzcab; Inner Chamber	23	....	24.5	97.5
No. 2, San Roque Rd., Oxkutzcab; at mouth	23	23.7	24.1	98.5
No. 2, San Roque Rd., Oxkutzcab; outside	23	....	30.3	74.6
Ziz, Oxkutzcab; Inner Pool	25	25.7	26.2	100.0
Loltun, Oxkutzcab; 1.5 km. inside	26	22.0	21.9	98.5
Loltun, Oxkutzcab; 0.5 km. inside	26	22.3	22.0	97.5
Loltun, Oxkutzcab; near mouth	27	22.7	22.1	98.5
Cinquo de Mayas, Tekax; inner part	29	23.5	24.0	98.0
Sabacha, Tekax; Inner Pool	30	22.2	22.8	98.0
Xmahit, Tekax; Inner Pool	31	24.5	26.2	99.0
Chakxix, Tekax; Inner Pool	Aug. 1	23.9	24.2	94.6
Spukil, Calcehtok; Inner Pool	5	25.2	26.1	97.8
Spukil, Calcehtok; Middle, high	5	23.9	25.3	98.5
Sazich, Calcehtok; Middle Pools	6	22.8	23.3	97.5
Sazich, Calcehtok; Inner Pool	6	....	23.5	99.5
Chacaljas, Calcehtok; Bottom	6	....	25.5	95.1
Xkyc, Calcehtok; Inner Chamber	7	....	26.5	99.5
Xconsacab, Tizamin; near mouth	11	24.5	24.4	90.2
Xconsacab, Tizamin; Inner Pool	11	....	23.3	93.0
Muruztun, Tizamin; Inner Pool	12	24.8	25.3	97.8

Yucatan troglobites.—The animals which in Yucatan show the most striking adaptations to life in caves are the arthropods and vertebrates: shrimps, isopods, millipedes, chelonethids, spiders, collembolans, crickets, ants, and fishes. Cave beetles, which are often found in North American and European caves, were not encountered. The troglobites in Yucatan caves show degenerate eyes and lack pigment. To compensate for such changes their legs and antennae tend to be elongated. The antennae of the common large cave cricket are seven times as long as its body.

Origin of yucatan troglobites.—As Creaser points out in his paper on crustaceans, animals have invaded the caves of Yucatan from the ocean, from ground waters, and from the surface of the land above. Some types (*Cirolana, Palaemon, Antromysis, Typhlias*) have relatives in the sea, others (*Typhlatya, Caecidotea*) have affinities with types which have long been established in fresh water, and others (*Porcellio*) belong to groups which live on land.

TABLE 3

Summary of Animals in Caves of Yucatan

Animals	Troglo-			Ground Water	Vege-tarian	Preda-ceous	Para-sites, etc.	Scav-enger	Copro-pha-gous	New Gen.	New Sp.	Total
	bite	phile	xene									
Land planarians	....	....	2	....	....	2	....	....	....	1	1	2
Parasitic flatworms	....	....	6	....	....	....	6	....	....	4	5	6
Nematodes	....	....	14	1	....	....	13	1	....	....	10	14
Leeches	....	....	2	2	....	....	2	....	....	....	1	2
Earthworms	....	....	2	....	....	....	....	....	....	....	....	2
Ostracods	....	....	1	1	....	1	....	....	....	....	1	1
Copepods	1	....	5	1	6	....	....	....	....	....	....	6
Malacostracans	5	2	....	5	....	3	....	4	....	....	1	7
Collembolans	2	4	....	....	....	....	....	7	....	2	5	7
Ant lions	....	....	1	....	....	1	....	....	....	....	1	1
Cave-crickets	1	1	....	....	....	....	....	2	....	1	2	2
Various insects	....	25?	80?	....	....	19	27	31	13	?	?	105
Ants	5	12	....	....	3	5	....	9	....	....	....	17
Millipedes	8	7	3	....	....	....	....	17	....	2	17	20
Scorpions	....	....	1	....	....	1	....	....	....	....	1	1
Pepidalpids	....	1	1	....	....	2	....	....	....	....	1	2
Ricinulids	....	....	2	....	....	2	....	....	....	....	2	2
Chelonethids	2	1	....	....	....	3	....	....	....	1	3	3
Mites and ticks	....	....	27	....	....	8	19	....	....	2	10	27
Spiders	2	2	11	....	....	15	....	....	....	4	15	25
Snails	....	....	22	....	22?	....	....	....	....	....	....	22
Fishes	2	1	1	3	1	1	....	....	....	2	2	4
Reptiles	....	1	3	....	....	4	....	....	....	....	....	4
Birds	....	....	2	....	....	2	....	....	....	....	....	2
Mammals	....	11	6	....	7	10	....	....	....	....	....	17
Fungi	....	....	5	....	....	....	....	5	....	....	....	5
Total	28	68	197	13	39	79	67	76	13	19	78	306

Effects of isolation.—Certain aquatic types (such as shrimps, isopods, and bagres) are widely distributed in ground waters and caves in Yucatan, and Hall (1935) has shown that the ground waters are uniform throughout the peninsula; but some terrestrial animals show the effects of long isolation in separate cave units. R. V. Chamberlin describes eight species of his new genus, *Yucodesmus,* from different geographical regions. "All are pale in color, either wholly lacking pigment, or showing but little." Nine of the twenty species of millipedes collected are without eyes.

Relations of yucatan caves to maya civilization.—As has been suggested, caves in Yucatan have been useful to Maya for centuries as dependable sources of water. Stone and pottery receptacles have long been used beneath dripstones to catch water and supplement that in natural pools. Masonry walls and even rooms indicate that caves have been used as places of refuge during times of trouble. In modern times some caves have been fitted up as bathing resorts (Fig. 8) and were doubtless so used in a simpler way in ancient times. Perhaps caves have also been used as places of worship. Some of the galleries in Kaua Cave are decorated with painted figures which the villagers say are ancient. At the innermost end of Balaam Canche Cave beside a quiet pool and against a white crystal-covered wall there is a stone pot on which is carved a figurine with upraised arms. The cave which leads from the side of Xtoloc Cenote toward the high priest's temple at Chichen Itza is said formerly to have led to the tunnel and cave below the temple; a mass of fallen material now blocks it completely 20 m. from the mouth. Probably careful search in any cave in Yucatan will show some potsherds, but the floors of caves that have been long used (Ebizt, Kaua, etc.) are covered with such remains, ancient and modern.

Diseases in caves.—At present the most prevalent diseases among the natives of Yucatan are amoebic and bacillary dysenteries (Shattuck 1933). Conditions in caves are favorable for the maintenance and spread of such intestinal disorders. High temperature and humidity, with rodents, scavenger insects and the peculiar food habits of the Maya are conducive to enteric disorders. No anopheline mosquitoes were collected in or near caves during the summer of 1936, but aedene mosquitoes were common. If conditions were the same when old Maya empires rose and fell in Yucatan, caves may have been centers for the spread of yellow fever, but not of malaria. Boyce (1911) believed that yellow fever perhaps existed among the native races of Central America when the Spaniards arrived but more recent studies by Carter (1931) and Sawyer (1935) indicate that Africa "was probably the original home of yellow fever." A plague flea (*Xenopsylla cheopis* Rothschild) was found on a mouse in a cave in Yucatan, but probably plague bacilli were not present in America during early Maya history. Bird ticks were found to be present in the caves in Yucatan. These spread relapsing fevers and typhus. Mites also transmit typhus fevers and are well represented in Yucatan caves. Conditions in caves are of course favorable for the spread of such parasites as hookworms, ascarids, and whipworms.

SUMMARY

1. The caves in Yucatan have played an important role in the development of Maya civilization. They have served as sources of water, shelters, and hunting grounds.

2. This paper discusses types of caves, conditions of life in caves, recent progress in speleology, and cave animals.

3. Twenty-seven caves visited in Yucatan were of two types, (a) fault and (b) two-cycle solution. During the summer of 1936 water temperatures in them ranged between 22° and 27.2° C and those in air between 21.9° and 27.9° C. Humidities varied between 90.2 and 100 per cent.

4. More than 300 species of animals were collected in Yucatan caves. Of these, 78 are described as new in papers in this report, as well as 19 new genera. About a tenth of the animals encountered were troglobites, a fifth were troglophiles, and seven-tenths were trogloxenes.

5. Important troglobites in Yucatan are chiefly arthropods and vertebrates—shrimps, isopods, millipedes, chelonethids, spiders, collembolans, crickets, ants, a brotulid fish, and a symbranchid eel.

6. Some Yucatan troglobites (*Cirolana, Palaemon, Antromysis, Typhlias*) have relatives in the sea, others (*Typhlatya, Caecidotea*) have affinities with types which have long been established in fresh water, and others (*Porcellio*) belong to groups which live on land.

7. Some troglobites, such as certain millipedes, show the effects of isolation and are more or less peculiar to particular caves or regions; others are wide-ranging in Yucatan, especially those crustaceans which live in ground water.

8. Some animals found in caves (ticks, mites, fleas) may have been contributing causes of human diseases. Conditions in caves are suitable for the spread of such parasites as hookworm, ascarids, and whipworms.

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I

FUNGAL FLORA OF YUCATAN CAVES

Frederick A. Wolf
Duke University

Collections in caves, of soil samples, of bat excrement, and of frass from leaf-cutting ants, were given me to determine what species of fungi could be isolated therefrom. The results of these studies are rather meagre and inconsequential. The same criticism, moreover, may be directed at reports of all previous investigations, as disclosed in available literature dealing with the fungous flora of caves, a field of investigation that, for some reason, has been almost completely neglected. The following brief summary is prepared at this time in the hope of stimulating interest, on the part of those favorably situated, in investigations of fungi occurring in caves.

Apparently little attention has been given to plants in caves whereas the cave fauna has been intensively studied by many various investigators. The difference between animals and plants in dependence upon light is the most obvious reason for this discrepancy. Caves constitute a source of a wide variety of animals for studies in the modificatory adaptations induced by continuous darkness. Since light is absolutely essential for the sustained growth of all green plants one would anticipate that the interior of caves, except near the entrances, would be devoid of all chlorophyll-bearing plants. *Schistostegia osmundacea* (Dicks.) Mohr. is the classic example of a moss structurally adapted to grow in subdued light rather distant from cave entrances. Findings support the anticipated absence of green plants within the interior of caves, however, except in cases where artificial illumination has been provided. Miss Harring (1930) has reported, for example, that she found growing, in the Howe Caverns, near electric lights, the following species of bryophytes: *Marchantia polymorpha* L., *Amphidium mougeotii* (Bryol. Eur.) Schimp., *Amblystegium juratzkanum* Schimp., *Bractythecium rutabulum* Bryol. Eur., *Bryum caespiticum* Hedw., *B. capillare* Hedw., *Funaria hygrometrica* Hedw., and *Leptobryum pyriforme* (Hedw.) Wils.

Many fungi can complete their entire cycle of development in the absence of light. Such species therefore might be expected to thrive well in caves. In the case of others, however, light exerts a morphogenic or a phototactic effect or may be required for reproduction, matters which are capably dealt with in the volumes by Buller (1909, 1934). Our knowledge of the occurrence of fungi in caves appears to have come largely as the result of incidental observations and collections by geologists and zoologists. In the Luray Caverns, Hovey (1879) collected one of the black molds that he described as *Mucor stalactites*. This species is not included in Saccardo's "Sylloge Fungorum" and may, therefore, be presumed not to be recognized as a valid species.

Packard (1887) collected, in Mammoth Cave, *Ozonium auricomum* Link (presumably the mycelial stage of *Coprinus* sp.), a "reddish button-shaped fungus, a green mold, a long white mold, and a fungus growing from the hind body of a cave cricket." He also observed a Peziza and a colorless agaric in Weyer's Cave.

Kryle (1923) mentions, in his monograph on speleology, the presence in caverns of species of *Mucor, Rhizomorpha, Leptomitus,* and *Myriotrichella.*

Hyalina fasciculare (presumably an Orbilia) and *Coprinus atramentarius* (Bull.) Fr. are the only species of fungi mentioned by Gebhardt (1932) in his studies of the caverns in Hungary.

In his studies of cave life in Kentucky, Bailey (1933) noted the presence of *Marasmius nigripes* Schw., *Coprinus atramentarius,* a species of *Stereum,* and one of the black molds.

Nine of the collections made by Dr. Pearse were negative. Cultural studies from five others yielded the following organisms:

Class ASCOMYCETES

Order Aspergillales

Family ASPERGILLACEAE

Aspergillus clavatus Desm.

(Figs. 1, 2)

Balaam Canche Cave, Chichen Itza, June 11, 262 m. from mouth of cave; cultured from bat feces.

Penicillium sp.

Xtoloc Cenote Cave, Chichen Itza, June 24, 8 m. from mouth of cave; cultured from bat feces. Xconsacab Cave, Tizamin, August 11, 8 m. from mouth of cave; cultured from bat feces.

Class PHYCOMYCES

Order Pythiales

Family PYTHIACEAE

Pythium sp.

Cinquo de Mayas Cave, Tekax, July 29; 9 m. from mouth to cave; cultured from scrapings from damp rocks.

Class SCHIZOMYCETES

Order Actinomycetales

Family ACTINOMYCETACEAE

Actinomyces griseus Waks.

San Isidro Cave, Merida, July 4; 47 m. from mouth of cave; cultured from soil. Xconsacab Cave, Tizamin, August 11; 8 m. from mouth of cave; cultured from bat feces. Xtoloc Cenote Cave, Chichen Itza, June 24; 8 m. from mouth of cave; cultured from bat feces. This species was identified for the writer by Dr. S. A. Waksman.

Order EUBACTERIALES

Family BACILLACEAE

Bacillus subtilis (Ehr.) Cohn. and *B. mycoides* Flugge

San Isidro Cave, Merida, July 4; 47 m. from mouth of cave; cultured from soil. Xconsacab Cave, Tizamin, August 11; 7 m. from mouth of cave; cultured from bat feces. Xtoloc Cenote Cave, Chichen Itza, June 24; 8 m. from mouth of cave; cultured from bat feces.

Many members of the genus *Aspergillus* are cosmopolitan. *A. clavatus* appears from records of collections to be a tropical species. It is known to be phototactic, and its reactions to light should be investigated. Attention may be called to the fact that this organism was collected in a situation where it was continuously dark, and that it can be made to fruit in the entire absence of light (Fig. 2). *Actinomyces griseus* has been isolated from a variety of soils, as is the case also with the two bacterial species. These three organisms are known to be capable of rapidly decomposing proteinaceous materials. Species of *Penicillium* utilize a wide variety of food substances and are world-wide in distribution. Members of the genus *Pythium* inhabit soils, especially those that remain saturated.

There is a rather voluminous literature dealing with fungi in mines, tunnels, cellars, and other hypogaen cavities made by man. Manifestly the organisms encountered in such situations need not necessarily indicate the kinds that one would expect to find in natural caves and caverns. Cave fungi should for convenience be divided into groups, normal or natural inhabitants and abnormal or unnatural inhabitants. In the former category are included those species which have become established in caves because such environmental factors therein, as humidity, temperature, and food substances are favorable for their growth and reproduction. Such species subsist upon the bodies or the dejecta of species of animals that have become adapted to spending their entire life or a portion of it in caves. It is these species of fungi about which more knowledge is especially desirable. The abnormal or unnatural inhabitants of caves include those species that are introduced into caves, and occur there only temporarily. Such species are typified by wood-rotting fungi or by organisms on discarded food or other rejectamenta introduced by explorers or casual visitors in caves.

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Fig. 1 — *Aspergillus clavatus* in Petri dish culture on horse dung agar. The culture was illuminated unilaterally and the conidiophores are of two lengths, short and long. The short conidiophores scarcely project above the mycelial mat. The long conidiophores are an inch or more in length and are directed toward the source of light. This response occurs in daylight or when cultures are maintained in blue light.

Fig. 2 — *Aspergillus clavatus* on the same substratum but continuously kept in total darkness. Darkness was provided by wrapping the Petri dishes as panchromatic photographic films are protected from light. The whitish portion of the mycelial mat is due to the profusion of short conidiophores, entirely like those in Fig. 1. When cultures are grown in red light they appear as in Fig. 2. This organism is therefore adapted to reproduction within caves, but its reproductive structures are profoundly modified by lack of light.

II

LAND PLANARIANS FROM YUCATAN

Libbie H. Hyman

American Museum of Natural History

The triclad material consisted of two vials of land triclads, Nos. 155 and 166. The specimens in each vial proved to be of the same species. One of them (No. 155) was found on further study to belong to a known species while the other (No. 166) is not only new but of unusual interest.

Family GEOPLANIDAE

Geoplana multipunctata Fuhrmann 1914

1. Description.—The material of this species (No. 155) appears to correspond in all respects to Fuhrmann's description. My specimens, judging from the state of the reproductive system, were not fully grown. The largest were about 18 mm. in length, while Fuhrmann gives the length of his material as ranging from 12 to 55 mm. The color is black above (described as "slaty black" in life in a personal communication from Dr. Pearse), grayish-brown below on the creeping sole with a narrow black line bordering the sole. The body is flat below, very convex above, and tapers towards each end, more so toward the pointed anterior end. Along each side of the body are seen the numerous light spots from which the specific name is derived. Each such spot encloses an eye but not all the eyes are so encircled. The very numerous eyes begin at each side of the anterior tip as a single row of somewhat circular black spots. After about 1 mm. the row becomes irregular and the band of eyes increases in width towards the middle of the body, then decreasing again to the posterior end (Fig. 1). The eyes of the middle regions are smaller than those nearer the anterior tip and of more irregular form, often consisting of a dot and a black crescent (Fig. 1, B). The more anterior eyes are not set in definite white spots as are those farther back. Figure 1 is a drawing of the animal from the side showing distribution of the eyes (the white areas around the eyes not shown). Fuhrmann's photograph (1914) of this species is somewhat dark and the eyes are clearly seen only in the central part of the body, but the photograph gives an excellent reproduction of the natural appearance, with numerous lateral white spots each enclosing an eye. I estimate that there is a total of 500 eyes on each side of my 18-mm. specimens. Fuhrmann gives 1300 as the number of eyes in his specimens. Probably the number of eyes increases with age and the very small eyes seen here and there are presumably new eyes in process of development.

The anterior tip is white and probably the seat of a sensory epithelium although nothing definite was found in this location on the sections. The mouth in an 18-mm. specimen is situated about 11 mm. from the anterior tip, the genital pore at 14 mm.

The general histological structure appears typical of the Geoplanidae. The whole flat ventral surface constitutes a creeping sole having a columnar ciliated epithelium through which discharge the usual numerous gland cells. The surface epithelium elsewhere is not ciliated and is more vacuolated and taller than the sole epithelium. At the boundary between the sole and the dorsal epithelium (i.e., at the angle where dorsal and ventral surfaces meet), is found a ciliated groove in the most anterior part of the body. This pair of ciliated grooves is common in *Geoplana* and as it is thoroughly illustrated in von Graff's classical monograph (1899) there seems no necessity of figuring it here.

None of the specimens appeared to be in full sexual maturity although all parts of the reproductive system were present in one specimen sectioned serially in the frontal plane and the vasa deferentia contained sperm. Another specimen of the same size sectioned sagittally showed only a few very immature testes. A third specimen mounted whole had evidently a copulatory apparatus present.

The reproductive system corresponds to Fuhrmann's description, as judged from the frontal series. The testes, which are inactive in this specimen, are very near the dorsal surface between the intestinal diverticula and relatively few in number although occurring along the whole body length. The genital atrium is a large oval cavity into whose anterior part projects the relatively small conical penis. Fuhrmann gives a sagittal view of the genital atrium and my Figure 2 is a frontal section. The penis has conspicuous circular and longitudinal fibers, the latter spreading fan-wise into the parenchyma. The penis is perforated by the somewhat sinuous ejaculatory duct which, some distance anterior to the penis, receives the two vasa deferentia. The short female duct enters the rear end of the atrium. The oviducts could not be followed, nor were the glands seen by Fuhrmann around the oviducts and in the dorsal atrial wall in evidence in my specimens, no doubt because of their immaturity.

2. LOCALITY.—The Yucatan specimens were collected under stones at the mouth of Loltun Cave, near Oxkutzcab, Yucatan, July 26. The type locality lies in the Andes near Bogota, Colombia, at an altitude of 2660 m. The Yucatan locality is only slightly hilly, according to Dr. Pearse's statement in a letter. The finding of the species in two habitats differing so considerably in location and altitude indicates that *Geoplana multipunctata* probably has a wide distribution in northern South America, Central America, and Mexico.

FIGS. 1-6—LAND PLANARIANS

1: *Geoplana multipunctata,* preserved specimen seen from the side to show distribution of eyes. A, one of the anterior eyes enlarged. B, an eye from middle of body with encircling white area. 1, eyes; 2, mouth; 3, genital pore.

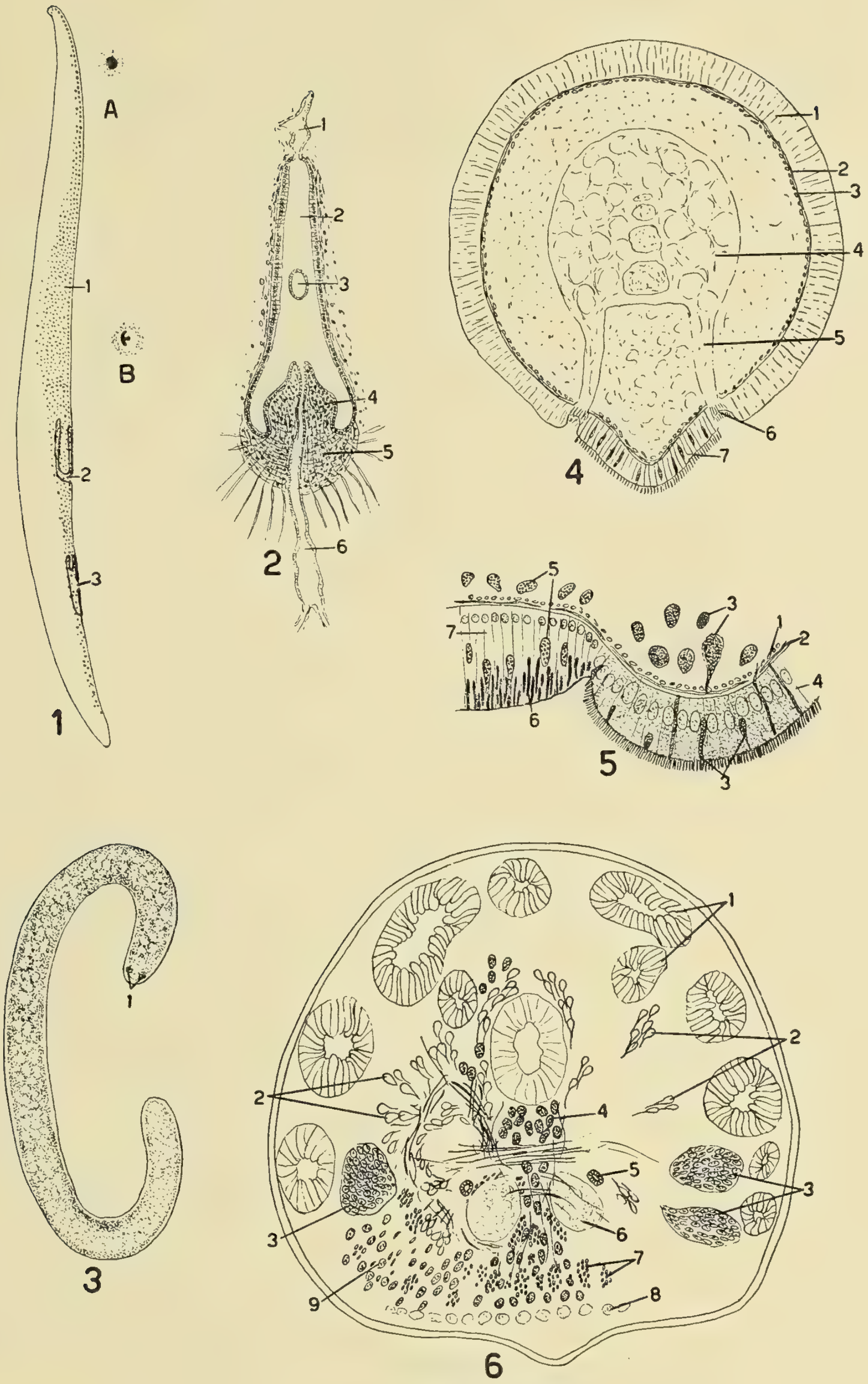
2: Frontal view of copulatory complex of *G. multipunctata.* 1, female duct entering atrium; 2, genital atrium; 3, genital pore; 4, penis papilla; 5, penis bulb; 6, common vas deferens.

3: *Diporodemus yucatani,* preserved specimen. 1, eyes.

4: Section through head of *D. yucatani,* showing the two ciliated grooves and their connection with the brain. 1, general body epithelium; 2, circular muscle layer of body wall; 3, longitudinal muscle layer; 4, brain; 5, brain tract to ciliated grooves; 6, ciliated groove; 7, creeping sole.

5: Enlarged view of small part of body epithelium and sole epithelium of *D. yucatani.* 1, longitudinal muscle layer of body wall; 2, circular muscle layer; 3, cyanophilous glands of sole; 4, epithelium of sole; 5, eosinophilous glands of general body epithelium; 6, rhabdites; 7, general body epithelium.

6: Section through the prepharyngeal region of *D. yucatani.* 1, intestinal diverticula; 2, long-stalked shell (?) glands; 3, testes; 4, cyanophilous glands; 5, oviduct; 6, ventral nerve cord; 7, bundles of longitudinal parenchymal muscles; 8, subepithelial nerve plexus; 9, rhabdite-forming gland cells.



Figs. 1-6—LAND PLANARIANS
(For description see opposite page.)

Family RHYNCHODEMIDAE

Diporodemus yucatani n. g., n. sp.

1. Description.—The material of this very interesting species (No. 166) consisted of two specimens, one of which was greatly curled. The other was sectioned sagittally but unfortunately an accident occurred during the sectioning and some important sections were lost. The curled specimen yielded a complete series of sections, but these are a little difficult to interpret owing to the extreme coiling of the animal. By combining the two series it has been possible to work out all details of the copulatory apparatus, which turns out surprisingly enough to have two genital pores, differing in this respect from nearly all other triclads and all other land triclads except *Digonopyla harmeri* (Graff) 1899, to which, however, the species is not closely related. This feature has necessitated the erection of a new genus for the species. I propose the name *Diporodemus* and the specific appellation *yucatani.*

Diporodemus yucatani has the typical appearance of a member of the Rhynchodemidae. The specimens were about 12 mm. long and in full sexual maturity. The worms are elongated, black, nearly cylindrical, and blunt at the two ends (Fig. 3). The anterior end bears a pair of eyes near its tip. The black pigment of the dorsal surface had a somewhat net-like distribution in the specimens but this appeared to be the result of fixation. Dr. Pearse in a letter gave the color in life as slaty black.

No suggestion of an apical sense organ or sensory pit has been seen on the specimens when whole or in section. Sections through the head are practically circular. At about the level of the eyes there begins on the ventral surface a pair of ciliated grooves which extend posteriorly for about 0.3 mm. (Fig. 4). They are very similar in location and appearance to those described by Ikeda (1911) for *Pseudartiocotylus ceylonicus* and von Graff (1899) has figured a similar pair of ciliated grooves for other species of Rhynchodemidae. Each ciliated groove has a broad conspicuous connection with the brain (Fig. 4) and consequently must be an important sense organ. The histological condition of my material is not suitable for a study of the minute structure of the ciliated grooves. In so far as details could be seen, the grooves appear similar to the figures of von Graff (1899, Pl. 49, Fig. 14); that is, they consist of sensory nerve cells whose long hair-like terminations constitute the "cilia" which fill the grooves. The cilia are therefore really sensory hairs and the term ciliated groove is not very appropriate; sensory groove would be preferable.

The ciliated grooves bound the creeping sole (Fig. 4). Towards the anterior end of the grooves, the sole is flat and not much differentiated from the general surface epithelium. At about the middle of the grooves, the sole begins to take on its characteristic appearance and from there posteriorly forms a midventral ridge. I can hardly agree with the statement of Ikeda that the ciliated grooves are anterior continuations of the creeping sole since the sole is fully present some sections anterior to the posterior limits of the grooves.

The creeping sole of *Diporodemus* has the characteristic appearance figured by von Graff (1899) for other Rhynchodemidae. It forms a low midventral ridge covered by a columnar ciliated epithelium composed of finely vacuolated cytoplasm (Fig. 5). The epithelium is normal in all respects, showing nothing of the "eingesenkt" condition reported by von Graff for some Rhynchodemidae. The outlets of numerous cyanophilous glands pass through the epithelium to the surface. The cilia are short and thick and seem to be different from ordinary cilia. Towards the posterior end the sole becomes flatter and broader.

The general surface epithelium contrasts strongly with that of the sole in being taller, unciliated, provided with numerous rhabdites, and penetrated by the exits of numerous eosinophilous gland cells (Fig. 5). There appears to be no "Sinneskante" or "Drüsenkante" adjacent to the sole.

The subepidermal muscle layer is thin, consisting of a thin layer of circular strands next the basement membrane of the epithelium and an equally thin layer of longitudinal fibers internal to this (Fig. 4). Heinzel (1929) divided the Rhynchodemidae into two subfamilies on the basis of the subepithelial musculature: the Rhynchodeminae with a weak musculature and the Desmorhynchinae with a powerful surface muscle layer in which the longitudinal fibers are assembled into bundles. *Diporodemus* obviously belongs to the first subfamily.

The interior presents the usual maze of parenchyma, muscle fibers, and gland cells, depicted in a simplified manner in Figure 6. The digestive tract is displaced dorsally and its diverticula occupy the peripheral dorsal and lateral regions. The two ventral nerve cords are found just below the center of the section and near the outer surface of each one is seen an oviduct. The testes occur in a ventro-lateral situation, two to four to each section, on a level with the lowermost diverticula of the intestine. An abundance of parenchymal muscle fibers occurs throughout the central and ventral portions of the cross section. Centrally above the ventral cords, the fibers are mostly transverse and dorso-ventral. Ventrally below the cords are found numerous longitudinal fibers, mostly arranged in bundles. These are undoubtedly associated with the activities of the creeping sole. Four different sorts of gland cells are to be seen in sections. The most noticeable are the very long-stalked glands which occur in small clusters between the intestinal diverticula in the central part of the section. In Mallory's triple stain they show very conspicuous refringent orange-red granules. They apparently have some relation to the oviducts. Cyanophilous glands staining deep blue in Mallory's stain occur abundantly in the central and ventral portions of the worm and probably are related to the creeping sole. Eosinophilous glands, with coarse granules staining pink with eosin or fuchsin, occur near the periphery and open through the surface epithelium. The fourth type of gland cell is the rhabdite-forming cell, most abundant in ventrolateral regions.

The reproductive system has resemblances to various other Rhynchodeminae in the well-developed penis with its powerful bulb and the large seminal bursa but differs from that of all other genera of land triclads except *Digonopyla* Fischer 1926 in the presence of separate male and female genital pores. A general view of the copulatory complex is given in Figure 7.

The testes occur in moderate numbers in ventro-lateral regions near the most ventral intestinal diverticula. Two to four appear in a cross section. No testes were found in the postpharygeal part of the body. The testes are in an inactive state in both of the available specimens but as the vasa deferentia are packed with sperm, the testes are presumably spent, not immature. The vasa deferentia could not be identified in the more anterior part of the worm but farther back at the level of the pharynx they form the usual expanded sinuous tubes packed with sperm, the so-called false seminal vesicles. These are situated near the oviducts above the ventral nerve cords. As they approach the penis bulb these external seminal vesicles acquire a muscular wall which becomes very thick near the penis bulb, consisting of circular fibers. These very muscular ends of the vasa deferentia enter the penis bulb separately but close together.

The penis is a well-developed, elongated structure very similar to that of many other Rhynchodemidae. About half of it is imbedded in the parenchyma as a penis bulb and the posterior half projects freely into the male atrium as a penis papilla. There is no demarcation between bulb and papilla. The elongated cavity (seminal vesicle) is lined by a tall epithelium which consists chiefly of glandular bodies filled with secretion granules, a condition similar to that figured by Heinzel (1929) for the lining epithelium of the seminal vesicle of *Rhynchodemus pyrenaicus*. In *Diporodemus* these glandular bodies are cyanophilous in the posterior part of the seminal vesicle, mostly eosinophilous in the anterior part (Fig. 8) with some admixture of cyanophilous bodies chiefly dorsally. These granule-filled bodies seem to be the epithelial cells themselves but it is more probable that they are the ducts of the unicellular glands found in the adjacent parenchyma (Fig. 8). The epithelium diminishes greatly in height towards the tip of the penis papilla. Outside the epithelium is a very strong and thick layer of circular muscles, thickest in the bulb, diminishing towards the papilla. The penis papilla is clothed by a very thin flat epithelium, under which is found first a circular and then a longitudinal muscle layer, both thin. The roof of the male atrium is lined by a similar flat epithelium but its floor has a high ciliated epithelium underlain by first circular and then longitudinal muscle fibers.

The narrowed posterior end of the male atrium leads into the common genital atrium which continues directly ventrally to the genital pore. This must be con-

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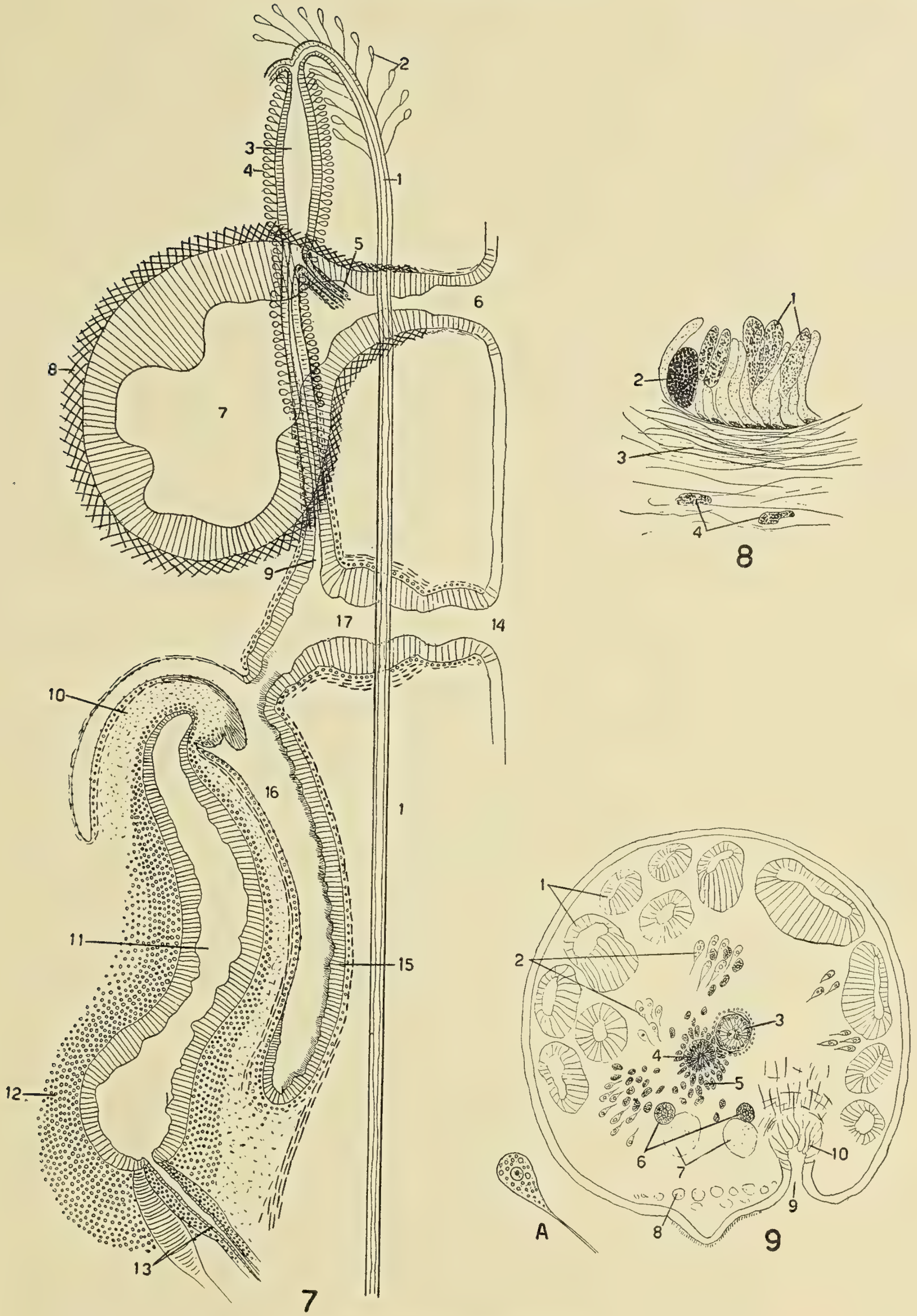
Figs. 7-9—LAND PLANARIANS

7: Diagrammatic sagittal view of the copulatory complex of *D. yucatani.* 1, oviduct; 2, long-stalked shell (?) glands (their connection with the oviducts was not actually seen); 3, glandular duct; 4, its gland cells; 5, Beauchamp's canal (connection of bursa with glandular duct); 6, vaginal pore (exit of bursa); 7, seminal bursa; 8, muscle layers of seminal bursa; 9, entrance of glandular duct into the common genital atrium; 10, penis papilla; 11, seminal vesicle (lumen of penis); 12, circular muscle layer of penis; 13, muscular terminations of the vasa deferentia; 14, common genital pore; 15, ciliated epithelium of floor of the male atrium; 16, male atrium; 17, common genital atrium.

8: Enlarged view of the wall of the penis bulb of *D. yucatani,* showing details of the epithelium with its glandular bodies. 1, eosinophilous gland body; 2, cyanophilous gland body; 3, circular muscle layer; 4, gland cells of the parenchyma.

9: Cross section through the vaginal pore of *D. yucatani.* 1, intestinal diverticula; 2, long-stalked shell (?) glands; 3, cross section of Beauchamp's canal; 4, cross section of the glandular duct; 5, gland cells of glandular duct; 6, oviducts; 7, ventral nerve cords; 8, subepithelial nerve plexus; 9, vaginal pore; 10, vagina (ventral end of bursa stalk). A, one of the shell (?) glands enlarged showing eosinophilous droplets.



Figs. 7-9—LAND PLANARIANS

(For description see opposite page.)

sidered a common genital pore since the glandular duct also opens into the common genital atrium. The common atrium is divisible by a constriction into two portions, a dorsal portion with a tall bulbous epithelium, and a strong musculature of inner circular and outer longitudinal fibers and a ventral portion whose epithelium resembles that of the body surface, being crossed by the exits of numerous eosinophilous glands, and whose musculature is reduced. The ventral portion opens below by the genital pore; the dorsal portion receives anteriorly the male atrium and posteriorly the glandular duct. These relations are similar to those of other Rhynchodemidae.

The ovaries present nothing especial. The oviducts pass backwards to the outer side of the ventral nerve cords. Throughout their course they have a ciliated cuboidal epithelium covered externally by muscle fibers, first circular, then longitudinal. The oviducts pass below the penis, then run to either side of the common genital atrium and the bursa stalk, and finally some distance behind the seminal bursa (Fig. 7), they unite to form the glandular duct. Throughout most of their course the oviducts appear to receive the very long-stalked glands seen in Figures 6 and 9. These glands are absent or scanty in body levels in which the oviducts do not occur and their stalks seem to be directed towards the oviducts. They contain, as already mentioned, bright eosinophilous droplets and are probably so-called shell glands.

The glandular duct (Drüsengang of German writers) proceeds directly forwards to the left of the seminal bursa and joins the common genital atrium. It is lined by cuboidal epithelium and completely encircled by cyanophilous glands. As it approaches the seminal bursa it diminishes in diameter and opens into the lumen of the lower part of the bursa by a duct (Beauchamp's canal), which is practically transverse in location. The glandular duct then continues forward towards the male atrium. It enlarges, loses its glands, and acquires a muscular wall of inner circular and outer longitudinal fibers. The glandular duct thus comes to be identical histologically with the dorsal section of the common atrium for some distance before it joins the latter.

The seminal bursa is a very large sac a little posterior to the male apparatus. It closely resembles histologically the copulatory bursa of fresh-water planarians. It is lined by the usual, very tall epithelium thrown into waves and has a thick muscular wall composed of diagonal layers. The bursa narrows ventrally into a stalk which opens on the ventral surface by a pore, here called vaginal pore. The vaginal pore is not in the midventral line but it and the bursa stalk or vagina are to the right (Fig. 9). The dorsal portion of the bursa stalk has the same structure as the bursa itself and it is this portion which received Beauchamp's canal (connection with the glandular duct). The part of the bursa stalk next the pore, which could be termed vagina, is but slightly muscular and has an epithelium like that of the body surface. No connection was found between the seminal bursa and the digestive tract; such connection is usually lacking in rhynchodemids with a large bursa.

The most important feature of the reproductive system of *Diporodemus* is, then, the presence of two genital pores, the *common genital pore* through which the penis protrudes and which also serves presumably for the laying of the capsules, and the *vaginal pore* or bursa opening, through which no doubt copulation takes place. In other rhynchodemids with a large bursa, this connects with the common atrium or the glandular duct or both but in *Diporodemus,* in addition to such a connection, the bursa has an exit to the exterior. The distance between the two genital pores was estimated from a count of the serial sections to be about 0.35 mm.

2. Taxonomic considerations.—The occurrence of two genital pores in *Diporodemus yucatani* has been deemed a sufficient justification for the creation of the new genus *Diporodemus* for the species. There is only one other land triclad with two genital pores, namely, *Digonopyla harmeri* (Graff) 1899. This worm had been placed in the genus *Dolichoplana,* belonging to the family Rhynchodemidae, by von Graff but the re-examination of this species by Fischer (1926) revealed the presence of the two genital pores. Fischer consequently created for the species the new genus *Digonopyla* and the new family Digonopylidae. It might be anticipated that *Diporodemus* would resemble *Digonopyla* and so find place in the family Digonopylidae. To the contrary, the two forms are widely different. In *Digonopyla harmeri* the male and female systems are entirely separate with separate pores. The more anterior male pore leads only into the male atrium containing the penis and the terminal parts of the female system have no connection with the male atrium. The more posterior female pore leads into a vertical female atrium into which the glandular duct and oviducts open by way of an intervening canal. *Digonopyla* has further numerous pharynges and mouth openings. It is evident that *Diporodemus* has no close relationship to *Digonopyla.*

Despite the presence of two genital pores I see no good grounds for separating *Diporodemus* from the family Rhynchodemidae. It differs only from other members of this family which have a large seminal bursa in that the bursa possesses its own opening to the exterior. *Diporodemus* falls in the subfamily Rhynchodeminae of Heinzel's definition and appears to be most closely related to *Pseudartiocotylus ceylonicus* Ikeda 1911. Here, too, the very large muscular seminal bursa opens directly to the exterior by a genital pore, which, however, is stated by Ikeda to be the only genital pore. However, due to an accident, Ikeda's sections are imperfect and some important ones are missing. It is not at all impossible that *Pseudartiocotylus* also has two genital pores. *Diporodemus* further resembles *Pseudartiocotylus* in the presence of the two ciliated grooves on the ventral side of the head. *Diporodemus* also has many similarities as regards copulatory complex to the species of *Artiocotylus.* In *Artiocotylus* the very large bursa has two exits: one, Beauchamp's canal, leading into the glandular duct; and the other, vaginal canal, leading into the common genital atrium. *Diporodemus* differs primarily in that the vaginal canal opens separately to the exterior and does not connect with the common genital atrium. On these grounds I retain *Diporodemus* in the family Rhynchodemidae, subfamily Rhynchodeminae Heinzel 1929.

3. Diagnosis.—*Diporodemus* n. g. Rhynchodeminae in which the large seminal bursa has no direct connection with the common genital atrium but opens ventrally by a vaginal pore, separate from and posterior to the common genital pore; bursa connected to the glandular duct by Beauchamp's canal; otherwise similar to *Artiocotylus*. Type and only known species, *D. yucatani* n. sp.

4. Locality.—The specimens were collected under stones near the mouth of Sabacha Cave, Tekax, Yucatan, July 30.

SUMMARY

The land triclad material from Yucatan consisted of two species, one a known species, *Geoplana multipunctata* Fuhrmann 1914, and the other a new form necessitating the creation of a new genus *Diporodemus,* family Rhynchodemidae, subfamily Rhynchodeminae. *Diporodemus* differs from other genera of the Rhynchodemidae in that the seminal bursa opens ventrally by its own vaginal pore, separate from and posterior to the common genital pore. The new species is named *Diporodemus yucatani,* type and only known species of *Diporodemus.*

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III

PARASITIC FLATWORMS FROM YUCATAN

Horace W. Stunkard
Biological Laboratory, New York University

MATERIAL AND METHODS

The material consisted of nine vials of specimens preserved in alcohol. According to the accompanying data, seven of the bottles, Nos. 25, 30, 42, 44, 71, 171, and 193, contained trematodes and the others, Nos. 116 and 168, contained cestodes. Vials numbered 25 and 71, respectively, contained single specimens which are referred to the same species, while those numbered 30 and 42 contained single specimens representing different species. There were six specimens, all of the same species in vial No. 44. Vials 171 and 193 each contained about 25 specimens and, although collected at different dates and from different localities, the worms were from the same host and belong to a single species. Two tapeworms were found in vial No. 116, but there were no specimens in vial No. 168. The hosts were identified by specialists in the respective groups, the bats by A. Remington Kellogg, the reptiles by H. T. Gaige, and the fishes by C. L. Hubbs.

Type specimens of new species are deposited in the collection of the Department of Lower Invertebrates, American Museum of Natural History, New York.

Because of the scarcity of material, the worms were treated with the greatest care and only standard techniques were employed. Trematodes selected for whole mounts were stained in dilute solutions of paracarmine or haematoxylin. Specimens for sections were stained deeply with haematoxylin before dehydrating, clearing and embedding. Such procedure facilitated orientation in embedding the worms, and after the sections were affixed to the slide, excess stain was removed by dilute acid in 75 per cent alcohol. The sections were then blued by treatment with alkaline alcohol, counterstained with erythrosin in 95 per cent alcohol, and mounted in damar. By this method, sections were not placed in solutions weaker than 75 per cent alcohol and there is little danger of their detachment from the slide in the higher grades of alcohol. In the study of cestodes, specimens for whole mounts were stained in haematoxylin, and sections were prepared by the method used for trematodes.

The fixation of the material was poor, and although the whole mounts are satisfactory for the study of larger structures, the tissues were so disintegrated that it is very difficult to trace tubules in sections or reconstruct the details of the reproductive organs. Perhaps the high temperature and other conditions in the field had caused decomposition to begin before the specimens were fixed.

TREMATODA

Family LECITHODENDRIIDAE

Parabascoides yucatanensis n. g., n. sp.

(Fig. 1)

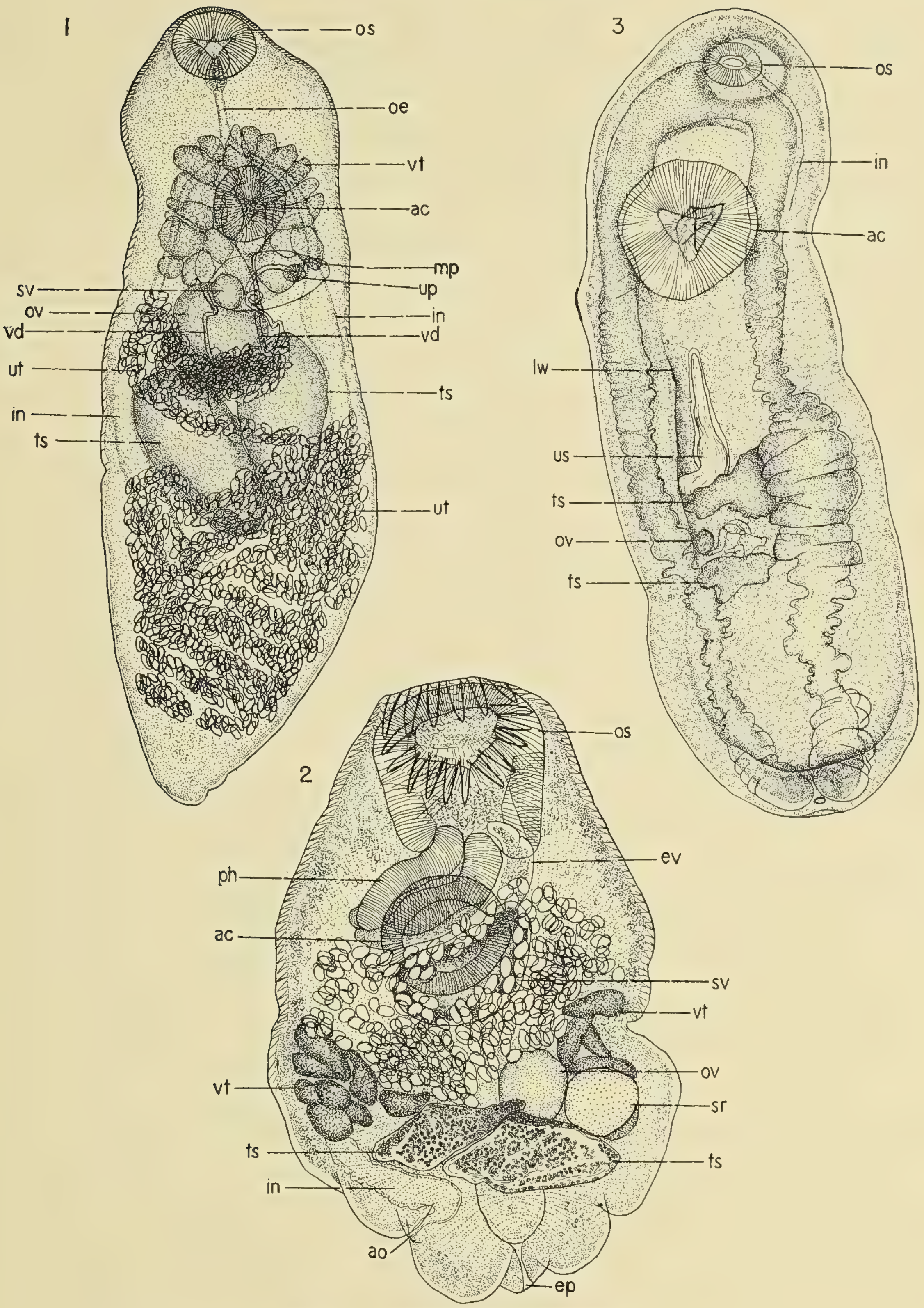
The material of this species consisted of six specimens (vial 44) collected June 23, from the bat *Natalus mexicanus* Miller, at Balaam Canche Cave, Chichen Itza. The location of the parasites in the host was not stated, although presumably they were from the intestine. Three specimens were prepared as whole mounts and two were cut in serial sections, one in the transverse and the other in the sagittal plane.

From dorsal or ventral aspect the worms have an elongate, oval outline and the region of greatest width varies to a considerable degree. One specimen is widest at the level of the acetabulum, and tapers gradually toward the posterior end. In it the vitellaria are disposed in a broad band across the body; the ovary and testes have the relative positions shown in Figure 1, but due to contraction of the anterior and extension of the posterior portions of the body, they are situated in the anterior half. In other specimens the sides are more or less parallel, while in the one selected as type and reproduced in Figure 1, the greatest width is immediately posterior to the testes. The specimen is extended in the zone between the bifurcation of the digestive tract and the testes, and the structures of this region are easily observed. The worms are flattened dorsoventrally and cross sections are oval in outline. The specimen cut in cross sections measures 0.26 mm. in width and 0.19 mm. in thickness at the level of the acetabulum. All of the worms are sexually mature and they do not vary greatly in size. The type specimen is 0.86 mm. long and 0.295 mm. wide. The others vary 0.8-1 mm. in length and 0.24-0.3 mm. in greatest width. The acetabulum is 0.07-0.085 mm. in diameter and is situated one-fourth to one-fifth of the body length from the anterior end. At the cephalic end the cuticula bears spines, but they gradually diminish in size and number posteriorly, and are absent behind the testes.

The oral sucker is approximately the same size as the acetabulum, the mouth is subterminal and the opening to the pharynx almost directly opposite. There is a very short prepharynx. The pharynx is spherical to oval, 0.027-0.037 mm. in diameter, situated dorsal and posterior to the oral sucker. The esophagus extends about three-fourths of the distance to the acetabulum; the ceca pass laterad and posteriad, and end blindly a short distance behind the testes. The bifurcation of the digestive tract and the anterior portions of the ceca are covered on the dorsal and lateral sides by lobes of the vitellaria.

The excretory structures are not distinguishable in whole mounts. The pore is terminal and a short duct, 0.05-0.09 mm. in length, communicates with a V-shaped bladder, the crura of which extend forward between the uterine loops about one-half the distance to the ends of the digestive ceca. Although the collecting tubules appear occasionally in the sectioned specimens, it has not been possible to trace their course and manner of branching.

The testes are large, adjacent, oval structures, situated on opposite sides, at or near the middle of the body. The right testis is behind the ovary and slightly



Figs. 1-3—PARASITIC FLATWORMS

(Drawn from camera lucida tracings. See Figs. 4, 5 for abbreviations.)

1: *Parabascoides yucatanensis,* type specimen, ventral view, × 147. 2: *Acanthostomum minimum,* type specimen, dorsal view, × 155. 3: *Clinostomum intermedialis* Lamont, ventral view, × 26.

posterior to the left one. In one specimen the left testis extends forward almost as far as the anterior end of the ovary. The testes measure 0.1-0.11 mm. in width and 0.13-0.17 mm. in length. Sperm ducts arise from the anteromedian faces of the testes and unite to form the vas deferens, which enters the cirrus sac. Within the sac there is a large, coiled seminal vesicle and a short duct, surrounded by glandular cells, which leads to the male genital pore. The pore is situated below the digestive cecum of the left side, at or slightly behind the caudal margin of the acetabulum. The posterior end of the cirrus sac is on the left side of the body and opposite the ovary. In the specimen cut in cross sections, the cirrus sac extends forward almost to the bifurcation of the digestive tract; the major part of the sac is dorsal to the acetabulum and the male genital pore is in the section containing the caudal margin of the sucker. Comparison of this condition with that shown in Figure 1 indicates the variation in relative position of these structures.

The ovary is spherical to oval, measuring 0.08-0.11 mm. in diameter. It is located at the right of the middle of the body, usually immediately behind the acetabulum. It may partially overlap the sucker or there may be an interval of 0.075 mm. between the two organs. The oviduct arises at the dorsomedian, posterior margin of the ovary and passes ventroposteriad where it receives a short duct from the seminal receptacle. In the worm cut in sagittal sections the receptacle measures 0.024 by 0.032 mm. and lies in front of the ootype. From the seminal receptacle, near its communication with the oviduct, Laurer's canal courses dorsally and opens to the surface above the ootype. In the specimen cut in sagittal sections there is an enlargement, filled with spermatozoa, near the middle of Laurer's canal. Just below and behind the communication with the seminal receptacle, the ootype receives the common vitelline duct, and this region is surrounded by a few secretory cells, which comprise Mehlis' gland. The vitellaria consist of large follicles, confluent dorsally, which cover the dorsal and lateral faces of the digestive ceca between the bifurcation of the alimentary tract and the ovary. Collecting ducts arise from the median, posterior portions of the vitellaria, pass posteriad, and unite behind the ovary to form the common vitelline duct which discharges into the ootype. From the ootype the descending limb of the uterus passes backward below and between the testes. It then turns dorsally and continues in long transverse loops almost to the posterior end of the body where it turns forward and the ascending limb continues a winding course below the loops of the descending limb. As it approaches the testicular zone, the uterus turns to the left and crosses below or between the testes to the right side where it makes a conspicuous loop between the testis and the ovary. It then crosses the body transversely, on the dorsal side, between the ovary and the testes and, near the anterior end of the left testis, becomes continuous with the metraterm. The latter duct is narrow and thick-walled; it passes anteriad and ventrad along the median face of the ovary and then winds about to open at the surface about 0.06 mm. median and posterior to the male genital pore. The two openings are entirely separate and distinct. The uterine pore is surrounded by a strong sphincter and radial muscles extend from it to the body wall. The pore may be elevated on a papillary projection, which in whole mounts has the appearance of a raised, thickened ring surrounded by radiating lines.

Eggs in the initial portion of the uterus are irregular in form with thin, light-colored shells. As they pass along they become more regular in shape, thicker-shelled, and darker in color. Those in the terminal portion of the uterus measure 0.017-0.019 mm. by 0.01-0.0115 mm. They are operculate and contain well-developed larvae.

DISCUSSION

Systematic allocation of these specimens has proved very difficult. They are members of the family Lecithodendriidae, but differ in certain respects from all previously described forms. The closest agreement appears to be with a worm collected at Cairo, Egypt, from the intestine of *Vesperugo kuhli,* which Looss (1907) described as *Parabascus lepidotus.* Looss described the species from the single specimen, and erected the genus *Parabascus* to contain it. The Yucatan specimens differ from *P. lepidotus* in several features. In the worm described by Looss, the esophagus is longer and the bifurcation of the alimentary tract is more posteriad. The acetabulum is farther back and twice as large as the oral sucker; it is sunk deeply below the surface and covered by folds of the body wall. The vitelline follicles are smaller and more numerous; the gonads are more posterior; and the ducts of the male and female systems open immediately behind one another in a common pit, situated in the fold of the body wall which overlies the acetabulum. Since the description of *P. lepidotus* is based on a single specimen, it is impossible to determine the amount of variation in the species and to decide positively whether the differences listed should be regarded as of generic significance. None of the present specimens manifests the above features, which are considered diagnostic for *Parabascus.* Accordingly, the present specimens are regarded as members of a distinct genus for which the name *Parabascoides* is proposed, although the study of additional material of *Parabascus* may necessitate the suppression of *Parabascoides.*

In the genus *Parabascus,* Looss included, at least provisionally, *Distomum semisquamosum* Braun 1900, *D. limatulum* Braun 1900, and a form described by van Beneden (1872) as *Distoma lima* Rudolphi. Braun (1900) had shown that the determination of van Beneden was incorrect and that the specimens described by him could not be *D. lima* Rudolphi. After study of additional material from South America, Travassos (1921) erected the genus *Limatulum* to contain *D. limatulum.* Mödlinger (1930) described a specimen collected in Hungary from the intestine of *Eptesicus serotinus* which he identified as *D. limatulum* Braun. Mehra (1935), accepting Mödlinger's determination, declared, "*Distomum limatulum* Braun, 1900, belongs to the genus *Parabascus* Looss." This action would invalidate *Limatulum* and suppress it as a synonym of *Parabascus.* But the specimens of Braun were poorly preserved, their morphology is very incompletely described, and the species at present rests on the description of Travassos. Furthermore, there seems to be good reason for doubting Mödlinger's determination. Comparison of his description and figure with those of *D. limatulum* by Braun (1900) and *P. lepi-*

dotus by Looss (1907) shows more resemblance with the latter than the former. I am inclined to agree with Mehra that the specimen described by Mödlinger belongs to *Parabascus,* and possibly to *P. lepidotus,* but its identity with *D. limatulum* Braun appears improbable. Furthermore, Macy (1932) described *Limatulum oklahomensis* (=*L. oklamomensis,* obviously an error of transcription) from *Tadarida cynocephala,* taken in Kansas and Oklahoma, and his specimens can not be referred to *Parabascus.* The description of *D. semisquamosum* as given by Mödlinger agrees in essential respects with that of Braun, but this species can not be retained in *Parabascus* and should be transferred to *Limatulum* as *L. semisquamosum* (Braun).

Choristogonoporus n. g.

The species described by van Beneden (1872) as *D. lima* Rudolphi does not belong to the genus *Parabascus.* The configuration of the digestive system and arrangement of the vitellaria are unlike those of *P. lepidotus,* while the excretory vesicle recalls that of *Plagiorchis.* Since the parasites were common and abundant, it is surprising that they have not been restudied by later workers. The description of van Beneden is sufficiently complete to establish the species and in certain respects, e.g., the description of the copulatory organs, the account is detailed. Since the species can not be included in any existing genus, the new genus *Choristogonoporus* is proposed for it. The name of the species becomes *C. lima* (van Beneden). In separation of genital pores it agrees with *Parabascoides,* and while it is assigned to the family Lecithodendriidae, its exact systematic position must await further investigation.

The limits of the family Lecithodendriidae, as stated in the diagnoses of Travassos (1928), Fuhrmann (1928), Stiles and Nolan (1930), Srivastava (1934), and Mehra (1935) are very indefinite, and the group contains a heterogeneous assemblage of genera that manifest great morphological diversity. There have been repeated attempts to arrange the genera in subfamilies; after a detailed review of the subject Mehra (1935) recognized six subfamilies, Lecithodendriinae, Anchitreminae, Pleurogenetinae, Eumegacetinae, Phaneropsolinae, and Exotidendriinae. More recently, on the basis of similarity of larval as well as adult specimens and on similarities in the life history, Rothschild (1937) has noted apparent relationship between the Microphallinae and members of the Lecithodendriidae. In fact such agreement in adult forms has long been recognized and, referring to *Microphallus opacus,* Looss (1899) stated, "glaube ich das *Dist. opacum* Ward als Typus einer eignen Gattung betrachten zu sollen, die nahe Verwandtschaft zu *Lecithodendrium* zeigt." A comparison of the cercarial stages of *Maritrema* as given by Rothschild, and of a species of *Levinseniella* which I have studied (unpublished data), with larval stages of *Lecithodendrium chilostomum* as described by Brown (1933) and of *Mosesia chordeilesia* as described by McMullen (1936), shows general agreement which may be of genetic significance. The agreement may not indicate family relationship since the cercariae of *Cryptocotyle lingua* (see Stunkard, 1930) and *Opisthorchis felineus* (see Vogel, 1934), which belong to different families, are so similar in appearance that they might easily be confused by an inexperienced observer. The two latter families, however, are closely related and it is not improbable that a similar relationship exists between the Microphallinae and the Lecithodendriidae. As noted by Stunkard (1937), "All members of a natural family follow a similar course of development and it has become clearly evident that types of life cycle are closely correlated with phylogenetic and systematic relations of the worms. The life cycles of animals, and especially parasitic ones, provide the best evidence of their genetic relations and systematic position." While the larval stages lack reproductive organs, on which specific distinctions are largely based, and consequently appear more alike than the adult forms, it is nevertheless true that similarity or diversity is more significant in the larval than the adult stages where later adaptations to diverse conditions found in different host species may have influenced the definitive form. The present confusion in the taxonomy of these trematodes may be explained on both genetic differences and adaptive modifications, and the ultimate solution of the problem is to be sought in more complete information concerning larval stages and in life history studies. At present there appear to be no satisfactory criteria for separating the genera into subfamilies, and empirical allocations are of little value. If the effort expended in these attempts were used in solving life histories, a sounder basis of classification would soon be available.

Family ACANTHOSTOMIDAE

Acanthostomum minimum n. sp.

(Fig. 2)

The material consisted of two specimens from *Rhamdia guatemalensis,* one (vial 25) collected June 16 at Kaua Cave and the other (vial 71), July 3 at San Isidro Cave. The first specimen was stained and mounted *in toto,* the other was cut in serial sections. The first specimen (Fig. 2) is much contracted, 0.63 mm. long by 0.39 mm. wide. The second specimen is more extended and before sectioning measured 1.18 mm. in length and 0.42 mm. in width. The suckers in the two worms are the same size. The acetabulum measures 0.12 by 0.13 mm. and the oral sucker 0.17 by 0.18 mm. The acetabulum is situated one-third to two-fifths of the body length from the anterior end, but this relation may be somewhat abnormal since the specimens are distorted. The mouth is subterminal and the anterior end bears a single row of large spines, about 0.04 mm. in length, though the measurement is approximate since they were set at an angle. In one specimen 20 spines were counted; in the other only 18 were observed. They are set in a muscular thickening of the body wall and are separated by conspicuous glandular cells. At the anterior end, the cuticula is beset with broad, flattened spines, which decrease in size and number posteriorly and are absent behind the testes.

The oral sucker is thick-walled, funnel-shaped, but so retracted that the prepharynx protrudes into the sucker. The pharynx is large, 0.1-0.11 mm. in length and 0.068-0.085 mm. in width. The esophagus is short; the digestive ceca arise just behind the pharynx and open to the surface of the body on either side near the posterior end. The excretory pore is terminal and the vesicle is Y-shaped.

The stem extends forward on the ventral side to the middle of the body where it turns dorsally and divides into the crura which continue to the level of the prepharynx.

The testes are irregularly oval, wider than long, and measure 0.14-0.22 mm. by 0.07-0.15 mm. They are situated obliquely, with adjacent faces flattened, the anterior testis on the left and the posterior testis on the right side of the body. Sperm ducts from the testes unite and discharge into a large, coiled seminal vesicle. This extends across the body behind the acetabulum, turns forward dorsally on the right side of the sucker, and a narrow duct leads ventrad and forward to the genital pore immediately in front of the acetabulum. The ovary is situated on the right side, slightly anterior to the testes and is ventral in position. It is almost spherical, measuring 0.07-0.15 mm. in diameter. The oviduct arises from the dorsal surface of the ovary and communicates by a short duct with the seminal receptacle, which is above, behind, and at the right of the ovary. The receptacle measures 0.08-0.13 mm. in diameter. The oviduct then expands to form the ootype from which Laurer's canal passes to the dorsal surface. Near the origin of Laurer's canal, the ootype receives the short common vitelline duct. Mehlis' gland is represented by a few secretory cells. The vitellaria consist of large, irregularly-shaped, compact follicles which lie in the lateral areas of the body between the testes and the seminal vesicle. Collecting ducts pass mediad at the level of the ootype to form the common vitelline duct. The coils of the uterus occupy the central portion of the body from the level of the ovary to the genital pore. The eggs measure 0.028-0.03 mm. by 0.016-0.018 mm. They are ovate, operculate, and those in the terminal part of the uterus contain miracidia.

DISCUSSION

The discovery of this species adds another to the list of trematodes which have anal openings. Stunkard (1931) described *Acanthochasmus diploporus* from the alligator and listed other trematodes in which the digestive ceca open to the surface of the body, either directly or by way of the excretory vesicle. With the restoration of the name *Acanthostomum, Acanthochasmus diploporus* becomes *Acanthostomum diploporum*. The original diagnosis of the genus *Acanthostomum* was emended by Looss (1901) and later contributions were reviewed by Stunkard (1931). While it appears almost incredible that so accurate an observer as Looss overlooked anal openings in the species studied by him, the discovery of two species of the genus *Acanthostomum* in which these structures occur suggests that their presence may be a generic character.

Family CLINOSTOMIDAE

Clinostomum intermedialis Lamont 1920

(Fig 3)

A single specimen (vial 30) from *Rhamdia guatemalensis,* collected June 17 at Kaua Cave, is regarded as identical with those reported earlier by Lamont (1920) from the Rio Castaño. From similarity in general appearance and structure but without experimental proof, Lamont identified these metacercariae as larvae of

Clinostomum intermedialis, a species which she described from the cormorant, *Phalacocorax vigua.* The mature worms on which the specific description was based had been collected by Dr. Pearse in Venezuela.

The worm (Fig. 3) was stained and mounted *in toto.* It measures 5 mm. in length and 1.35 mm. in width at the level of the acetabulum. The dorsal surface is convex, with the ends and lateral edges turned ventrad. The oral sucker is retracted and the mouth is at the base of a deep oval depression. A conspicuous transverse ridge or protrusion of the body wall extends across the ventral side immediately behind the oral indentation. There is a depression in the body wall between this ridge and the acetabulum. The posterior half of the body bears fine cuticular spines, but these structures are missing on the anterior portion. The acetabulum is situated about one-fourth of the body length from the anterior end and measures 0.88 mm. in diameter. Its opening has the form of an elongate triangle with the base anteriad and its apex posteriad.

The relative size and position of the organs are shown in the figure. The oral sucker measures 0.37 by 0.27 mm. The esophagus is short and lies above the oral sucker. No pharynx could be distinguished although there is a thickening at the posterior end of the esophagus. The digestive ceca, which extend almost to the caudal end of the body, are large and filled with coagulated material. No communication with the excretory vesicle was observed.

The excretory pore is dorsoterminal, but the ducts of the system could not be traced.

The testes are irregular in outline, the anterior one somewhat larger than the posterior. They are about 0.6 mm. in width, the anterior 0.4 mm. and the posterior 0.18 mm. in greatest length. The ovary is situated between the testes, on the right side of the body, and measures 0.144 by 0.16 mm. The oviduct, female genital complex, and initial portion of the uterus appear as coiled tubules in the area at the left of the ovary. The uterine sac extends forward about two-thirds of the distance from the cephalic testis to the acetabulum. The genital pore was not observed.

DISCUSSION

In addition to the specimen from *R. guatemalensis,* Dr. Pearse kindly sent other mounted specimens, taken from *Rhamdia* sp. at different localities in Yucatan during the summer of 1932, which had been identified as *C. intermedialis.*

Specific determination of metacercariae is exceedingly difficult and the allocation of the present specimen is tentative. Comparison of metacercariae from *Rhamdia* with hundreds of others taken from various species of fishes and amphibians in different parts of North America shows both morphological similarity and diversity. There is much variation in shape of body, position of reproductive organs, size of suckers, location of acetabulum, and length of uterine sac, even among specimens from the same host and locality, and it has been impossible to recognize specific differences among these larvae or to separate them into distinct groups. Whether the variation manifested by these metacercariae is the result of genetic difference or is a differential response to varying physiological conditions is not clear. Recent experimental studies on other groups have shown that environmental influences and development in diverse host species may have a profound effect in modifying morphological features.

There is much uncertainty concerning the validity of the described species of *Clinostomum*, even when mature specimens have provided the basis for description. The subject was reviewed by Baer (1933) and Nigrelli (1936) and these authors have listed the more significant literature. Without precise knowledge concerning the extent of variation in a given species or the effect of development in different hosts, it is impossible to determine the status of previously described species. The problem is complicated further by the incompleteness and inadequacy of many existing descriptions. It is my conviction that many of the present species rest upon errors of interpretation and that features used in diagnosis are mere variations and not specific distinctions. The discovery of the life cycle of *Clinostomum heluans* by Lutz (1934) and of *C. marginatum* by Krull (1934) and the Hunters (1934, 1935) has opened the field to experimental analysis, and provided a method for the final solution of the species problem.

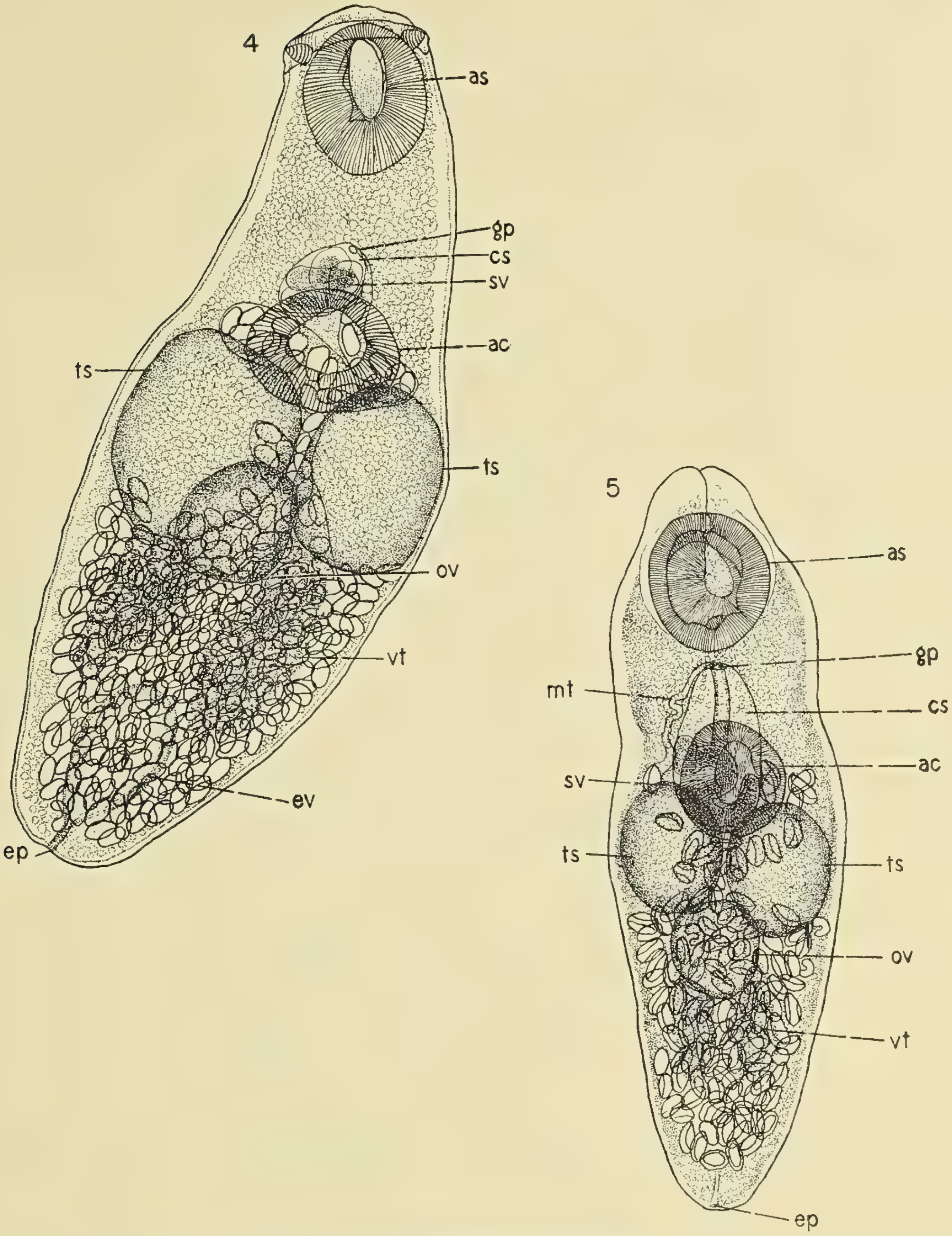
Family sedis incertae

Anenterotrema auritum n. g., n. sp.

(Fig. 4)

The material consisted of 25 specimens (vial 171) from the bat, *Micronycteris megalotis mexicana* Miller, collected July 31 at Xmahit Cave, Tekax and 34 specimens (vial 193) from the same host, collected August 11 at Xconsacab, Tizamin. Twenty-three of the worms were prepared as whole mounts and six were cut in serial sections.

The specimens are oval, with the region of greatest width at the testicular zone near the middle of the body. Usually the anterior region is narrower than the posterior, which is distended with eggs. The worms are flattened, sometimes concave ventrally, and oval in cross section. They measure 0.45-0.8 mm. in length and 0.2-0.34 mm. in width. The specimen selected as type is the largest one and is well extended. It is 0.8 mm. long and 0.3 mm. wide. Across the dorsal side of the anterior end there is a thickened ridge which extends ventrad on either side and ends in a small muscular papilla. There may be thickenings on the ridge, but whether they represent other papillae could not be determined. The two lateral papillae are often conspicuous and recall similar structures of the papillose Allocreadiidae as described by Hopkins (1934). In the present specimens, however, the ridge and papillae appear to be a part of the body wall and independent of the anterior sucker. The ridge may be flattened and extended in front of the sucker, or the sucker may be protruded with the disappearance of the ridge. In either of these conditions, the papillae may not be distinguishable. The cuticula in most of the specimens is frayed and appears to be disintegrated; no spines were observed. The acetabulum is situated about one-third the body length from the anterior end. In contracted specimens it may be more anterior while, if the anterior end is protruded, it may lie farther back. It measures 0.1-0.125 mm. in diameter.



Figs. 4, 5—PARASITIC FLATWORMS
(Drawn from camera lucida tracings.)

4: *Anenterotrema auritum,* type specimen, dorsal view, × 158.
5: *Anenterotrema singulare,* type specimen, dorsal view, × 158.

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ac—acetabulum
ao—anal opening
as—anterior sucker
cs—cirrus sac
ep—excretory pore
ev—excretory vesicle
ga—genital atrium
gp—genital pore
in—intestine
lm—longitudinal muscle
lw—lateral wall of body
mp—male genital pore
mt—metraterm
oe—esophagus
os—oral sucker
ov—ovary
ph—pharynx
sg—shell gland
sr—seminal receptacle
sv—seminal vesicle
ts—testis
up—uterine pore
us—uterine sac
ut—uterus
vd—vitelline duct
vf—vas deferens
vg—vagina
vt—vitellaria

There appears to be no distinct alimentary tract in these worms. In none of the stained specimens, whether prepared as whole mounts or in serial sections, is there any trace of a pharynx, esophagus, or digestive ceca. The anterior sucker is 0.1-0.13 mm. in diameter; its opening is subterminal. The wall of the sucker is continuous except for the opening to the exterior and its structure is similar to that of the acetabulum. Around the sucker there are gaps in the parenchyma, which appear as sinuses or lacunae, although there is the possibility that, due to delayed or poor fixation, they are remains of disintegrated digestive ceca. This interpretation appears to be precluded, however, by the presence of similar spaces throughout the body, particularly around the acetabulum, and by the persistence of delicate structures which presumably would decompose more rapidly. One may postulate the disintegration and disappearance of the digestive system after the death of the worms by the action of enzymes present in the lumen or cells of the ceca, but such an explanation would not account for the absence of a pharynx and the continuous wall of the anterior sucker. The commissure of the nervous system and the nuclei of the associated cells are well preserved. In the lateral areas behind the anterior sucker there are masses of nuclei, sometimes aligned in rows but their irregular arrangement confutes rather than supports the suggestion that they are the remains of digestive ceca.

The excretory pore is terminal. The bladder is saccate and extends forward between the coils of the uterus about one-half the distance to the ovary. In several of the specimens it is filled with fluid and almost spherical. In a worm cut in frontal sections the vesicle measures 0.09 mm. in length. The course and subdivisions of the collecting tubules could not be traced although they appear frequently in sections.

The testes are large, opposite, symmetrical, and situated in the middle third of the body. They are spherical to oval, usually longer in the anteroposterior axis and 0.1-0.19 mm. in diameter. Sperm ducts arise from the anteromedian ends of the testes and pass forward and mediad, uniting as they enter the cirrus sac. The cirrus sac is oval, 0.05-0.08 mm. in length and 0.04-0.07 mm. in diameter. It is slightly lateral, usually on the left side, in front of and partially above the acetabulum. In the cirrus sac the sperm duct enlarges to form a much coiled seminal vesicle, and the ejaculatory duct leads to the common genital pore. The cirrus is partially extruded in one specimen.

The ovary is dorsal, usually slightly to the left, between and behind the testes, although it may lie farther forward if the specimen is contracted. It is spherical to oval, 0.06-0.12 mm. in diameter. The oviduct arises at the posteromedian face of the ovary, passes ventrad and toward the right where it enters the ootype. In two of the sectioned worms it is possible to recognize a small seminal receptacle on the antovarian side of the ootype and in one of them a strand of spermatozoa, extending toward the dorsal wall, probably represents Laurer's canal. The uterus passes in a winding course backward to the posterior end of the body and then forward, its loops filling the caudal third of the body. The ascending limb passes above and between the testes. In front of these organs it crosses the body transversely in an **S**-shaped double loop and opens into the metraterm which continues forward on the side opposite the cirrus sac and opens at the genital pore beside or in front of the male orifice. The genital pore is median, a short distance anterior to the acetabulum. The vitelline follicles occupy lateral fields among the uterine coils. They extend forward as far as the ovary and backward to the level of the excretory vesicle. Their ducts could not be traced to the ootype. The eggs are oval, operculate, 0.034-0.036 mm. by 0.02-0.023 mm., and those in the terminal part of the uterus contain miracidia.

DISCUSSION

The specimens are in such poor state of preservation that their structure can not be fully determined, and the description is therefore incomplete. A systematic allocation is accordingly impossible. The worms are undoubtedly members of an undescribed species which can not be referred to any existing genus. A new genus *Anenterotrema* is erected to contain the species *A. auritum,* which is designated as type of the genus. It may belong to the Lecithodendriidae or the Allocreadiidae, but it can not be included in either family as they are constituted at present.

A somewhat similar fluke was described from a Hungarian bat by Mödlinger (1930). In this species, which he called *Distomum mehelÿi,* the digestive system is inadequately described. From the account it appears that the ceca arise directly from the oral sucker and do not extend behind it. It is not improbable that *D. mehelÿi* and *A. auritum* are related species although study of better-preserved material is indispensable if a satisfactory comparison is to be made.

Anenterotrema singulare n. sp.

(Fig. 5)

The material of this species consisted of a single specimen (vial 42) from the bat, *Natalus mexicanus* Miller, collected June 22 at Balaam Canche Cave, Chichen Itza.

The worm was stained, mounted *in toto,* and drawn (Fig. 5). In order to study the internal structures it was then unmounted and cut in serial sections. It measured 0.625 mm. in length and 0.2 mm. in greatest width. Its shape and appearance are portrayed in the figure. The anterior end is protruded and folded, forming a ventral groove which becomes continuous with the aperture of the anterior sucker. Among the specimens of *A. auritum,* there are a few in which a similar condition was noted. The cuticula is thin and no spines are present. The acetabulum is situated near the caudal end of the anterior half of the body and measures 0.096 mm. long and 0.092 mm. wide. Sections show it to be surrounded by a large empty space.

The anterior sucker measures 0.116 mm. long and 0.1 mm. wide. It has a continuous wall and is surrounded by a large open space, similar to that about the acetabulum. No pharynx or digestive ceca could be distinguished.

The excretory pore is terminal; the vesicle is saccate and extends forward among the coils of the uterus almost half way to the ovary. Details of the system could not be traced.

The testes are almost opposite and in the middle of the body; their anterior ends lie in the acetabular zone. The right testis is 0.11 mm. long and 0.094 mm. wide. The left testis, which is slightly anterior to the right one, is 0.115 mm. long and 0.092 mm. wide. The sperm ducts arise at the anteromedian faces of the testes and unite to form a common duct which enters the posterior end of the cirrus sac. Within the sac the duct expands to form a large, coiled, seminal vesicle and there is a large, long, straight duct which leads to the genital pore. The cirrus sac measures 0.15 mm. long and 0.076 mm. wide; its caudal end is above the posterior end of the acetabulum. The genital pore is median, and a short distance behind the anterior sucker.

The ovary is almost spherical, 0.072 by 0.07 mm. in diameter. It is dorsal and slightly to the left of the midline; the oviduct arises at the posteromedian pole. The details of the female genital complex are similar to those of *A. auritum.* The arrangement and distribution of the vitellaria and course of the uterus are similar in the two species. In *A. singulare* the metraterm is much longer and it is located on the left side of the cirrus sac. This latter condition is probably not significant, since in four of the specimens of *A. auritum* the metraterm is on the left and the cirrus sac on the right. The eggs are thin-shelled, collapsed, and measure about 0.03 by 0.018 mm.

DISCUSSION

This species differs from the preceding one in relative size of suckers and gonads, and especially in the size and extent of the cirrus sac.

CESTODA

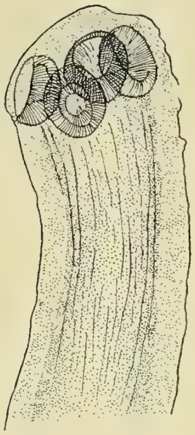
Family ANOPLOCEPHALIDAE

Oochoristica parva n. sp.

(Figs. 6-8)

Two specimens (vial 116) were collected at Gongora, Oxkutzcab, July 17, from *Coleonyx elegans* Gray, a nocturnal lizard that lives far within the caves and feeds on cave crickets and other small animals. Both specimens were stained, one was mounted entire, and mature proglottids of the other were cut in serial sections. In both worms the terminal segment is present, the strobilas are complete and no segments have been lost. The specimens do not differ greatly in size, one measuring 20 mm. and the other 25 mm. in length. Both contain mature proglottids, but no gravid segments. The longer strobila contains about 65 proglottids and measures 0.77 mm. in greatest width while the shorter one has about 60 proglottids and is 0.68 mm. in greatest width. The figures are camera lucida tracings of the scolex and segments 46 and 52 of the smaller worm.

6



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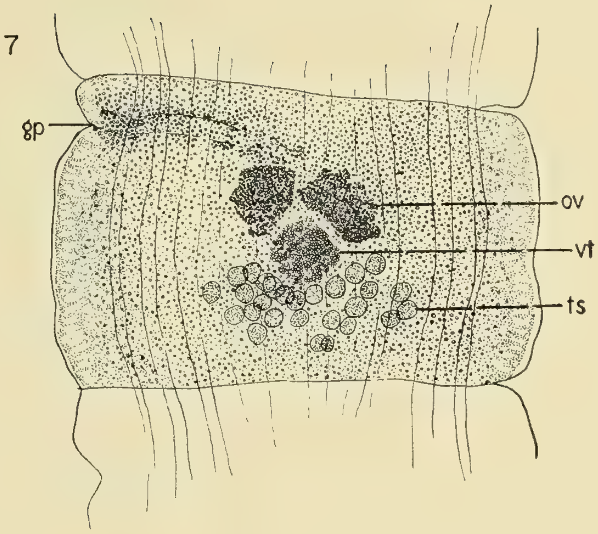

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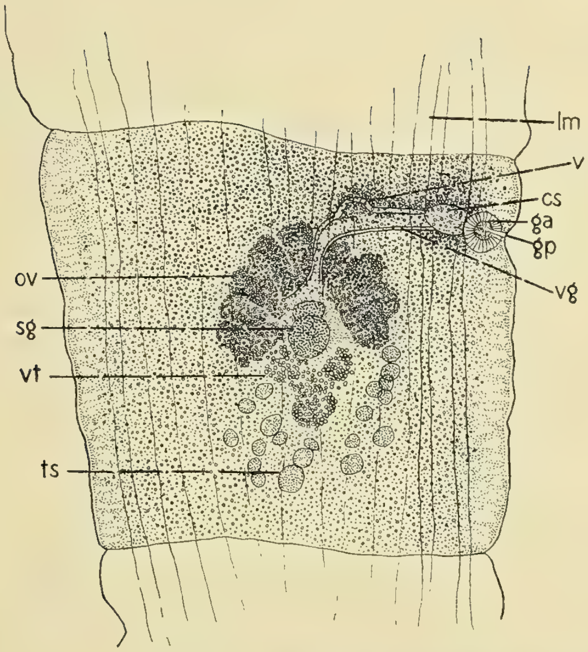

Figs. 6-8—PARASITIC FLATWORMS
(Drawn from camera lucida tracings. See Figs. 4, 5 for abbreviations.)

6: *Oochoristica parva,* type specimen, scolex, × 94.
7: *Oochoristica parva,* type specimen, segment 46, × 94.
8: *Oochoristica parva,* type specimen, segment 52, × 94.

The scolex measures 0.24-0.25 mm. in width and is not sharply delimited from the neck region. The suckers are small, measuring 0.07-0.086 mm. in diameter. The neck region is 3-5 mm. in length, and 10-15 segments can be distinguished before the genital primordia appear. About 15 segments farther the testes may be recognized, and 20 segments farther the proglottids are mature. The anterior segments are short and much wider than long, in mature proglottids the width and length are approximately equal, while the terminal segments are longer than wide. Longitudinal muscle fibers are conspicuous in the older proglottids.

The genital pores are irregularly alternate. Each is situated on the lateral margin of the proglottid, about one-fifth of the distance from the anterior end. The genital atrium into which the reproductive ducts discharge is provided with muscular walls. The opening of the vagina is immediately behind and below that of the cirrus sac. The testes, 20-30 in number, are caudal and lateral to the vitelline gland. They are arranged in a single layer and measure 0.02-0.028 mm. in diameter. Their ducts unite to form the vas deferens, which is coiled, filled with spermatozoa, surrounded by glandular cells, and extends laterally anterior and dorsal to the vagina. The cirrus sac measures 0.07-0.1 mm. in length and 0.03-0.057 mm. in width. The ovary is bilobed, median, and situated slightly in front of the middle of the segment. The ootype is behind the ovary and in front of the vitellaria. The oviduct arises at the posterior face of the ovarian bridge and turns toward the aporal side. It receives a duct from the seminal receptacle which is anterior and another from the vitelline gland which is posterior. The ootype region is coiled and surrounded by the shell gland, and from it a short duct leads ventrad to the uterus. In the sectioned proglottids the uterus consists of a transverse sac containing a few ova. From the seminal receptacle the vagina extends forward above the ovary and then turns laterad, passing directly to the genital atrium.

DISCUSSION

The genus *Oochoristica* has been reported previously from North America by Harwood (1932) who described five species from snakes and lizards of Texas. The present specimens resemble those described by him, but are smaller, the size difference being especially pronounced in the case of the scolex, suckers, and cirrus sac.

SUMMARY

The parasitic flatworms collected by Dr. A. S. Pearse during the 1936 expedition to Yucatan are described. The following trematodes were studied; *Parabascoides yucatanensis* n. g., n. sp. (Lecithodendriidae) from *Natalus mexicanus* at Balaam Canche Cave, Chichen Itza; *Acanthostomum minimum* n. sp. (Acanthostomidae) from *Rhamdia guatemalensis* at Kaua Cave and San Isidro Cave; *Clinostomum intermedialis* Lamont 1920 (Clinostomidae) from *Rhamdia guatemalensis* at Kaua Cave; *Anenterotrema auritum* n. g., n. sp. (Family sedis incertae) from *Micronycteris megalotis mexicana* at Xmahit Cave, Tekax, and Xconsacab, Tizamin; and *Anenterotrema singulare* n. sp. from *Natalus mexicanus* at Balaam Canche Cave, Chichen Itza.

Dist. semisquamosum Braun 1900 is transferred to the genus *Limatulum* Travassos 1921 and a new genus, *Choristogonoporus,* is erected to contain *Dist. lima* of van Beneden (1872). The limits and diagnostic characteristics of the Lecithodendriidae and the relationship of this family to the Microphallinae are discussed. Emphasis is placed upon the importance of larval stages and life cycles for systematic determination of trematodes.

A single cestode, *Oochoristica parva* n. sp. (Anoplocephalidae) is described from *Coleonyx elegans* from Gongora Cave, Oxkutzcab.

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IV

SOME NEMATODES FROM THE CAVES OF YUCATAN

B. G. Chitwood

Division of Nematology, Bureau of Plant Industry, U. S. Department of Agriculture

This collection contains 13 species of nematodes, 7 of which appear to be new. The collection is particularly rich in trichostrongyles of Cheiroptera, containing representatives of one new genus and two old genera, one of which was originally based on male specimens. A study of these forms has enabled the writer to obtain information of value on the relationships of the trichostrongylidae.

Family OXYURIDAE

?*Syphacia obvelata* (Rudolphi 1802)

One immature female was obtained from the jejunum of a rat (*Ototylomys phyllotis phyllotis* Merriam) collected in Balaam Canche Cave, Chichen Itza, June 10. The specimen obviously belongs to the genus *Syphacia* but owing to the absence of males specific identification could not be made with certainty.

Pharyngodon oxkutzcabiensis n. sp.

(Figs. 1-6)

Description.—Oral opening surrounded by 3 bilobed lips bearing an internal circle of 6 reduced papillae and an external circle of 4 large double papillae, and 2 amphids (Fig. 1).

Male 1.91 to 2.14 mm. long by 160 to 200μ wide. Lateral alae well developed, wide, extending from cervical region to region of cloacal prominence. Esophagus 275 to 350μ long; excretory pore 275 to 350μ from anterior extremity; cloacal orifice prominent. Tail attenuated then filiform. Caudal alae wide, not enclosing postanal papillae (Figs. 5, 6). One pair each of large preanal, of adanal and of postanal papillae; postcloacal prominence representing a fourth pair of papillae; phasmids opposite adanal papillae. Spicule absent.

Female 3.04 to 5.16 mm. long by 230 to 380μ wide. Sublateral alae narrow, esophagus 416 to 420μ long; excretory pore 422 to 500μ from anterior extremity; vulva slightly behind excretory pore, 540 to 558μ from anterior extremity; anus 750 to 835μ from posterior extremity; filiform part of tail ⅕ to ⅖ of tail length, depending upon age. (In older individuals—Fig. 6—the filiform part of the tail is relatively short.) The tail bears 13 to 15 spines. Eggs 120 to 130μ long by 33 to 37μ wide, elongated, ellipsoidal with small terminal knobs (Fig. 3).

Host.—*Thecadactylus rapicaudus* Houttuyn.

Location.—Rectum.

Locality.—Puz Cave, July 20, and in caves along San Roque Road, Oxkutzcab, July 22.

Specimens.—U. S. National Museum Helm. Coll. Nos. 42457 (cotypes) and 42476 (paratypes).

Pharyngodon yucatanensis n. sp.

(Figs. 7-10)

Description.—Head as in *P. oxkutzcabiensis.*

Male 1.11 to 1.12 mm. long by 56 to 60μ wide. Esophagus 200 to 215μ long; excretory pore 335 to 340μ from anterior extremity. Anus 114 to 140μ from posterior extremity. Tail attenuated, then filiform. One pair of large preanal, one of adanal and one of postanal papillae; caudal alae inclosing postanal papillae (Figs. 7, 8).

Female 2.7 mm. long by 400 to 410μ wide. Alae absent. Esophagus 400 to 410μ long; excretory pore 400 to 430μ from anterior extremity. Anus 750 to 880μ from posterior extremity; filiform part of tail 8/10 to 9/10 of tail length; and bearing 8 to 11 spines (Fig. 10). Vulva 330 to 560μ from anterior extremity. Eggs cylindroid, ends truncate; size 110 to 118μ long by 30 to 36μ wide (Fig. 9).

Host.—*Coleonyx elegans* Gray.

Location.—Rectum.

Locality.—Gongora and Ziz Caves, Oxkutzcab, July 17 and 24.

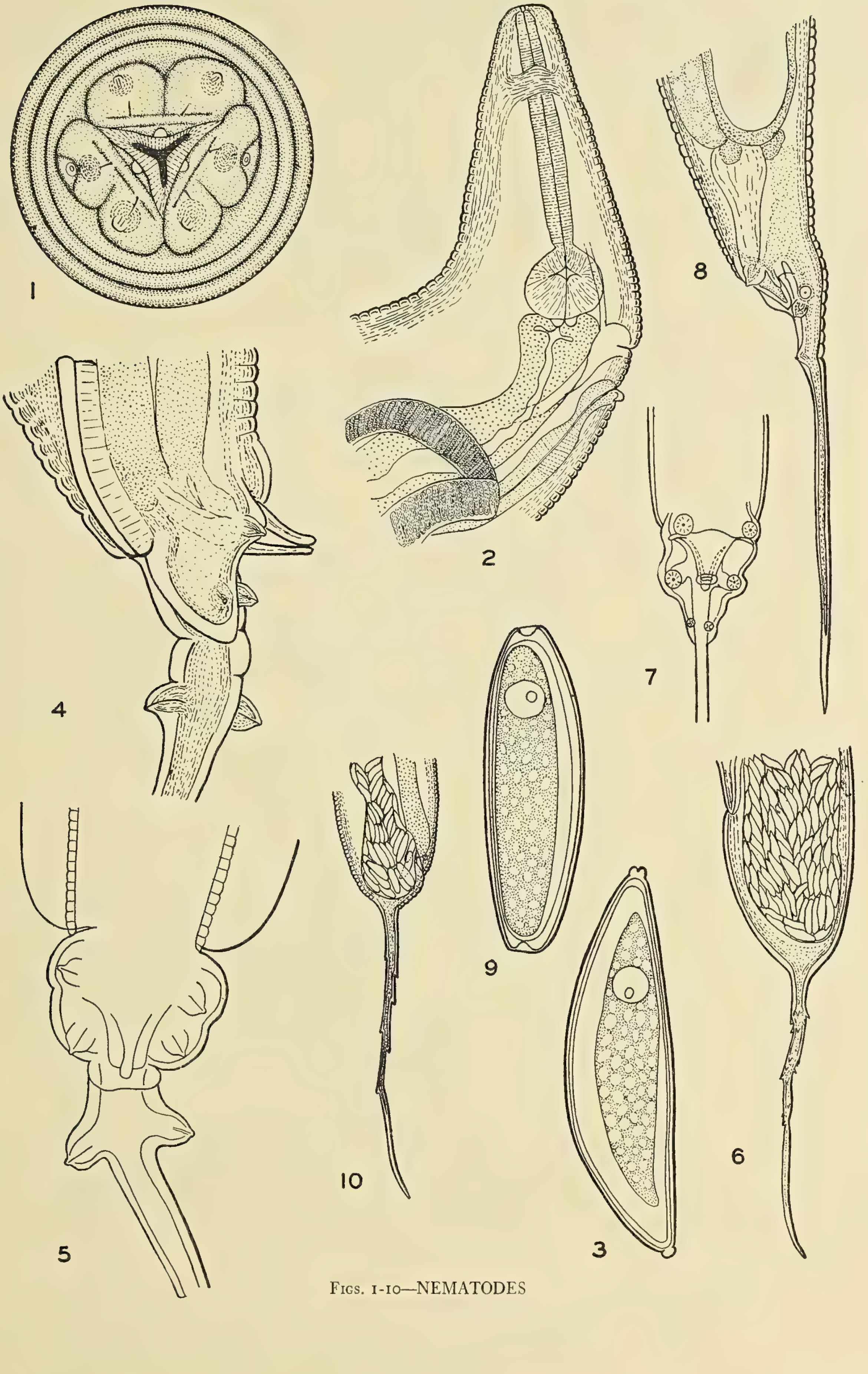
Specimens.—U. S. N. M. Helm. Coll. No. 42477 (cotypes).

The species *Pharyngodon yucatanensis* and *P. oxkutzcabiensis* differ from the majority of the species of the genus *Pharyngodon* in having a spiny tail (Refs. 1, 5, 14, 21, 31, 33, 37—p. 65). Two species possessing this character have been previously reported, namely, *P. spinicauda* (Dujardin 1845) and *P. extenuatus* (Rudolphi 1819). *P. oxkutzcabiensis* resembles *P. extenuatus* in that the caudal alae of the male do not include the posterior pair of genital papillae; it differs from that species in that the eggs are attenuated rather than quadrangular at the tips. *P. yucatanensis* is similar to *P. spinicauda* in that the caudal alae of the male include the posterior pair of genital papillae, but differs from that species in that the eggs are smaller in size (110 to 118μ long by 30 to 36μ wide (*P. yucatanensis*) as compared with 155μ long by 51μ wide (*P. spinicauda*), and the male has no spicule.

Family TRICHOSTRONGYLIDAE

Bidigiticauda n. g.

Diagnosis.—Ollulaninae: Oral opening rounded, lips absent; cephalic papillae consisting of an internal circle of minute papillae and an external circle of four large double papillae (dorsodorsal-laterodorsal and ventroventral-lateroventral) and one pair of small papillae (ventrolateral); stoma rudimentary, small, tooth present (Fig. 11). Cephalic inflation not collar-like; spines absent (Fig. 12). Deirids not observed; alae absent; ridges faint, observed near caudal extremity (Fig. 13). Male with wide, arcuate, alate spicules; gubernaculum absent. Bursa



Figs. 1-10—NEMATODES

small, not lobed; bursal rays papilliform, externodorsal ray apparently absent (Figs. 15-17). Female with 2 ovaries, viviparous, tail elongated, subcylindrical, bearing 2 digitiform caudal mucrones.

Type species.—*Bidigiticauda vivipara* n. sp.

Bidigiticauda vivipara n. sp.

(Figs. 11-17)

Description.—*Male* 5.12 mm. long by 168μ wide. Esophagus 360μ long. Spicules 256-270μ long. *Female* 8.02 to 8.06 mm. long by 172 to 201μ wide. Esophagus 380 to 400μ long; tail 224 to 240μ long. Vulva dividing body in proportions of 53:47 to 54:46.

Host.—*Artibeus jamaicensis yucatanicus* (Allen).

Location.—Small intestine.

Locality.—Puz Cave, Oxkutzcab, July 20.

Specimens.—U. S. N. M. Helm. Coll. No. 42478 (types), 42479 (paratypes).

Cheiropteronema globocephala Sandground 1929

(Figs. 18-21)

Description.—Subcephalic cuticle inflated, inflation rounded.

Male 14 mm. long by 408μ wide. Esophagus 500μ long. Spicules 410μ long, alate, transversely striated. Bursa trilobed, dorsal lobe longer than lateral lobes. Bursal rays papilliform, externodorsals having a common trunk with dorsal; dorsal ray prolonged in form of tail, bearing 1 pair of papillae.

Female 22.5 mm. long by 410μ wide. Esophagus 540μ long; anus 100μ from caudal extremity; tail bluntly rounded bearing 2 subdorsal and 1 ventral rounded mucrones and a short, fine median hair-like process. Vulva dividing body in proportions of 55:44. Eggs 108 to 115μ long by 66 to 75μ wide.

Host.—*Artibeus jamaicensis yucatanicus* (Allen).

Location.—Stomach.

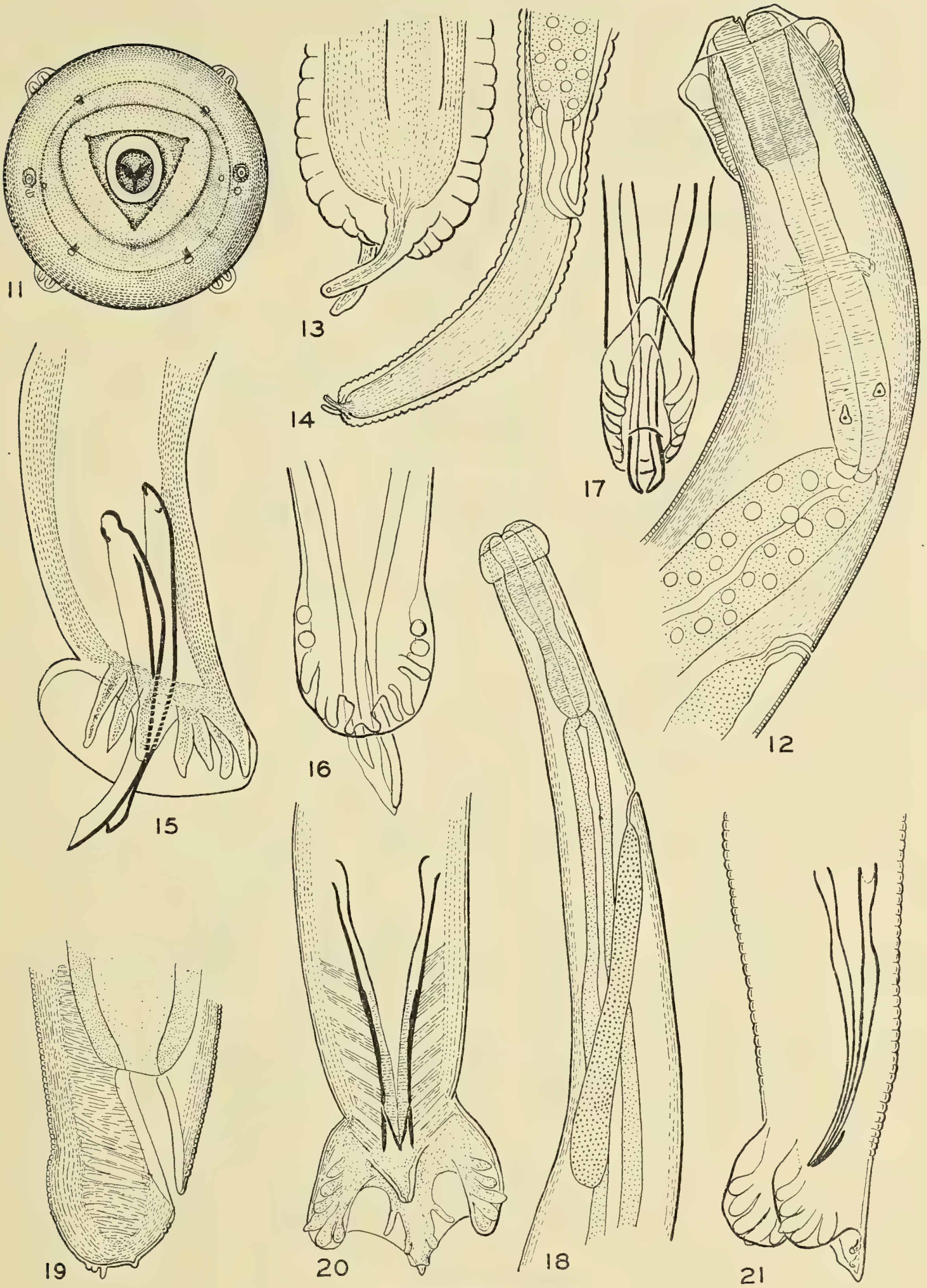
Locality.—Ebizt Cave, Oxkutzcab, July 19.

Specimens.—U. S. N. M. Helm. Coll. No. 42474.

This species was first described by Sandground (1929) from a bat, *Artibeus jamaicensis,* collected in Yucatan. The genus and species, based upon a single male specimen, was placed by that author in the Metastrongylidae. A study of the male indicates that while the bursa is atypical, there is not sufficient evidence from that point alone to place the genus in the Metastrongylidae. The female tail, form of ovejectors, and the cephalic inflation all point rather definitely to affinities with the trichostrongyles of bats described elsewhere in this paper.

Tricholeiperia Travassos 1935

Diagnosis.—Ollulaninae: Oral opening oval, surrounded by an internal circle of 6 reduced papillae and with an external circle of 4 well developed and 2 reduced papillae (Fig. 22). Stoma rudimentary, tooth present. Cephalic inflation in the form of collar-like, spineless projections. Deirids posterior to base of esophagus;



Figs. 11-21—NEMATODES

lateral alae wide. Cuticle with longitudinal ridges. Male with filiform, alate, transversely striated spicules; gubernaculum absent. Bursa well developed, trilobed, dorsal lobe smaller than lateral lobes. Bursal rays well developed, ventroventral and lateroventral parallel, ventrolateral separated from other laterals; dorsal ray elongated, distally bifurcate, each branch bidigitate; externodorsals arising from base of dorsal ray. Female with 2 ovaries, oviparous; tail with 2 large conical mucrones and a delicate median hair-like process. Anterior lip of vulva inflated.

Type species.—*Tricholeiperia leiperi* Travassos 1935.

Tricholeiperia carnegiensis n. sp.

(Figs. 22-26)

Description.—Male 2.5 mm. long by 80µ wide. Spicules 300µ long, setaceous, alate. *Female* 2.54 to 2.98 mm. long by 80 to 90µ wide. Esophagus 340 to 350µ long. Vulva dividing body in proportions of 70:30. Eggs unsegmented.

Host.—*Natalus mexicanus* Miller.

Location.—Jejunum.

Locality.—Balaam Canche Cave, Chichen Itza, June 23.

Specimens.—U. S. N. M. Helm. Coll. No. 42481 (cotypes).

Tricholeiperia pearsei n. sp.

(Fig. 27)

Description.—*Male* 2.75 mm. long by 66µ wide. Spicules 800µ long, setaceous, alate. *Female* unknown.

Host.—*Natalus mexicanus* Miller.

Location.—Lung ?

Locality.—Balaam Canche Cave, Chichen Itza, June 22.

Specimen.—U. S. N. M. Helm. Coll. No. 42492 (type).

Tricholeiperia pearsei differs from *T. carnegiensis* only in the greater length of the spicules, these structures being 800µ long in the former species and only 300µ long in the latter species.

The trichostrongyles described above seem to form a natural group with other trichostrongyles of Cheiroptera and Edentata, and with the genus *Ollulanus* of carnivores (Refs. 3, 4, 6, 7, 10, 16, 17, 22, 24, 26, 28, 30, 35, 41, 42). Travassos (1935)[1] placed several of the genera from the above host groups in a subfamily Strongylacanthinae, this subfamily being based on the presence of 3 cuticular projections on the tail of the female and on the presence of 2 ovaries. The same writer also proposed a new subfamily, Spinostrongylinae, basing this group on the presence of cephalic or cervical spines, the nature of the cephalic region, the presence of 2 ovaries, and on the presence of a pair of large "papillae" on the conoid female tail. Spination was once regarded as a subfamily character in the Nematoda, but it has since been found that spination occurs in a number of different forms and usually represents convergence rather than phylogeny.

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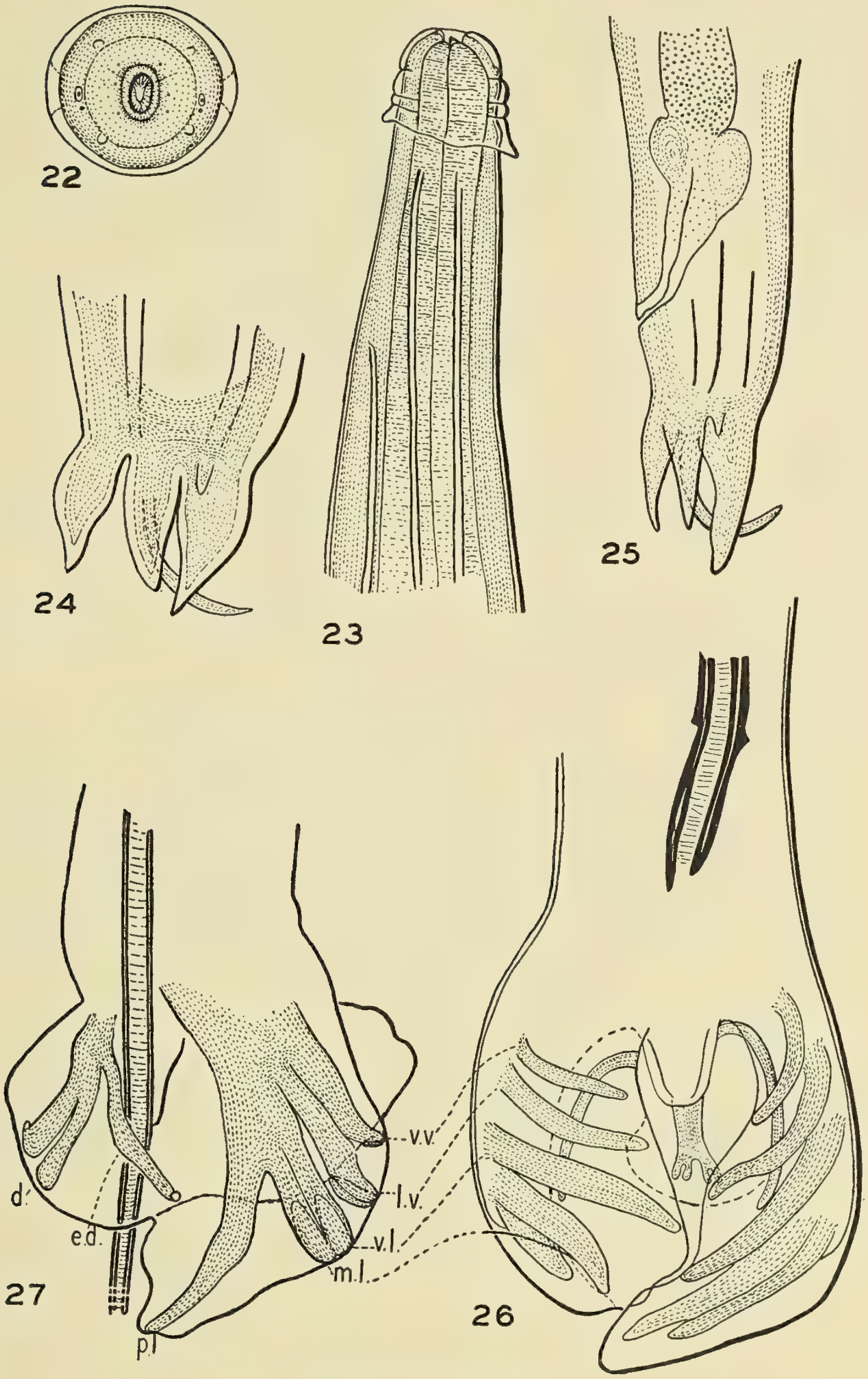
[1] This paper was written before the publication of Travassos, 1937, Revisao da Familia Trichostrongylidae Leiper, 1912, *Monogr. Inst. Oswaldo Cruz,* No. 1.



Figs. 22-27—NEMATODES

Yorke and Maplestone (1926) have placed the genus *Ollulanus* in the subfamily Heligmosominae; the reasons for this action being the presence of but one ovary in *Ollulanus,* which is characteristic of the heligmosomes. The presence of one ovary may well be an absolute character of a subfamily or of a family since two ovaries are considered the primitive number, but once an ovary is lost, one would not expect it to reappear. However, it does not follow that all one-ovaried forms within a large group are necessarily closely related, as for example, one-ovaried forms have arisen in nearly every family of the Rhabditoidea but this condition is characteristic of only one family, the Cephalobidae. Similarly in the Thelastomatidae, *Blatticola* (one ovary) and *Cephalobellus* (two ovaries) are practically identical except for ovarial number while *Galebia* (one ovary) is much more closely related to *Thelastoma* (two ovaries) than to *Blatticola.*

While the genus *Ollulanus* resembles the heligmosomes only in the number of ovaries, and since it is a very exceptional form of trichostrongyloid in being viviparous, it seems well to consider its other possible relationships. Unfortunately, the extreme variability in spicule form and bursal ray formula which make possible such a massive assembly of genera in the Trichostrongyloidea show little or no correlation with each other or with any other structures thus far considered. Any attempt to segregate genera into families or subfamilies on male characters alone seems to result in a chaotic grouping.

Sandground (1929) has placed the genus *Cheiropteronema* in the Metastrongylidae because of a reduction in the size of the bursa, but in this case the same argument as given for ovarial reduction holds for bursal reduction. Reduction in size of the bursa may be characteristic of a group, but all forms having that character do not necessarily belong in the same group. Species of the genus *Syngamus* often have a much reduced bursa but they are not placed with the Metastrongylidae. The cephalic inflation and female reproductive system of *Cheiropteronema* indicate trichostrongyle rather than metastrongyle affinities.

In the Trichostrongyloidea the form of the spicules is a character widely used as a basis for genera; there are two more or less distinct types of spicules in the superfamily, the setose (usually alate) form and the short twisted form. In this group we repeatedly find examples of what may be termed "generic twinning." For example, the genera *Bradypostrongylus* and *Allintoshius* differ mainly in that the spicules are short and twisted in the former and elongated and conoid in the latter; in *Torrestrongylus* the spicules are short and branched while in *Tricholeiperia* they are setose and alate.

Neveu-Lemaire (1930) has subdivided both the families Trichostrongylidae and Heligmosomidae into subfamilies on the basis of the spicules, having one subfamily with long slender spicules and the other with short stocky spicules in each family. Such a division admits the transformation from one to the other type of spicule at least twice, but there appears to be no reason for not assuming the same thing to have occurred 3, 4, 5 or more times. The same author places the genus *Nematospira* in the Heligmosominae as having long spicules. However, examination of spicule length in members of this group shows that Dikmans (1935) found a variation of from 230 to 800μ in species of the genus *Longistriata* and Travassos (1921) reports a variation of form 100 to 250μ in species of the genus *Viannaia*. Spicule length, therefore, is obviously a poor character. Form of the species appears to be a better character than length, since there is some correlation with length, short spicules being usually complex and long spicules being usually simple. However, short spicules may be simple and long spicules complex, and all gradients in degree of complexity may occur. The presence or absence of a gubernaculum has never been seriously considered as a character of greater than generic significance in this group.

The bursal ray pattern, while generally satisfactory as a generic character, usually varies in degree rather than in character, and has not thus far been found satisfactory as a character for higher grouping.

In casting around for other possible characters on which to base groups it may be noted that the tail of female trichostrongyles of the genera *Ollulanus, Anoplostrongylus, Molinostrongylus, Nycteridostrongylus, Strongylacantha* and *Tricholeiperia* are all similar in having large conoid caudal mucrones. These structures in the genus *Cheiropteronema* are small and rounded, those of the genera *Nicollina, Bradypostrongylus* and *Allintoshius* are small and conoid or papilloid, those of the genus *Bidigiticauda* are elongated and digitiform, those of *Histiostrongylus* apparently are digitiform while those of the closely related genus *Spinostrongylus* are papilloid. Furthermore, only the genera *Ollulanus* and *Bidigiticauda* are viviparous; only *Cheiropteronema* has a reduced atypical bursa while the genus *Bidigiticauda* has a partially reduced bursa, indicating a tendency toward bursal reduction. For the reasons just stated, the writer believes the above-mentioned genera constitute a natural group for which the subfamily name Ollulaninae is applied. The following recharacterization of the subfamily Ollulaninae and key to the included genera will serve to illustrate the writer's concept of the group.

Subfamily Ollulaninae

DIAGNOSIS.—Trichostrongylidae: Cephalic cuticle inflated, sometimes bearing spines, or an umbellate collar; tail of female bearing caudal projections in the form of mucrones. Spicules variable; gubernaculum present or absent. Bursa variable, sometimes reduced in size and atypical. Female usually with 2, rarely with 1 ovary; oviparous or viviparous. Parasites of chiropterans, edentates, or carnivores.

TYPE GENUS.—*Ollulanus* Leuckart 1856.

KEY TO GENERA OF OLLULANINAE

1. Female viviparous 2
   Female oviparous 3
2. Female with 1 ovary and 3 large conoid caudal mucrones; male with short divided spicules, gubernaculum present, externodorsal ray present...... *Ollulanus* Leuckart 1856
   Female with 2 ovaries and 2 digitiform caudal mucrones; male with elongated undivided spicules, gubernaculum present, externodorsal ray absent..... *Bidigiticauda* n. g.

3. Cephalic region bearing cuticular spines, female tail conoid...................... 4
Cephalic region not bearing cuticular spines, female tail not conoid.............. 5
4. Cervical spines present; spicules extremely large, not transversely striated........
Spinostrongylus Travassos 1935
Cervical spines absent; spicules extremely large transversely striated.............
Histiostrongylus Molin 1861
5. Tail of female bluntly rounded; caudal mucrones minute; bursa reduced.........
Cheiropteronema Sandground 1929
Tail of female not bluntly rounded; caudal mucrones conoid; bursa well developed.. 6
6. Paired subventral teeth present..........................*Strongylacantha* v. Beneden 1873
Paired subventral teeth absent... 7
7. Caudal mucrones small.. 8
Caudal mucrones massive.. 10
8. Dorsal tooth present.. *Nicollina* Baylis 1930
Dorsal tooth absent... 9
9. Dorsal ray cleft, each branch bifurcate; spicules twisted....... *Bradypostrongylus* Price 1928
Dorsal ray not cleft, bearing 2 pairs of short digitations......... *Allintoshius* Chitwood 1937
10. Cephalic inflation umbellate or collar-like (spicules variable).................... 11
Cephalic inflation not umbellate or collar-like (spicules setose, striated).......... 13
11. Spicules setose ....*Tricholeiperia* Travassos 1935
Spicules short, twisted, hooked or divided.. 12
12. Spicules divided distally................................. *Torrestrongylus* Vigueras 1935
Spicules hooked distally.............................. *Anoplostrongylus* Boulenger 1926
13. Dorsal tooth present, well developed; wide ventral cervical alae present..........
Nycteridostrongylus Baylis 1930
Dorsal tooth absent; ventral cervical ala absent....... *Molinostrongylus* Skarbilovitch 1934

Family CUCULLANIDAE

Seuratum cancellatum n. sp.

(Figs. 40-42)

Description.—Oral opening surrounded by an internal circle of 6 reduced papillae and an external circle of 4 double papillae. Stoma rudimentary; esophagus rounded anteriorly, stomatal region not distinct. Cuticle bearing longitudinal ridges broken by transverse striae to form rows of spines over the entire circumference in mid-region of the body, disappearing anteriorly and posteriorly but more extensive on the ventral preanal surface than on the dorsal preanal surface.

Male 2.0 mm. long by 80μ wide. Esophagus 250μ long; anus 80μ from posterior extremity, tail usually rounded at tip. For distribution of genital papillae see Figure 42. Spicules 80μ long; gubernaculum 66μ long. *Female* unknown.

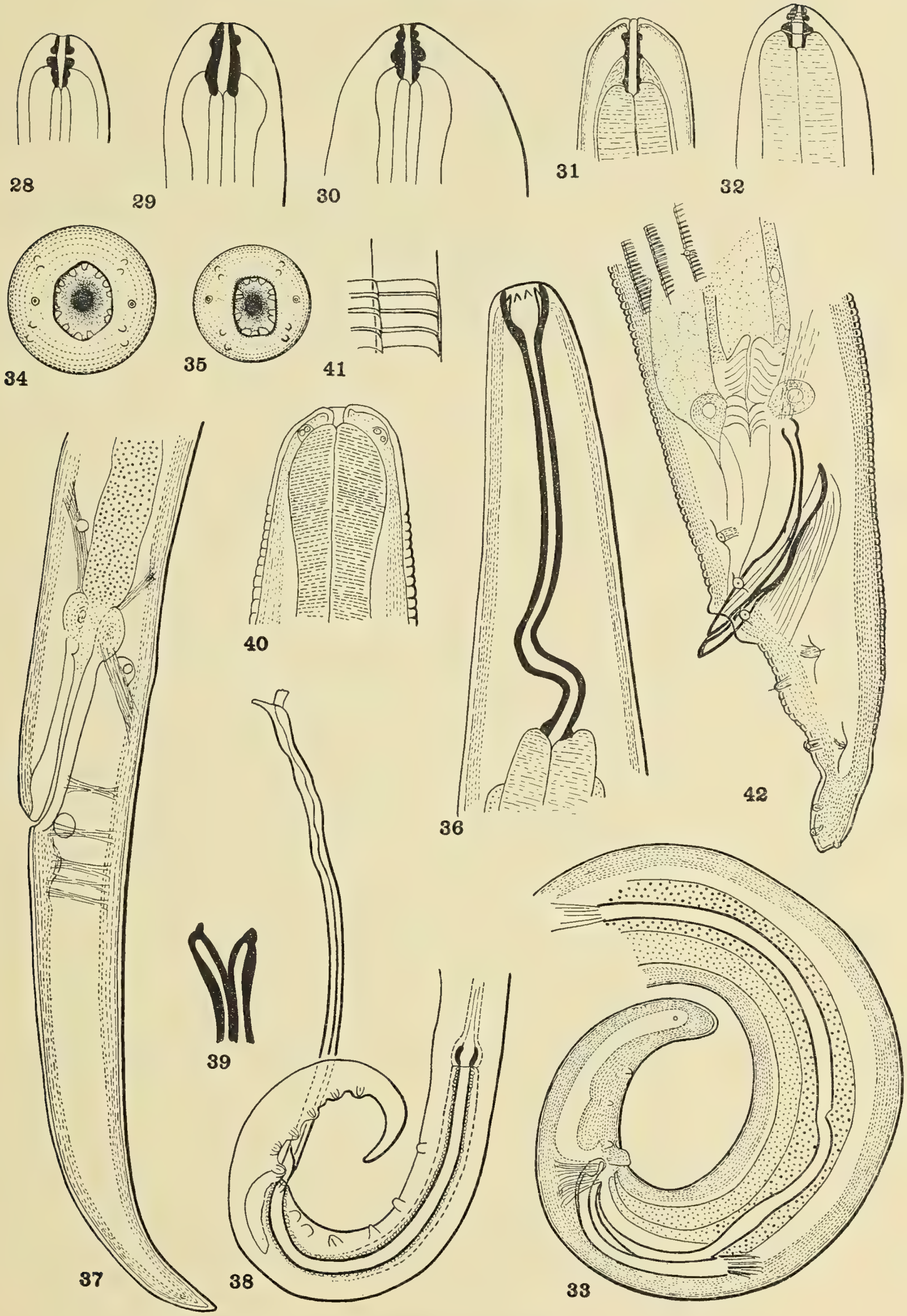
Host.—*Natalus mexicanus* Miller.

Location.—Cysts in lung.

Locality.—Balaam Canche Cave, Chichen Itza, June 22.

Specimen.—U. S. N. M. Helm. Coll. No. 42493 (type).

Seuratus cancellatum differs from *S. tacapense* (Seurat 1915) in that the stomatal region (vestibule) is not distinct, the genital papillae differ in arrangement and the male of *S. cancellatum* is but 2 mm. long while that of *S. tacapense* is 18.5 mm. long. The only other species of *Seuratum, S. mucronatum* (Rudolphi 1809) n. comb. (=*Ophiostoma mucronatum*) must be regarded as a *species inquirenda* until redescribed (Refs. 6, 13, 16, 19, 27, 32, 34).



Figs. 28-42—NEMATODES

Family THELAZIIDAE

Rhabdochona kidderi Pearse 1936

(Figs. 34-39)

DESCRIPTION.—Oral opening guarded by 14 teeth, 2 median, 4 submedian and 8 sublateral; no teeth at base of prostom.

Male 5.9 to 6.12 mm. long by 50 to 75μ wide. Stoma 100 to 116μ deep. Esophagus 1.43 to 1.60 mm. long. Anus 160 to 200μ from posterior extremity. Genital papillae consisting of 7 pairs of preanal and 6 pairs of postanal papillae. Left spicule 660 to 810μ long, bifurcate at tip; right spicule 50 to 70μ long.

Female 7.42 to 12 mm. long by 90 to 120μ wide. Stoma 100 to 140μ deep. Esophagus 1.12 to 1.29 mm. long. Anus 150 to 201μ from posterior extremity. Vulva dividing body in proportions of 51:49 to 58:42; eggs 29 to 40μ long by 13 to 21μ wide.

HOSTS.—*Rhambdia guatemalensis decolor* Hubbs and *Typhlias pearsei* Hubbs.

LOCATION.—Intestine.

LOCALITIES.—Kaua Cave, Kaua, June 17; Balaam Canche Cave, Chichen Itza, June 22; San Isidro Cave, Merida, July 5; San Bulha Cave, Merida, July 13.

SPECIMENS.—U. S. N. M. Helm. Coll. Nos. 42471 and 42473.

This species was recently described by Pearse (1936) from *Rhambdia guatemalensis* collected in caves of Yucatan during an earlier expedition. The original description gave no information as to the number and form of the teeth and no comparison with other species of the genus. The species is herein redescribed with such supplementary information as seemed necessary.

Rhabdochona kidderi differs from the majority of species of the genus *Rhabdochona* in the extreme dissimilarity in size of the spicules, having a ratio of about 10:1, while those of most of the other species have a ratio of not over 5:2 (Refs. 2, 12, 15, 25, 38, 43, 47). The present species appears to be most closely related to *R. opinensis* Hsü 1933, but differs from that species in the number of teeth and in the form of the spicule tip.

Family DIPETALONEMATIDAE

Litomosoides hamletti Sandground 1934

(Figs. 31, 33)

DESCRIPTION.—*Male* 14.6 mm. long by 120μ wide. Stoma 21μ deep (Fig. 31); esophagus 652μ long; anus 63μ from posterior extremity; tail bluntly rounded, slightly conoid; genital papillae postanal (Fig. 31). Left spicule 202μ long; right spicule 63μ long.

HOST.—*Glossophaga soricina leachii* Gray.

LOCATION.—Body cavity.

LOCALITY.—Xkyc Cave, Calcehtok, August 7.

SPECIMEN.—U. S. N. M. Helm. Coll. No. 42482.

Litomosoides sp.

(Fig. 32)

Description.—*Female* 15 mm. long by 190μ wide. Stoma 12μ deep (Fig. 32); esophagus 583μ long; anus 583μ from posterior extremity; vulva 810μ from anterior extremity.

Host.—*Artibeus jamaicensis yucatanicus* (Allen).

Location.—Body cavity.

Locality.—Ebizt Cave, Oxkutzcab, July 19.

Specimen.—U. S. N. M. Helm. Coll. No. 42494.

Owing to the many synonyms already existing in the genus *Litomosoides* (Refs. 8, 9, 18, 20, 23, 29, 40, 44, 45, 46) the writer does not feel justified in adding further to the confusion by describing new species on the basis of single specimens. Three genera and seven species have already been proposed, the present status being as follows:

Litomosoides Chandler 1931 [synonyms: *Vestibulosetaria* Vogel and Gabaldon 1932; *Finlaynema* Vigueras 1934].

Species.—*L. carinii* (Travassos 1919) Vaz 1934 [synonyms: *Filaria carinii* Travassos 1919; *Filaria patersoni* Mazza 1928; *Litomosoides sigmodontis* Chandler 1931; *Micropleura sigmodoni* Ochotoreno and Camballero 1932; *Vestibulosetaria patersoni* (Mazza 1928) Vogel and Gebaldon 1932; *Litomosoides patersoni* (Mazza 1928) Chitwood 1933].

Hosts.—*Sciurus* sp., *Holochilus vulpinus; Sigmodon lispidus; Mus decumanus; Nectomys squamipes.*

L. circularis (Linstow 1899) Chandler 1931 [synonym: *Filaria circularis* Linstow 1899]. Host.—*Hesperomys* sp.

L. guiterasi (Vigueras 1934) Sandground 1934 [synonym: *Finlaynema guiterasi* Vigueras 1934]. Host.—*Artibeus jamaicensis parvipes.*

L. hamletti Sandground 1934. Host.—*Glossophaga soricina soricina.*

L. brasiliensis Lins de Almeida 1936. Host.—*Myotis* sp.

Of these species the single female, *Litomosoides* sp., described above is most similar to *L. carinii,* particularly in the elongate probular form of the tail. Sandground (1934) and others have laid considerable stress on the form of the stoma, but the writer finds this structure entirely too variable for serious consideration. Figures 28-30 illustrate the stoma in specimens of *L. carinii* which, incidentally, were all obtained by Chandler from *Sigmodon hispidus* and represent paratypes of *L. sigmodontis.* No two specimens have yet been observed with identical stomata.

The form of the tail in both sexes appears to be significant but unfortunately the tail of the female in *L. guiterasi* and *L. brasiliensis* has neither been described nor illustrated and it seems probable that Vigueras has erred in stating that in *L. guiterasi* the anus is terminal.

Family DORYLAIMIDAE

Dorylaimus yucatanensis n. sp.

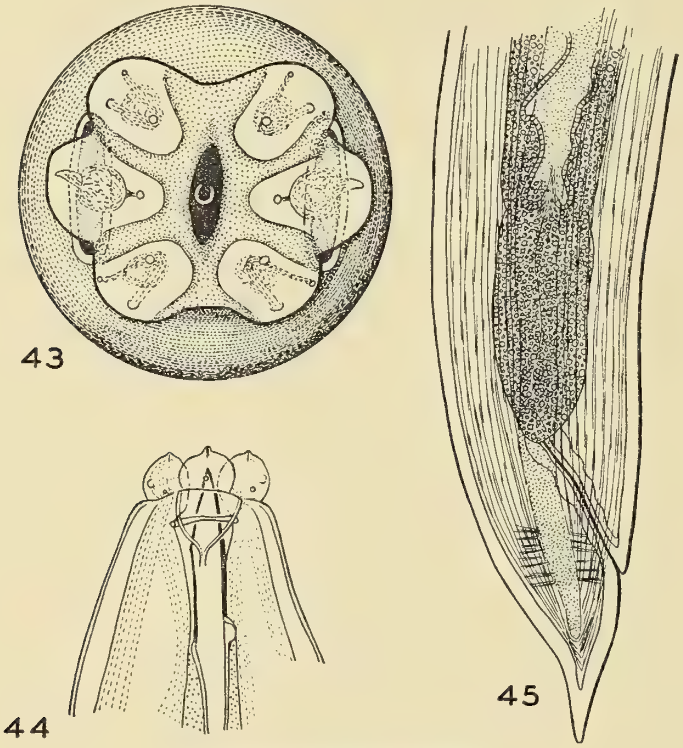
(Figs. 43-45)

Description.—*Male* unknown. *Female* 1.07 mm. long; α 14.5; β, 3.3; γ, 25; vulva dividing body in proportions 47.6:52.4. Cuticle not ridged. Lips distinct, discrete, set off by a constriction (Fig. 43). Amphids about ½ cephalic body diameter, opening slightly more than ½ length of stylet; esophagus enlarged for about ½ its length; rectum slightly longer than anal body diameter; prerectum 1½ times as long as rectum; tail conoid, dorsally somewhat convex and set off. Specimen non-gravid, ovaries each about 1/10 length of body.

Habitat.—Fresh water.

Locality.—Luchil Cave, Tixcacal, July 6.

Specimen.—U. S. N. M. Helm. Coll. No. 42497 (type).



Figs. 43-45—NEMATODES

A single specimen of this species was found in a tow net by Dr. Pearse. This species appears to be most closely related to *D. diadematus* Cobb 1936, but differs in that the lips are less prominent than those of *D. diadematus;* the tail of the female (Fig. 45) is somewhat convex dorsally while in *D. diadematus* it is conical; and the amphids are extremely prominent in *D. yucatanensis* while they are not figured (presumably they must not be prominent) in *D. diadematus* (Refs. 36, 39).

Family TRICHURIDAE

Capillaria sp.

A single female capillarid was obtained from the intestine of a bat, *Micronycteris megalotis mexicana* Miller in Xmahit Cave, Tekax, July 31.

Family ASCARIDIDAE

Agamascaris sp.

Numerous larval ascarids were obtained from the small intestine of a snake, *Tropidodipsas sartorii* Cope, in Loltun Cave, Oxkutzcab, July 26.

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V

LEECHES (HIRUDINEA) FROM YUCATAN CAVES

J. Percy Moore
Zoology Department, University of Pennsylvania

This collection yielded only three specimens of small leeches, representing two species, parasitic on fishes, and insufficient both on account of limitation of material and state of preservation to permit of complete study and description. One of these is the type of an undescribed species and is supplemented by two examples of the same species from Guatemala.

Piscicola platense Cordero (1933)

Two strongly contracted, curved, and very hard specimens are referred somewhat doubtfully to this species. Each measures approximately 8 mm. long, with the "neck" or anterior region 1.4 mm., 2 mm. in greatest width and 1.2 mm. in depth, the caudal sucker being slightly under 1 mm. in diameter. The form, as usual in strongly contracted species of the genus, is sharply divided into two regions of which the anterior ("neck") is subterete, very slightly depressed, slightly wider in the middle, narrowest at the anterior end, and somewhat wider at the caudal or clitellar end; the posterior region ("abdomen") about four times as long and three times as wide as the "neck", more depressed, subelliptical in section, and tapering both ways from the middle. Head very small, slightly narrower than the preclitellum, faintly bilobed at the anterior margin, the margin contracted to a broad oval ventral opening with the apex caudad and the greatest width about one-half the total width of the head. Clitellar region not conspicuously reduced in diameter but distinctly less than the anterior end of the abdomen which, however, is little developed into a prepuce-like, enveloping fold; clitellum constituted of somites XI and XII each of three primary annuli with faint indications of further subdivision on the dorsum. Gonopores separated by two primary annuli, the ♂ at XI/XII, ♀ at XII *a2/a3*. No sensillae, nephropores or lateral pulsatile vesicles can be distinguished in surface views and the specimens are not suitable for sectioning. Caudal sucker contracted to a hemispherical cup with a deep cavity and no discernible eye-spots. There is no definite color pattern, but minute specks of pigment, together with mucous glands, are scattered thickly throughout the translucent skin.

The exact annulation cannot be determined and is especially obscure at the ends. Between the head and the clitellum (somites V-X) the full 18 primary annuli can be counted on the venter, with further subdivisions, especially on the dorsum, of the more posterior segments, but these are so narrow, crowded and confused as to preclude any exact determination. On many of the complete somites of the middle region the 3-6-12 divisions of the primary, secondary and tertiary annulation can be distinguished, but there are no visible external criteria of somite limits.

These specimens resemble *P. punctata* Verrill especially in having but one pair of eyes on the caudal part of the head. But the structure of the clitellum differs from this species and resembles *P. platense,* which is the principal reason for referring it to the latter, the original examples of which were collected in Argentina and Uruguay on the fish *Hoplias malabaricus.* The present examples were taken by Dr. Pearse in San Bulha Cave, Motul, Yucatan, on July 9, 1936, from the gill chamber of *Rhamdia guatemalensis decolor* Hubbs (No. 98); and from gill chamber of the same host, San Bulha Cave, Merida, July 13, 1936 (No. 107).

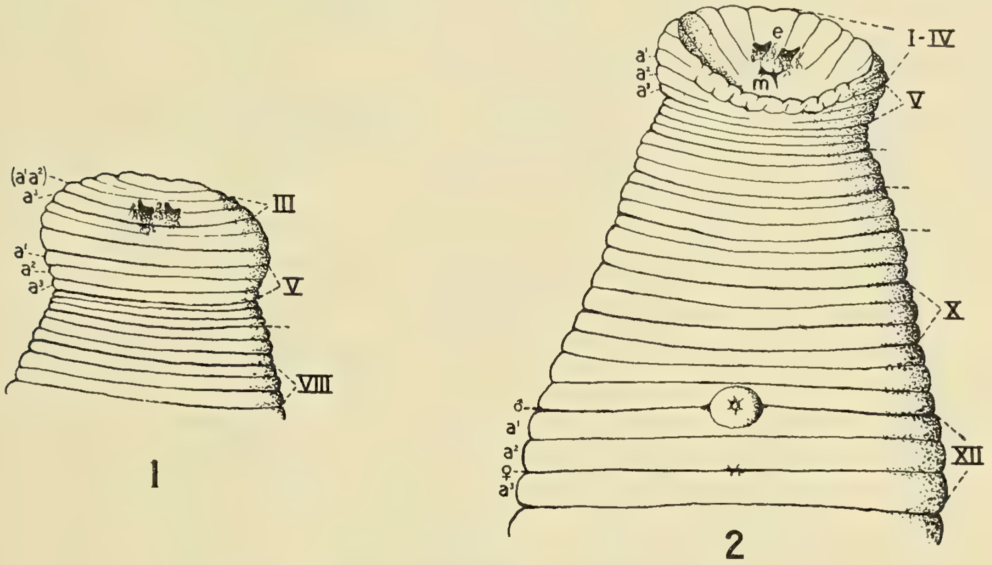
Glossiphonia magnidiscus n. sp.

In size, form, and general proportions this species resembles *Oligobdella* but has triannulate complete somites and a much larger caudal sucker. The strongly contracted type specimen measures in mm.: length 7.6, to ♂ pore 1.4, widths, at buccal ring (IV-V) .7, ♂ 1.3, maximum (XIX) 1.5, anus ca. .6; depths at the same points nearly uniformly ca. .5; diameter of caudal sucker 2.5. The two Guatemalan specimens are similar in form and proportions but owing to more extreme contraction are relatively deeper. Form as of a rather strongly contracted young glossiphonid; width of body nearly uniform for most of length except that a slight constriction near the middle results in bulges at the clitellum and XVIII/XIX; anterior to XI the body tapers to the nuchal constriction and posterior to XXII more rapidly to the narrow caudal peduncle.

Head definitely expanded, in the type nearly twice as wide as long, the preocular region contracted, truncate, with a steep profile. Eyes one pair on III, large, with black pigment cups, directed obliquely forward (Fig. 1) close together and in the type partly joined by loose pigment, in the Guatemalan examples embedded in a common mass of pigment. On the venter deeply cupped, with a sharply defined and prominent caudal rim (buccal ring) to form the cephalic sucker, the anterior margin slightly crenulated by the annuli of somites I-III, the separating furrows of which are clearly defined on the venter, converging obliquely toward the center, where the rather large mouth is situated (Fig. 2, m) in somite III. No definite clitellum. Gonopores (Fig. 2, ♂, ♀) separated by two annuli, ♂ in the furrow XI/XII, a rather large round pore surrounded by an elevated ring, the ♀ a transverse slit in the furrow XII *a2/a3,* the region including them wrinkled. Anus a conspicuous opening with lobulated border on the narrow caudal peduncle near the center of the sucker and between somite XXVII and a succeeding small annulus. Caudal sucker a very large, thin disk with smooth margins and no distinctive markings. The integuments of the body and sucker are quite smooth with no trace of papillae or warts and neither sensillae nor nephropores could be detected in surface views of the entire specimens.

Color faded, but body and suckers nearly uniformly tinted with pale rusty brown without any visible pattern but which seems to reside in minute chromatophores mostly disposed between the muscle fibers of both longitudinal and transverse layers.

Annulation (Figs. 1, 2) sharply defined by contraction and the resulting deepened furrows, except on parts of the head, but toward the ends of the body the annuli are very short and crowded. Somite I a median bilobed lip, faintly delimited from II on the dorsum, but on the venter the clearly defined bounding furrows obliquely convergent to the level of the eyes. II uniannulate but faintly divided into two on the dorsum, and on the venter undivided but with the limiting furrows bounding a wedge-shaped area reaching nearly to the mouth. III 2-annulate, $(a1\ a2)=a3$, the first including the eyes on the dorsum and the mouth on the venter. IV 3-annulate, $a1<a2<a3$, on dorsum where it forms the greater part of the post-ocular region of the head and on the venter the post-oral part of the cavity of the sucker and the buccal ring. V 3-annulate dorsally but shorter than IV, $a1$ and $a2$ more closely united, $(a1+a2)>a3$, forming the extreme caudal part of the head and on the venter losing its furrows to form the post-buccal ring bounded caudally by the nuchal constriction. VI 3-annulate, $a1<a2<a3$, the reduced $a1$ bounding and entering into the nuchal constriction, $a1$ and $a2$ more closely united. VII and VIII 3-annulate, similar to VI but successively larger. IX-XX 3-annulate, complete and typical of the entire middle body region; $a2$ seems usually slightly larger than the others and all furrows are of equal depth, but owing to strong and irregular contraction the exact proportions are obscured. XXI-XXIV 3-annulate but approaching the caudal end $a3$ tends to become reduced and $a1$ relatively larger. XXV shows definite closer union of $a1$ and $a2$ and might



Figs. 1, 2—*GLOSSIPHONIA MAGNIDISCUS*

1: Dorsal aspect of head end of type showing eyes, somites (roman numerals), and annuli (italics), × 40.
2: Ventral view of first 12 somites showing eyes (e) seen through the tissues, mouth (m), annulation (italics on left), male (♂) and female (♀) sex pores, × 40.

be considered biannulate. XXVI biannulate and XXVII uniannulate, with traces of subdivision on the right margin.

When cleared and mounted a few points relating to the internal anatomy can be made out. The long, slender, tapered proboscis begins in V and ends in IX, where it is continued by a delicate **S**-shaped esophagus, by the sides of which the diffuse salivary glands, which cannot be seen clearly, lie. Post-genital gastric caeca 7 pairs (XIII to XIX) containing a little blood; first three pairs small, the next three larger, reaching nearly to the margins; all except the first, slender, bifurcated distally into two simple lobes, occupying annuli *a1* and *a2*, the last pair arising in XIX, reflexed by the side of the intestine to XXII and bearing in each of the four somites a bilobate lateral branch. Owing to the opacity and superficial wrinkling of the clitellar region the terminal male organs are difficult to distinguish but atrial cornua appear to be large, the epididymes formed on each side by a compact snarl of rather short, wide tubes having no long posterior loop as in typical *Glossiphonia* and approaching *Placobdella.* Five pairs of testes containing active developmental stages are clearly distinguishable at XIV/XV to XVIII/XIX and a smaller pair doubtfully at XIII/XIV. Ovisacs are short and wide, extending through three somites to the end of XV.

The large size of the caudal sucker indicates that this may be a permanent or nearly permanent parasite. This is also a characteristic of young leeches of many species but the presence of many spermatogonia and spermatid-balls in the testes indicate maturity.

The type was taken from the gills of *Rhamdia guatemalensis decolor* Hubbs (Yu Fish No. 30) in San Bulha Cave, Motul, Yucatan, on July 26, 1932, by Pearse and Creaser and the two cotypes, along with six examples of an undetermined species of *Cystobranchus,* from the mouth of *Petenia splendida* at El Paso de Caballo on Rio San Pedro de Martin, Guatemala, on April 15, 1932, by C. L. Lundell. The *Cystobranchus* is the sames species reported in Hirudinea of Yucatan Cenotes.

VI

EARTHWORMS IN YUCATAN CAVES

Grace E. Pickford
Osborn Zoological Laboratory, Yale University

INTRODUCTION

The earthworm fauna of Central America is very inadequately investigated and although the present collection was not a large one it has proved to be of quite unusual interest. It contains two well-known peregrine species of the genus *Dichogaster,* viz. *D. affinis* and *D. bolaui.* The taxonomy of these two species is in a state bordering upon confusion and the study of this new material has provided an opportunity of reviewing the problem. As a result it has been possible to synonymise the following species which were formerly regarded as distinct: *D. sinuosus* Stephenson 1931=*D. affinis* (Michaelsen 1890), and *D. rugosa* (Eisen 1896)=*D. bolaui* (Michaelsen 1891).

Of greater general interest are the two endemic species of Acanthodrilinae, both new to science. One of these belongs to the ancestral genus *Eodrilus,* although it appears to be somewhat aberrant; the other is referable to a new genus which presents characters of unusual interest. In the latter case it seemed advisable to take this opportunity of making a thorough anatomical study of the species; all too little is known about the vascular system and micro-anatomy of the Acanthodrilinae. This is very unfortunate in view of the fact that it is the stem subfamily of the Megascolecidae.

It is doubtful whether any of the species here recorded can be regarded as truely cavernicolous forms; presumably they merely wandered into the caves from adjacent regions. In the absence of a further knowledge of the earthworm fauna of Yucatan no conclusions can be drawn.

Family MEGASCOLECIDAE

Subfamily Acanthodrilinae

Genus *Eodrilus* (Michaelsen)

Eodrilus oxkutzcabensis n. sp.

(Figs. 1-5)

MATERIAL

1. Puz Cave, Oxkutzcab; near mouth (Loc. 136); July 21, 1936, A. S. Pearse leg.: 2 clitellate specimens, alcohol; type and paratype.

2. First cave on San Roque Road, Oxkutzcab; either by pool, 60 m. from mouth (Loc. 139), or near mouth (Loc. 140); July 22, 1936, A. S. Pearse leg.: 3 non-clitellate, semi-mature specimens, alcohol.

3. San Isidro Cave, Merida; near mouth (Loc. 70); July 3, 1936, A. S. Pearse leg.: 1 very immature specimen, alcohol.

DESCRIPTION OF TYPE AND PARATYPE

LENGTH.—49 mm. (paratype, 42 mm.).

DIAMETER.—Maximum, at anterior end, 2 mm.; slightly less in the clitellar region.

COLOR.—Both specimens from this locality are now stained a uniform light brown, they were apparently originally unpigmented (compare specimens from other localities).

PROSTOMIUM.—Epilobic (½); in the paratype there is a cross furrow approximately on the level of the anterior margin of segm. 1.

CLITELLUM.—On segms. 13-17 dorsally, ⅓13-⅓17 ventrally; ring-shaped.

COPULATORY PAPILLAE.—Absent.

DORSAL PORES.—Present; the position of the first dorsal pore is very difficult to see because they become progressively smaller anteriorly, it may be at intersegm. 4/5; in the type the first two really conspicuous pores are at intersegms. 12/13 and 13/14, they are absent at the subsequent clitellar intersegments but appear again at 16/17; in the paratype dorsal pores are visible at all the clitellar intersegments.

NEPHRIDIAL PORES.—Rather difficult to see except at the anterior end and in the clitellar region; situated on the anterior borders of the segments slightly above setal line *d*.

SPERMATHECAL PORES.—Two pairs at intersegms. 7/8 and 8/9 respectively, lying deep in the intersegmental furrows whose walls are slightly swollen in their proximity.

FEMALE PORES.—One pair on segm. 14; situated immediately in front of the *a* setae on a ventral, transversely ovoid glandular area on the anterior third of segm. 14, which extends laterally to setal line *b* on each side.

PROSTATIC PORES.—Two pairs on segms. 17 and 19 respectively, on conical papillae in setal line *b*, not approximated towards the mid-ventral line.

MALE PORES.—One pair on segm. 18, in the seminal grooves which run between glandular walls and connect the male pore with the prostatic pores of its side; the ventral setae of segm. 18 are not visible externally but dissection (see below) shows that the male pore is situated just lateral to the *b* seta.

INTERSETAL RATIOS.—The setae are fairly closely paired; in the anterior region *aa* is about equal to *bc*, in the middle and posterior regions *aa* is slightly less than *bc*; *aa:bc:dd*, for anterior region=ca. 1:1:4, for middle and posterior regions=1:1+:5.

The following observations on internal anatomy refer only to the type; the paratype was not dissected.

GIZZARD.—Single and muscular in segm. 5.

PHARYNGEAL GLANDS.—The salivary glands do not extend backwards beyond septum 4/5, in accordance with the presence of a muscular gizzard.

CALCIFEROUS GLANDS.—Wanting.

INTESTINE.—Widens abruptly in segm. 15.

TYPHLOSOLE.—Begins as a small ridge in the posterior half of segm. 15 and reaches its full size in segm. 16.

HEARTS.—Two pairs of large intestinal hearts are present, situated in segms. 11 and 12 respectively; slender connections with both dorsal aorta and supra-intestinal vessel were visible; in segms. 7-10 there are dorso-ventral commissural vessels of much smaller diameter than the true hearts. In segm. 7 both dorsal aorta and commissural vessels are fringed with whitish glandular appendages; serial sections of this region were not made but presumably these must be masses of chloragogen cells.

NEPHRIDIA.—A single pair of meganephridia in each segment; the duct is without terminal vesicle and enters the body wall immediately in front of the closely approximated bases of the lateral pair of setae (*cd*).

TESTES AND SPERMIDUCAL FUNNELS.—Holandric; two pairs each, free in segms. 10 and 11 respectively.

VASA DEFERENTIA.—Unite on each side in segm. 18 and immediately enter the body wall just lateral to setal follicle *b;* the ventral setae are very small and close together but can clearly be seen in the dissection.

SEMINAL VESICLES.—Two pairs, lobulated, depending from septa 9/10 and 11/12 into segms. 9 and 11 respectively.

OVARIES.—One pair, typical in segm. 13.

OVISACS.—One pair depending from septum 13/14 into segm. 14; with finger-like processes, filled with eggs.

PROSTATES.—Long coiled tubular glands occupying many segments each; the duct is confined to the first prostatic segment which also contains the beginning part of the gland; the ectal part of the duct is very stout and muscular, it is straight and opens not directly onto the prostatic papilla but into a shallow atrium which receives also the openings of the penial setal follicle and of the copulatory pouch (see below); the ental part of the duct (ca. ½) is thin and coiled, it is sharply demarcated from the gland which widens out abruptly. On each side the prostatic glands extend back into segm. 28; that is to say, the anterior pair occupies twelve and the posterior pair ten segments each.

COPULATORY POUCHES.—Immediately in front of the prostatic duct at its ectal opening, and just lateral to the entrance of the penial setal follicle sac, there is a small muscular ovoid pouch which communicates with the common prostatic atrium (Fig. 1). Such a structure has not been described previously for any Acanthodriline worm.

PENIAL SETAL RETRACTOR MUSCLES.—The penial setal sacs lie alongside the prostatic glands but do not extend so far backwards; the retractor muscles of the anterior pair originate from the body wall at intersegm. 24/25, those of the posterior pair at intersegm. 25/26.

PENIAL SETAE.—Only one bundle of penial setae appears to be associated with each prostatic atrium; each bundle contains one full-grown functional and one half-grown reserve seta; it was not possible to ascertain whether this bundle is homologous with the *a* or *b* bundles which are normally modified on the prostatic segments of other Acanthodrilinae, the matter is discussed below. The penial setae are long and slender, diminishing very gradually in diameter from base to tip; the proximal half of the stem is almost straight but the distal half is gently curved; the extreme distal end is strongly recurved to form a sharply pointed hook. Below the hook is a series of several large, single teeth. The functional seta of the left anterior bundle (Fig. 2) has three such large teeth and one very small one which is situated more proximally, the reserve seta of this bundle (Fig. 3) has four very large and two less conspicuous teeth, farther back there is another very inconspicuous one. On their outer sides, in the region of the large teeth, both setae show a few very faint and slightly serrated markings. In the left posterior bundle the functional seta has five large teeth, the reserve five large and a sixth very small one.

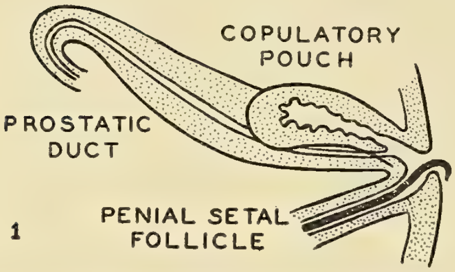
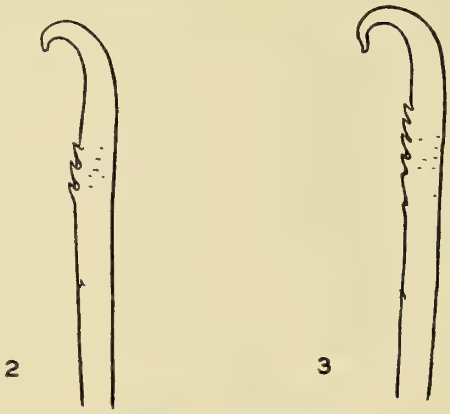


FIG. 1—*EODRILUS OXKUTZCABENSIS* n. sp.

Diagram showing relations of penial setal follicle, prostatic duct, and copulatory pouch at the prostatic atrium, based on dissections and serial sections.



FIGS. 2, 3—*EODRILUS OXKUTZCABENSIS* n. sp.

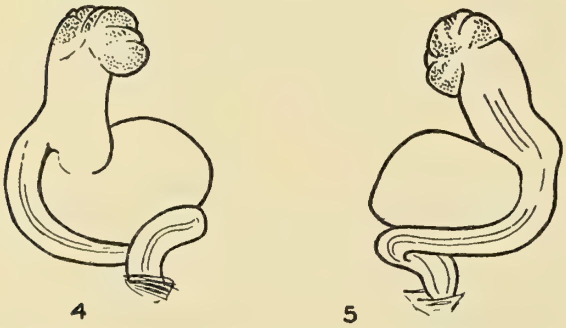
2: Distal end of functional penial seta from left anterior bundle of type, × 333.3.

3: Distal end of reserve penial seta from same, × 333.3.

DIMENSIONS OF PENIAL SETAE.—The following measurements refer only to functional full grown setae of the left anterior and left posterior bundles: length=ca. 3.5 mm.; maximum diameter near base=ca. 42.5μ; about middle of proximal half of stem=21-22μ; about middle of distal half of stem=14-15μ; at narrowest immediately below ornamented region=ca. 11.5μ.

SIGMOID SETAE.—Distal end faintly ornamented; length seta L. 22 *a*=0.283 mm., nodal index=55.5, diameter at node 21μ; genital setae are not present.

SPERMATHECAE (Figs. 4 and 5).—The form of the spermatheca is very peculiar and characteristic on account of the elongation of the duct; the ampulla is ovoid and receives the duct and diverticulum



FIGS. 4, 5—*EODRILUS OXKUTZCABENSIS* n. sp.
Left anterior spermatheca of type.

4: Viewed from left side, × 26.6.

5: Viewed from right side, × 26.6.

together by a short common passage entering on its anterior face. The long slender duct coils itself around the ampulla and passes to its exit at the spermathecal pore. The diverticulum has a wide straight stalk which bears a knobbly and evidently internally-chambered cap at its free extremity. The total length of the diverticulum is about half the total length of the duct but it is twice as wide. Each spermatheca is confined to the segment to which it belongs.

IMMATURE SPECIMENS

The immature specimens from other localities do not call for a detailed description, since in all essential features they are in complete agreement with the type.

Color.—On account of the discoloration of the type and paratype it is important to observe that all the other specimens are unpigmented.

Penial setae.—The most immature specimen (from Loc. 70) has four growing setae in each bundle but only a single bundle is present in relation to each prostate; the most advanced of these precursories is essentially similar to a penial seta of the adult type, it is more slender (diam.=9.5μ immediately below ornamented region) and bears only two not very conspicuous teeth; the next precursory has already four teeth and resembles the adult type in every respect. It is evident that the number of teeth is variable even in adult setae; the broken tip of a penial seta belonging to this species was found in the vial containing specimens from the San Roque Road cave (Loc. 139 and 140), this seta has as many as eight large teeth the tips of which are very worn.

DISCUSSION

Several attempts were made, both by means of whole mounts of the prostatic region and by serial sections through an immature specimen, to elucidate the homologies of the penial setal bundle and copulatory pouch. It seemed probable that the single setal bundle might represent the *b* follicle but in no case was it possible to find definite evidence of the missing *a* bundle. Serial sections indicated traces of what might have been an atrophied *a* bundle immediately ventral to the prostatic atrium, but the picture was inconclusive. It is evident that earlier stages would have to be studied, beginning at the time of hatching when presumably as in *Chilota purcelli* (Pickford, 1937) the ventral setae of the prostatic segments are still of the unmodified sigmoid type. In the meanwhile two possibilities remain open: (1) as suggested above, the *a* setal follicle may have degenerated while the *b* follicle forms the functional penial setae; or (2) the copulatory pouch may represent the metamorphosed follicle of either the *a* or *b* seta, presumably (from its position) the latter.

The presence of this copulatory pouch is in itself rather remarkable. Černosvitov (1935) created a new Octochaetine genus *Neogaster* partly on the basis of a somewhat similar bursa copulatrix which, in this case, receives the vas deferens on segm. 18. The condition found in *E. oxkutzcabensis* would almost justify a similar procedure, but it seems desirable to reserve judgment until more is known about other neotropical species of *Eodrilus*.

Even if one neglects this important character, since in most cases the species descriptions are not sufficiently detailed to preclude the possibility that some such structure was present, it is extremely difficult to assess the relationships of this apparently rather aberrant species. Eleven previously described American species are referable to the genus *Eodrilus.* Of these four are from South America (Chile and Patagonia) and, apart from geographical considerations, show no special features which might relate them to *E. oxkutzcabensis.* One of the remaining seven species, *E. ulrici* Michaelsen, comes from Cuba; it has been well described and shows distinctive characters which immediately separate it from the species under consideration. The same may also be true of the single Mexican species, *E. vasliti* (Eisen); unfortunately mature specimens were not obtained and the description is therefore incomplete. Eisen (1896) states that penial setae are wanting as also are the ventral setae of the prostatic segments; on the other hand he maintains that each prostatic pore receives two muscular, not glandular, prostates. His description and figures suggest that one or both of these "muscular prostates" may have been empty penial setal follicles. However, his drawings show no sign of a copulatory pouch and the species seems to differ from *E. oxkutzcabensis* in several other respects, notably in having three pairs of hearts in segms. 10-12, and in possessing a very rudimentary typhlosole.

The five remaining American members of the genus are Guatamalan endemics and it is among these forms that one might expect to find the nearest relatives of *E. oxkutzcabensis.* Three are provided with calciferous glands and may therefore be excluded, viz.: *E. crystallifer, E. hamiger* and *E. tamajusi.* One of the two remaining forms, *E. tecum-umami* Michaelsen, is an unusually large worm, moreover it is pigmented dark violet-grey and has a number of distinctive anatomical characters which preclude it from consideration. It is difficult to estimate how closely *E. oxkutzcabensis* may be related to the remaining Guatamalan species, *E. whitmani* (Eisen); both are rather small, unpigmented worms but they appear to differ in a number of important characters. In *E. whitmani* the penial setae are unornamented, the gizzard is said to be in segm. 6, the intestine begins in segm. 16, the form of the spermathecae is different and seminal vesicles are present in segms. 9, 11 and 12 instead of only in segms. 9 and 12. Moreover Eisen's original description (1900) and figures make it quite clear that in *E. whitmani* both penial setal bundles are present and there is no copulatory pouch.

Genus *Balanteodrilus* nov.

DIAGNOSIS

SETAE.—Eight per segment (lumbricine arrangement).

NEPHRIDIAL PORES.—In a single series on each side.

SPERMATHECAL PORES.—One pair at intersegm. 7/8.

MALE PORES.—One pair at intersegm. 18/19.

PROSTATIC PORES.—One pair on segm. 19 (balantine arrangement).

GIZZARD.—Strongly muscularised, single, in one simple oesophageal segment.

CALCIFEROUS GLANDS.—Five pairs of transversely partitioned pockets opening dorsally in segms. 7-11 respectively.

NEPHRIDIA.—Meganephric, without terminal vesicles.

TESTES AND SPERMIDUCAL FUNNELS.—Two pairs each, free in segms. 10 and 11 respectively (holandric arrangement).

PROSTATIC GLANDS.—Tubular.

TYPE.—*Balanteodrilus pearsei* n. sp.

DISCUSSION

The specimens described below are undoubtedly referable to the subfamily Acanthodrilinae of the Megascolecidae, although, as will be shown immediately, they show special features which parallel those found in the most primitive members of the Megascolecinae. They present, furthermore, an interesting combination of characters which might logically have been anticipated although hitherto unrecorded among the Acanthodriline genera.

As is well known to students of the Oligochaeta, the Acanthodrilinae include a somewhat miscellaneous assemblage of forms which have sprung up around the ancestral Megascolecid genus *Eodrilus* (=*Acanthodrilus* s. l.). Many of them are highly modified but not in those directions which have led to the evolution of the three derived subfamilies, the Megascolecinae, Octochaetinae and Ocnerodrilinae.[1]

Balanteodrilus is an Acanthodriline genus which retains the primitive holandric arrangement of the male gonads; it is therefore excluded from the proandric Section Chilotacea. On the other hand it does not exhibit either of the special modifications, reduplication of the gizzard or alternation of the nephridial openings, which would relate it to the Diplocardiacea or Maoridrilacea respectively. It must therefore be referred to the Section Acanthodrilacea, the most ancestral division of the Acanthodrilinae. It can be derived directly from the ancestral genus *Eodrilus* by loss of the anterior pair of prostates (balantine reduction).

In *Eodrilus* the male ducts open on segm. 18 and there are two pairs of tubular prostates which open on segms. 17 and 19 respectively. This primitive acanthodriline arrangement is retained in a number of derived genera while in related forms the posterior pair of prostates may be lost (microscolecine reduction). The alternative, balantine reduction, is of less frequent occurrence; in fact among the Acanthodrilinae only two balantine species, belonging to the endemic South African genus *Udeina,* were hitherto known. But whereas *Udeina* has undergone proandric reduction, and is therefore referred to the Chilotacea, *Balanteodrilus* remains holandric and is in this respect closer to the ancestral type.

A recent study of the South African Acanthodrilinae (Pickford, 1937) has indicated that the structure of the nephridia may be of considerable importance in the systematic analysis of this subfamily. The ancestral genus *Eodrilus* has

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[1] The classification here adopted is that of Stephenson (1930, p. 721) except that since the publication of this work the fifth subfamily of the Megascolecidae, the Diplocardiinae, has been disbanded (see p. 95).

simple meganephridia without dilated terminal vesicle; in various derived genera the nephridial duct has acquired a muscular enlargement, the nephridial vesicle. It is not at present clear whether a separation of the Acanthodriline genera into two sections on the basis of this character alone would reflect their natural relationships; nor indeed, in the present state of our knowledge, is such a division possible. Pending a more complete investigation of non-South African genera, it is preferable for the present, to retain the old division into sections on the basis of quite other characters even if these sections must to some extent be regarded as polyphyletic. Nevertheless it is of great interest to find that this new neotropical genus belongs, like the ancestral *Eodrilus,* to the avesiculate group.

The position and structure of the calciferous glands in *Balanteodrilus* is also of taxonomic interest. As a general rule calciferous glands are wanting among the Acanthodrilinae; they are absent for example in all the South African species. When present they appear frequently to be little more than lamellated outpouchings of the oesophageal wall but it must be admitted that their internal structure has not been adequately investigated. The segments in which such glands occur vary greatly from species to species and up to the present it has not been possible to relate their position and structure to the classificatory system of the Acanthodrilinae. In a previous contribution (Pickford, 1937, p. 79) I enumerated the position of the calciferous glands in those species of *Eodrilus* for which they had been recorded; some of these are neotropical forms and it is evident that a complete reinvestigation of the American Acanthodrilinae is needed.

Probably the only adequate account of the calciferous glands in any Acanthodriline genus is that of Smith (1924) who has studied what he believes to be incipient calciferous glands in members of the North American genus *Diplocardia.* In this genus there are longitudinal folds in the oesophageal wall of segms. 14 and 15, and in two of the species investigated, *D. floridana* and *D. mississipiensis,* the free edges of these folds unite to enclose longitudinal tunnels in the wall of the oesophagus. The secretion of calcium by these glands does not appear to have been demonstrated. Whatever may be the true nature of the glands in *Diplocardia* it is clear that they have nothing in common with the rather highly developed and specialised type described below for *Balanteodrilus pearsei.*

The relation of *Balanteodrilus* to other subfamilies of the Megascolecidae may now be considered. In the first place the peculiar structure of the calciferous glands so closely resembles that described by Stephenson and Prashad (1919) for *Eutyphoeus waltoni* that one is tempted to inquire into the exact relationships between this genus and the Octochaetinae. The ancestral Octochaetine genus *Howascolex* differs from the Acanthodrilinae primarily in the possession of more than one pair of nephridia in each segment. Other characters which appear in the derived genera are not of such fundamental significance and in many ways even the most highly evolved Octochaetine genera retain an essential similarity to their Acanthodriline ancestors; for example they possess simple tubular prostatic glands and penial setae.

The gulf between the Octochaetinae and the Acanthodrilinae has to a large extent been bridged in recent years by the discovery that certain neotropical species formerly referred to the genus *Eodrilus* (=*Acanthodrilus* s. l.) possess one or more pairs of meronephridia in addition to the regular meganephridia in each segment (Pickford, 1937). Although little is known as to their internal structure, well-developed calciferous glands are present in some of these American species, provisionally referred to the genus *Howascolex*. *Balanteodrilus* has already undergone balantine reduction and cannot therefore be directly ancestral to the Octochaetinae, but if its peculiar type of calciferous gland should prove to be shared by some neotropical species of *Howascolex* and *Eodrilus* it might well be regarded as an offshoot lying close to the Octochaetine stock.

Balanteodrilus also possesses features which relate it to *Diplotrema,* the ancestral genus of the Megascolecinae. *Diplotrema* is essentially an Acanthodriline genus which has undergone that peculiar type of balantine reduction which Stephenson has termed megascolecine; the anterior pair of prostates has been lost and the posterior pair of prostatic pores has moved forward so as to open on segm. 18, near to the male pores. In *Balanteodrilus* there has been no forward migration of the prostatic pores but rather a backward migration of the male pores to the extreme posterior margin of segm. 18. This appears to constitute a fundamental difference between the two genera because the forward migration of the prostatic pores is the first step towards their union with the male pores on segm. 18, the condition characteristic of all other genera of the Megascolecinae. *Balanteodrilus* thus merely parallels the Megascolecine ancestry, a view which is confirmed by the presence of well-developed calciferous glands of so distinctive a type; in the primitive Megascolecine genera calciferous glands are either rudimentary or wanting.

Balanteodrilus appears to have nothing in common with the remaining Megascolecid subfamily, the Ocnerodrilinae, although if the calciferous glands were confined to segms. 9 and 10 the matter might assume a different aspect. It is in any case evident that the American members of this subfamily are inadequately known.

Balanteodrilus pearsei n. g., n. sp.

(Figs. 6-14; Pls. 1-3)

MATERIAL

1. Gongora Cave, Oxkutzcab, Yucatan; either on floor, under debris, 10 m. from mouth (Loc. 109), or among roots, 45 m. from mouth (Loc. 111); July 16, 1936, A. S. Pearse leg.: 3 clitellate specimens of which two are complete and one is without posterior end, 1 very immature specimen; well preserved, in alcohol; *type* and *paratypes*.

2. San Isidro Cave, Merida, Yucatan; near mouth (Loc. 70); July 3, 1936, A. S. Pearse leg.: 1 clitellate and 1 semi-mature specimen, the former without posterior end, also fragments and tail ends probably referable to this species; in rather poor preservation, alcohol.

DESCRIPTION OF TYPE

Length.—75 mm.

Diameter.—Max. ca. 4 mm. in middle region of body behind the clitellum, slightly constricted in the clitellar region.

Color.—Apparently unpigmented, slightly pinkish brown; at the time of their first examination the specimens had not been sufficiently long in alcohol for all traces of pigmentation to have dissolved away if it had been originally present.

Prostomium.—Tanylobic.

Clitellum.—On segms. 13-½18 dorsally, complete ventrally from ½14-½16 inclusive, although less strongly developed.

Copulatory papillae.—Median ventral oval papillae are present at the following intersegms.: 11/12, 12/13, 13/14, 18/19 and 19/20, the two last are so poorly demarcated from each other as to appear almost continuous across segm. 19; there is a small oval papilla on the posterior border of segm. 20 in the mid-ventral line.

Dorsal pores.—First visible at intersegm. 11/12.

Nephridial pores.—Very difficult to see except in the clitellar region and at the extreme posterior end of the body; situated on the anterior borders of the segments slightly above the line of the lateral pair of setae (*cd*).

Spermathecal pores.—One pair at intersegm. 7/8 on the posterior face of a conspicuous oval papilla situated in setal line *b* on each side; the pore is at the bottom of a crescent-shaped, anteriorly concave groove.

Female pores.—On a conspicuous transversely ovoid ventral field which is situated on the anterior half of segm. 14; the pores themselves lie slightly medio-ventral and anterior to the *a* setae at a distance about equal to *ab* measured diagonally forwards from seta *a* towards the mid-ventral line.

Male porophores (Fig. 6).—The male pores are situated at intersegm. 18/19, probably on the extreme posterior border of segm. 18 (see below), in setal line *b;* they open on the anterior part of a large swollen papilla, the male porophore, which also bears the openings of the prostatic ducts. Since this glandular swelling entirely obliterates the intersegmental furrow, it is not possible to ascertain the morphological position of the male pores with greater accuracy. The porophores of left and right sides are not approximated towards the mid-ventral line but are separated from each other by the partially fused ventral copulatory papillae of intersegms. 18/19 and 19/20. The male pore is connected with the prostatic pore by a deep groove, the seminal groove, which is strongly curved (laterally convex). The prostatic duct and penial setal follicles open close together in a shallow atrium

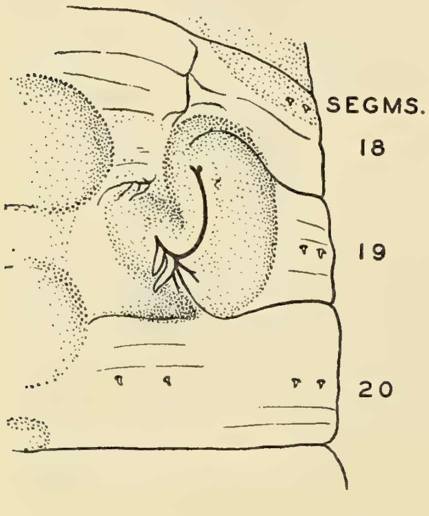

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Fig. 6—*BALANTEODRILUS PEARSEI* n. g., n. sp.

View of left male porophore of type, × 26.6.

which is continuous with the posterior end of the seminal groove. The porophore papillae are roughly triangular or almost **T**-shaped, with the apex of the triangle or leg of the **T** directed towards the mid-ventral line. The curved tips of the penial setae project outwards into the postero-medial hollow behind the papilla.

INTERSETAL RATIOS.—The setae are closely paired, intersetal ratios are approximately as follows: on segm. 6, *aa:bc:cd*=1:1:3; in the middle region, 1:1:5, on segm. 18 the ventral pair of setae (*ab*) is apparently wanting.

GIZZARD.—In segm. 5, muscular and well developed; when the gizzard has been slit open its stout cuticular lining is well seen and can be lifted away from the epidermis.

PHARYNGEAL GLANDS.—In correlation with the presence of a well-developed oesophageal gizzard the salivary glands do not extend backwards beyond the fourth segment.

CHROMOPHIL GLANDS.—Small tufted glandular masses are attached to the coelomic wall of the oesophagus in segm. 6 and the beginning of segm. 7; serial sections through one of the paratypes (see below) show that these have the typical appearance of chromophil glands.

CALCIFEROUS GLANDS.—Five pairs of unstalked oesophageal swellings in segms. 7-11 respectively, indicate externally the position of the calciferous glands; the first pair is the largest and the rest follow in decreasing order of size; between each pair of swellings the oesophagus is intersegmentally constricted at the insertion of the septa. When the oesophagus is opened along the mid-dorsal line the glands are revealed as transversely lamellated pockets which communicate by a wide dorsal aperture with the lumen of the alimentary canal. Four or five major transverse lamellae partition the cavity of the pouch into chambers which are in turn subdivided by smaller incomplete lamellae of second and subsequent order. The structure of these glands was further examined on one of the paratypes by means of serial transverse sections (see below).

INTESTINE.—The oesophagus terminates abruptly and the intestine widens out in the middle of segm. 14.

TYPHLOSOLE.—Present; beginning gradually in segm. 15, it increases in size and reaches its full development in segm. 17.

SEPTA.—3/4, 4/5, and 5/6 are very thin; 6/7-11/12 thickened.

HEARTS.—The last pair is in segm. 12; the more important blood vessels of the anterior region were checked and found to be in accordance with the diagram (Fig. 14) which was reconstructed from serial sections through one of the paratypes.

NEPHRIDIA.—Meganephric and avesiculate; the nephridial duct enters the body wall in front of the lateral pair of setae (*cd*) in approximate accordance with the external position of the nephridial pore.

TESTES AND SPERMIDUCAL FUNNELS.—Holandric; two pairs, free in segms. 10 and 11 respectively.

VASA DEFERENTIA.—On each side the two vasa deferentia run side by side and unite immediately before entering the body wall at intersegment 18/19, just in front of the septum.

Seminal vesicles.—Two pairs depending from septa 9/10 and 10/11 into segms. 9 and 11 respectively; the posterior pair are smaller but more highly lobulated.

Ovaries.—One pair, in segm. 13.

Ovisacs.—One pair, depending from septum 13/14 into segm. 14.

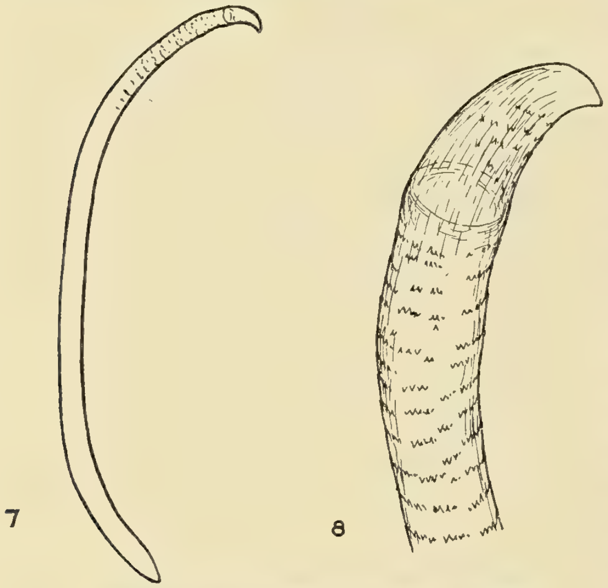
Oviducts and oviducal funnels.—Normal.

Prostates.—Duct U-shaped and very muscular, opening into the seminal groove immediately postero-lateral to penial seta *b;* gland tubular, highly coiled, in segms. 18 and 19.

Latero-ventral constrictor muscles.—Two strong muscular bands run from the lateral body wall to be inserted in the mid-ventral line; the first pair lie immediately behind septum 18/19, in front of the prostatic duct; the second pair lie behind the prostatic duct and in front of septum 19/20.

Penial setal retractor muscles.—Originate dorso-laterally from the body wall in segm. 19.

Penial setae.—(Figs. 7, 8).—Setae of the *a* and *b* bundles essentially alike, those of the *b* bundle slightly shorter. The setae are stout and, in the middle region of the stem, fairly straight; the greatest diameter is near the base which is bent at an obtuse angle; the distal quarter is more strongly curved and the curvature appears in mounted preparations to be in one plane and in the direction of curvature of the base. In setae which have not been compressed the distal curvature has a marked spiral twist. The extreme distal end of the seta is sharply pointed and slightly hooked; somewhat below the tip the distal end is slightly dilated and shows a peculiar internal ring structure (Fig. 8); this is apparently not an artifact since it was also seen in penial setae from other specimens. Approximately the distal quarter of the seta is ornamented with short rows of teeth which, at their maximum development, tend to meet so as to form scarcely interrupted rings around the stem. On the inner face of curvature the ornamentation extends farther both proximally and distally.



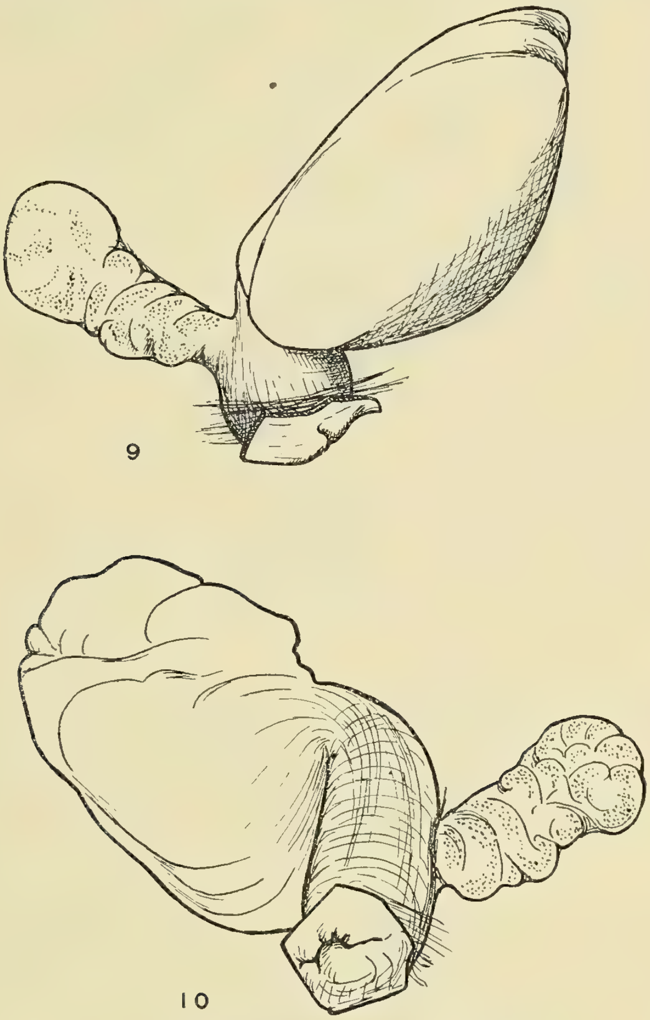
Figs. 7, 8—*BALANTEODRILUS PEARSEI* n. g., n. sp.

7: Left penial seta *b* of type, × 66.6.
8: Distal end of left penial seta *a* of type, × 333.3.

Dimensions of penial setae.—The following measurements refer to the left bundle: length, *a*=ca. 1.26 mm., *b*=ca. 1.21 mm.; maximum diameter near base, *a* and *b* alike=ca. 63.5μ; about middle of proximal half of stem diam. *a* and *b*=ca. 50μ; about middle of distal half of stem diam. *a* and *b*=ca. 46μ.

Sigmoid setae.—The distal end is ornamented with short rows of teeth; a ventral seta from segm. 23 measures 0.23 mm. in length and has a nodal index (hilt × 100/shaft) of 57; diameter at node = 27µ.

Genital setae.—Although present in the damaged paratype and in the specimens from Locality 70 (see below), the type has no modified genital setae; the ventral setae of segm. 8 are simple unmodified sigmoid setae.



Figs. 9, 10—*BALANTEODRILUS PEARSEI* n. g., n. sp.
9: Antero-lateral view of left spermatheca of type, × 26.6·
10: Postero-lateral view of same, × 26.6·

Spermathecae (Figs. 9, 10).—Ampulla irregularly ovoid, duct stout and muscular, diverticulum elongately pear-shaped and marked externally by numerous swellings and protuberances which clearly reflect an internal chambering; the diverticulum which projects forwards through septum 7/8 into segm. 7, enters the duct on its anterior face; the ampulla is loosely bound to septum 8/9 by strands of tissue which overlie but do not actually unite with its surface.

DESCRIPTION OF PARATYPES

Length.—The complete mature specimen is slightly longer than the type, measuring 80 mm.

Clitellum.—In the two mature specimens the clitellum has the same extent as in the type.

Copulatory papillae.—In the complete adult specimen ventral intersegmental papillae are present at 11/12, 12/13 and 19/20; the damaged specimen has conspicuous ventral papillae at 11/12, 12/13 and 13/14, and ill-defined papillae at intersegm. 18/19 and on the posterior border of segm. 19.

Dorsal pores.—In the complete adult specimen the first dorsal pore is very inconspicuous at intersegm. 10/11; in the incomplete specimen it is at 11/12 and is also very small.

Genital setae.—These are only present in the damaged specimen and since they were not conspicuous externally they were overlooked until after the anterior segments had been sectioned. No description is therefore possible but presumably they resembled those described below for the San Isidro specimens. As in the case of the latter it is the ventral setae of segm. 8 which are modified; in the complete mature specimen which was only dissected the ventral setae of this and neighbouring segments are unmodified.

In all other characters these specimens are in essential agreement with the type. The very immature specimen from the type locality is undoubtedly referable to this species; all determinable characters are in agreement and there are rudiments of the prostatic glands in segm. 19, together with the tips of growing penial setae which are of unmistakable form.

On account of the remarkable structure of the calciferous glands and of the interest which attaches to this new Acanthodriline genus it was decided to make serial sections through the anterior region of the incomplete paratype; segments 6-15 were removed for this purpose. The special results of this investigation are reported below under a separate heading.

DESCRIPTION OF SPECIMENS FROM SAN ISIDRO CAVE

These specimens are not very well preserved and their examination was therefore difficult. All essential characters are recorded and there can be no doubt that they are in satisfactory agreement with the type, such minor differences as exist, e.g., in the extent of the clitellum, being of no taxonomic importance. The examination assumed more than routine importance when it was discovered that the description of the form of the genital setae in this species must rest on those of these specimens since genital setae are wanting in the type and were only discovered in one paratype after the anterior segments had been sectioned. Unless otherwise stated the following description refers to the mature specimen which is incomplete posteriorly.

Color.—Unpigmented.

Prostomium.—Faintly tanylobic.

CLITELLUM.—On segms. 13-17 inclusive, saddle-shaped and extending ventrally only to setal line *a*.

COPULATORY PAPILLAE.—Wanting in both specimens.

DORSAL PORES.—Present, at least behind the clitellar region; their anterior extent is uncertain.

NEPHRIDIAL PORES.—Difficult to see; in the clitellar region they are situated on the anterior borders of the segments very slightly above setal line *d*.

SPERMATHECAL PORES.—One pair at intersegm. 7/8, on swollen papillae in setal line *b*.

FEMALE PORES.—Situated on a transversely ovoid glandular area on the anterior ventral part of segm. 14.

MALE POROPHORES.—A pair of rounded papillae on segm. 19 in the line of the ventral setae (*ab*); on the postero-medial border of the papilla there is a shallow common atrium which receives both the openings of the prostatic duct and penial setal follicles. The penial setae, lying immediately in front, can be seen through the macerated and therefore semi-transparent skin. The male pore which is apparently situated on the extreme posterior border of segm. 18, is connected with the prostatic atrium by the seminal groove. The exact position of the male pore was determined by an examination of the cuticle which, in this partially macerated specimen, was easily stripped away from the body; it is definitely not on the extreme anterior border of segm. 19 but on the extreme posterior border of segm. 18. Since the exact position was impossible to determine in the type the above observation provides important supplementary evidence.

SETAE.—Closely paired.

GIZZARD.—In segm. 5.

CALCIFEROUS GLANDS.—Five pairs are present as in the type but their structure is difficult to recognise on account of poor preservation.

INTESTINE.—Begins in segm. 14.

TYPHLOSOLE.—Present, first visible in segm. 16.

LATERAL HEARTS.—Last pair in segm. 12.

NEPHRIDIA.—Can only be studied behind the clitellar region; the terminal duct enters the body wall in front of the lateral setae (*cd*) and is without dilated vesicle.

TESTES AND SPERMIDUCAL FUNNELS.—Two pairs, free in segms. 10 and 11 respectively.

VASA DEFERENTIA.—Unite on each side in segm. 18 and immediately enter the body wall; there is a highly glandular area ventral to the male pore in this region and no trace of the ventral setae could be found on segm. 18.

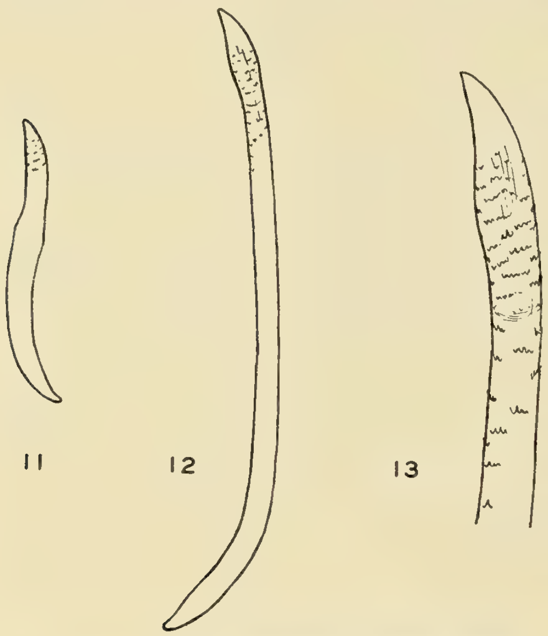
SEMINAL VESICLES.—Two pairs depending from septa 9/10 and 10/11 into segms. 9 and 11 respectively.

PROSTATES.—Duct muscular, U-shaped; gland very long, tubular and highly coiled, occupying two segments.

PENIAL SETAL RETRACTOR MUSCLES.—Originate from the body wall latero-dorsally at and in front of septum 19/20.

Penial setae.—Closely resembling those of the type; dimensions of setae from the left bundle are as follows: length, *a*=ca. 1.24 mm., *b*=ca. 1.16 mm.; diameter, maximum near base (? too great, poor preservation has made the setae soft and therefore easily compressed) *a*=ca. 85μ., *b*=ca. 73μ.; about middle of proximal half of stem, *a*=ca. 57μ., *b*=ca. 63μ.; about middle of distal half of stem, *a*=ca. 44μ., *b*=ca. 50μ.

Genital setae.—In both specimens the ventral setae of segm. 8 are modified as genital setae. Setae of the *a* and *b* bundles are alike and their form (Fig. 12) can be regarded as intermediate between that of unmodified sigmoid setae (Fig. 11) and that of fully modified penial setae (Fig. 7.) It is unfortunate that no half-grown specimens of this species are available because it seems probable that the form of the genital setae might closely resemble that of precursory penial setae; but the immature paratype is so young that only the growing tips of the modified setae are apparent, while the semi-mature specimen from this locality has already developed full-grown penial setae of the adult type. The position of the node in the genital setae is obscure, it may be represented by an ill-defined swelling about one-third from the base. The base is bent at an obtuse angle but the more distal part of the stem is moderately straight; the extreme distal end terminates in a slightly curved and sharply pointed tip. Below the tip the distal end (Fig. 13) is slightly dilated and immediately below the dilation it shows internal ring markings reminiscent of those found in the penial setae. Approximately the distal quarter of the stem is ornamented with rows of teeth which tend to align themselves to form interrupted rings.



Figs. 11-13—*BALANTEODRILUS PEARSEI* n. g., n. sp.

11: Left sigmoid seta *b* from segment 9 of mature specimen from San Isidro Cave, × 133.3.
12: Left genital seta *b* from segment 8 of mature specimen from same, × 133.3.
13: Distal end of genital seta shown in Fig. 12, × 333.3.

Dimensions of genital setae.—The following measurements refer to those of the left side: length, *a*=0.63 mm., *b*=0.605 mm.; diameter, maximum near base, *a*=34.5μ., *b*=27μ.; about middle of stem, *a*=23μ., *b*=25μ.; immediately below the distal swelling, *a*=17.5μ., *b*=21μ.; at distal swelling, *a*=21μ., *b*=25μ.

Sigmoid setae.—Sigmoid seta L. 9 *b* was mounted for comparison with the genital setae; in general it closely resembles the sigmoid seta from segm. 23 which was studied in the case of the type but exact measurements show that the nodal index is slightly higher, i.e., the node is shifted slightly towards the base. The phenomenon appears to be the same as that found in the ventral setae of segm. 18

in *Chilota purcelli* (Pickford, 1937), here also close proximity to highly modified setae (the penial setae of the prostatic segments) has apparently had the same slight effect on the position of the node. The dimensions of sigmoid seta L. 9 *b* are as follows: length=0.285 mm., nodal index=62, diameter at node=27µ.

SPERMATHECAE.—Essentially similar to those of the type.

STUDY OF SERIAL SECTIONS

As already mentioned, and primarily with a view to elucidating the structure of the calciferous glands, segms. 6-15, inclusive, were removed from the damaged paratype and prepared for sectioning. In order to remove possible grit the piece to be sectioned was treated with a dilute solution of hydrofluoric acid in 70 per cent alcohol. By an oversight the specimen was not first decalcified with hydrochloric acid and in consequence characteristic crystals of calcium fluoride have appeared in the calciferous glands (see especially Pl. 3, figs. 9, 10, x). This observation serves to confirm the nature of these organs.

A complete series of transverse sections was obtained and their study permits not only a more detailed account of the anterior regions of the alimentary canal but also a reconstruction of the main blood vessels of the anterior region.

ALIMENTARY CANAL.—The strongly muscular gizzard (Pl. 1, fig. 1, GIZZ.) is the most conspicuous feature at the beginning of the series; the thickness of its wall is largely made up of circular muscle fibres although on the very outside there is a relatively thin longitudinal layer. The gizzard is lined by a regular low columnar epithelium which secretes on its surface an unusually stout cuticle, ca. 11.5µ in thickness. Among the bases of the columnar cells are groups of shorter cells which do not reach to the surface of the epithelium; these may be replacing cells. Blood vessels penetrate the wall of the gizzard but in this region there is no sub-epithelial blood sinus.

The gizzard passes abruptly into a constricted region of the oesophagus in segm. 6 (Pl. 1, fig. 2, OES.). In this region the lining epithelium is thrown into conspicuous longitudinal folds and the relatively thin wall of the oesophagus has an inner circular and an outer longitudinal muscle coat, both only a few fibres deep. The epithelial lining consists of very tall columnar cells which, at their bases, seem to lose themselves among what previous authors have termed loose "reticular tissue." Masses of deeply staining basophil cells, no doubt homologous with the chromophil cells of other Oligochaets, are attached to the oesophageal wall in this segment (Pl. 1, fig. 2, CHROM.) and also at the beginning of segm. 7. In the anteriormost part of segm. 6 one first finds only isolated chromophil cells embedded in the sub-epithelial "reticular" tissue; later they become organised into glandular masses on the outside of the oesophagus.

The structure and function of glands such as these have been extensively investigated in other earthworms and the subject is fully reviewed by Stephenson (1930, pp. 78-88). According to Keilin (1920) these cells secrete mucin which passes into the lumen of the gut along special mucin ducts between the epithelial cells. Stephenson believes that these ducts are merely channels without proper walls. Their general appearance in *Balanteodrilus* would be in accordance with the view that the ducts are the long drawn-out necks of the mucin cells; one sees them passing at frequent intervals and usually in groups to discharge together at the surface of the epithelium. Moreover the muscular coats are obviously interrupted for their passage. Admittedly the conditions observed in this specimen which has only been "pickled" in strong alcohol cannot supply crucial evidence in such a controversy.

The lining epithelium of the oesophagus in segm. 6 and at the very beginning of segm. 7 is without conspicuous basement membrane, as is also true in the case of the gizzard. At the transition from gizzard to oesophagus the epithelial cells not only increase very greatly in height but also lose their cuticular covering; at their free edges one can find neither cilia nor rodlets, nor even a simple striated border.

In the extreme anterior part of segm. 7 the oesophagus remains of the same character as in segm. 6 and with it are associated both isolated chromophil cells within the oesophageal wall and also masses of chromophil glands attached to its outside. Almost immediately however there appear the outpouchings of the first pair of calciferous glands.

The main features of the calciferous glands have already been described from simple dissection; each consists of a pocket, open above and closed laterally and ventrally by a wall which separates it from the central lumen of the oesophagus. Their structure is further illustrated by microphotographs (Pl. 3, figs. 9-11, C.G. 1) passing through the beginning, middle and end of the first pair of glands. In the mid-ventral line where the lateral partitioning walls come together, there is a deep groove (Pl. 3, fig. 10, GR.). The tall columnar cells which form the oesophageal covering of these walls are provided with long cilia (Pl. 3, fig. 12, CIL. EP.); these cilia become progressively shorter towards the mid-ventral line, in the furrow of the V-shaped groove. Above the groove the dorsal wall of the oesophagus is lined by columnar cells of medium height which at first bear no cilia but appear to secrete a thin cuticle (Pl. 3, fig. 12, CUT.); farther back and in the four posterior gland segments the dorsal epithelium is for the most part ciliated, although the cilia are always shorter than on the lateral walls. In neither location do these cilia resemble the rodlets described by Stephenson and Prashad (1919) in *Allolobophora*. Their appearance can hardly be attributed to poor fixation because it happens that the fixation is remarkably good for alcohol-preserved material, one can find mitotic figures, for example, in the ovary.

Each calciferous gland is traversed by a limited number of vertical transverse lamellae which unite the outer oesophageal wall to the inner lateral wall of the pocket. Between these primary transverse lamellae, about four in number, are secondary foldings and the ramifications of the gland lumen ultimately tunnel into the outer wall of the oesophagus. The surface of the primary lamellae, as also the wall of the lateral lamella which turns inwards towards the interior of the pocket, is covered by a rather low columnar epithelium which is for the most part nonciliated. Where the ciliated epithelium of the oesophageal lumen passes over into the almost cuboidal epithelium of the gland, as at the free edge of the lateral lamella or on the opposed dorso-lateral wall of the gland, the cilia at first become very short and then apparently give way to a very thin cuticle which is lifted from the surface of the cells; finally this too disappears leaving only the free surface of the epithelium.

In the interior tunnellings of the gland the surfaces of the low columnar or cuboidal lining cells have that ragged or shredded appearance described by Stephenson and Prashad (1919); it is a matter of dispute whether this is to be attributed to disruption of the cells by secretory activity or whether it is due to an entanglement of very long cilia. The appearance sometimes suggests the latter and sometimes the former hypothesis and both have found their proponents.

Among the elongated bases of the epithelial cells which line the oesophageal lumen there are many scattered nuclei which evidently belong to branching cells that do not reach to the surface. This tissue has been vaguely described as reticular tissue by previous authors, but some at least of these branching cells must belong to the enteric nerve plexus; unfortunately I have before me only Roger's preliminary report on the subject (1936).

Immediately beneath this reticular tissue lies the blood sinus which ramifies in the wall of the alimentary canal from here backwards, lying between the muscular coats and the epithelial lining. Wherever they appear these blood sinuses are lined by a very distinct intima (Pl. 3, fig. 12, INT.), along whose surface lie infrequent, flattened nuclei. Much discussion has centered around this problem of the internal lining of the blood vessels in earthworms and the subject is fully reviewed by Stephenson (1930, p. 152 ff.). The occasional nuclei may belong to blood corpuscles or they may represent a true endothelial lining, although this latter hypothesis is not very generally accepted. The matter need not be further discussed here but the relation of the intima to the epithelium is of some interest since it appears to have been mistaken at times for the basement membrane, for example by Stephenson and Prashad (1919) in *Allolobophora.* In *Balanteodrilus* an intima such as that seen in the oesophageal sinus can be found lining all major blood vessels; it only appears in the alimentary canal in direct relation to the sinuses and quite obviously belongs to them (compare Pl. 3, fig. 12).

Inside the tunnellings of the calciferous glands the "reticular tissue" becomes minimal and the low epithelium rests directly on the intima of the blood sinus.

In the region of the calciferous glands the muscular coats of the oesophagus are greatly reduced and appear only as occasional fibres in its outer wall; a longitudinal band remains however in the mid-ventral line beneath the V-shaped groove.

Intersegmentally, between each successive pair of calciferous glands, the oesophagus is constricted and its inner wall is thrown into longitudinal folds (Pl. 2, fig. 6). In contrast to the anterior constricted region of segm. 6, the epithelial lining here consists of ciliated columnar cells and beneath the sub-epithelial reticular tissue there is a well-developed blood sinus. There are also no chromophil cells in these regions. Behind the last pair of calciferous glands, in segms. 12, 13 and at the beginning of 14, the narrow oesophageal tube has a somewhat similar structure; the vascular plexus is less distended but anastomosing channels are very abundant beneath the columnar ciliated epithelium. The muscular coats are very thin, consisting merely of an internal circular and external longitudinal sheet of fibres. Chloragogen cells (Pl. 2, figs. 7, 8, CHLOR.) appear covering the lateral and dorsal coelomic surfaces of the oesophagus; they are taller here than on the intestine, at least in its anterior region which was studied, but appear to be of typical structure. At the beginning of segm. 14 the longitudinal foldings of the epithelial lining increase in height and constrict the lumen of the oesophagus so as to form in this, as in other Acanthodrilinae (Pickford, 1937), a kind of oesophageal valve which guards the entrance into the intestine.

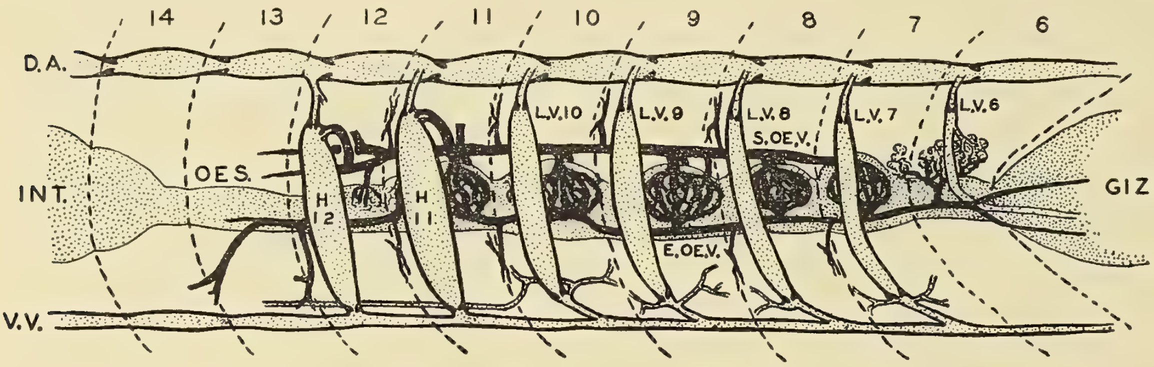


FIG. 14—*BALANTEODRILUS PEARSEI* n. g., n. sp.

Diagram of vascular system in anterior segments. D.A., dorsal aorta; E.OE.V., extra-oesophageal vessel; GIZZ., gizzard; H 11, H 12, intestinal hearts of these segments; INT., intestine; L.V. 6-10, lateral vessels of these segments; S.OE.V., supra-oesophageal vessel; V.V., ventral vessel; 6-14, numbers of somites.

The wall of the intestine has the structure characteristic of this region in other earthworms and need not be described in detail. In the anterior segments which were sectioned it is lined by a low columnar epithelium which is not ciliated, as is often the case in other forms, but which is provided with a well-marked striated border of quite typical appearance. The muscular coats are very thin and consist of the usual inner circular and outer longitudinal layers.

VASCULAR SYSTEM.—Although the specimen was not specially prepared by injection the blood vessels are well filled with blood and all the main features of the vascular system can be followed on the sections. A diagrammatic reconstruction of the vascular system in segms. 6-15 is given in Figure 14; no attempt was made to follow the smaller branches and ramifications which are presented in a strictly diagrammatic manner.

As in all earthworms the dorsal aorta (Pls. 1-3, D.A.) runs forward carrying blood to the anterior regions of the body. The direction of flow is clearly shown by the form of the valves (e.g., Pl. 1, fig. 4, D.A. VALVE), bilateral flaps which direct the blood forwards. These valves occur in every segment immediately in front of the origin of the commissural vessels; the aorta is constricted in the region of the valves. They seem to be of the same type as in the Lumbricidae (see review by Stephenson, 1930, p. 159 ff.) but to be differently located in relation to the commissural vessels.

No attempt was made to study the septal and intestinal vessels which enter the dorsal vessel behind septum 12/13 and these are omitted in the diagram. It was observed however that it receives median ventral vessels from the gut sinus and slender lateral vessels from the anterior face of the septa. This is in accordance with the condition in other earthworms; a failure to find direct connection through these septal vessels to the ventral vessel is probably to be attributed to lack of specially injected material since these vessels are very slender.

The ventral vessel lies immediately above the nerve cord. For the most part it lies freely in the body cavity but in the region of the male organs of segms. 10 and 11 it is suspended by a short mesentery (Pl. 2, fig. 5, MES.). Four pairs of large lateral vessels connect the dorsal aorta with the ventral vessel in segms. 7, 8, 9, and 10, respectively. Like the dorsal aorta these commissural vessels have a thin layer of circular muscle fibres, and possibly also an outer layer of longitudinal fibres, in the wall; it is therefore probable that they are contractile and may correctly be termed dorso-ventral hearts. Each pair originates from the dorsal aorta just after it has passed through the septum; at their origin they are constricted and provided with valvular flaps which direct the flow of blood outwards from the aorta.

Towards their ventral ends the dorso-ventral hearts are again constricted and flap valves guard their communication with a much narrower vessel which connects them with the ventral vessel. These valves direct the flow of blood ventralwards and prevent back flow into the heart. Their presence here is probably important because immediately beyond the valve the lateral vessel gives off one or two branches which supply the septum and body wall; it then passes forwards to enter the ventral vessel somewhat more anteriorly. As far as could be ascertained from the specimen sectioned the lateral vessels of segm. 7 give off an anterior and a posterior branch, the posterior one serving in part the spermathecae; the lateral vessels of segm. 8 give off only one branch; those of segm. 9 have again two branches and those of segm. 10 a single one which immediately divides, sending one vessel forwards and another backwards. The branches to septa 9/10 and 10/11 are important because they supply the walls of the seminal vesicles; the main posterior branch from the lateral vessels of segm. 10 runs backwards in the body wall alongside the vasa deferentia and could be traced as far back as segm. 15, giving subsidiary branches into the body wall and septa.

In segm. 6 a pair of lateral vessels also arise from the dorsal aorta but they do not pass ventrally to communicate with the ventral vessel; instead they run diagonally downwards and forwards to branch in the wall of the gizzard. As in the case of the hearts the origin of these vessels from the dorsal aorta is guarded by valves which direct the flow of blood outwards, just beyond the valves there is an important branch which supplies the chromophil glands of this segment. Dissections showed that the salivary glands are supplied by more anterior branches of the dorsal aorta, which were not traced on the sections.

In segms. 11 and 12 one finds the true or intestinal hearts. These are very large contractile vessels which receive blood not only from the dorsal aorta but also from the supra-intestinal vessel. The intestinal hearts communicate directly with the ventral vessel without giving off branches to the septa and body wall; their entrance is guarded by flap valves (Pl. 2, fig. 6, VA.) which project into the lumen of the ventral vessel and prevent back flow of the blood. The anterior pair of hearts, in segm. 11, receives blood from the dorsal aorta by a lateral communication on each side, guarded where it enters the heart by valves which direct the blood ventralwards. In the case of the posterior pair of hearts there is a median vessel which arises ventrally from the dorsal aorta (Pl. 2, fig. 8) and bifurcates immediately into left and right branches communicating with the hearts.

The hearts also receive blood from the supra-intestinal sinus by short connecting vessels (Pl. 2, fig. 6, COMM.); these enter the hearts immediately in front of the valves which guard their communication with the dorsal aorta. Their openings are also guarded by similar valves which direct the blood outwards into the heart.

In the region studied the ventral vessel (Pls. 1-3, V.V.) receives no tributary vessels, other than those mentioned above, and distributes no branches to the body wall. The only distributing vessels in this part of the body are therefore the branches derived from the four pairs of lateral vessels in segms. 7-10. This condition is rather remarkable and has not been found in other genera of earthworms. The ventral vessel is without valves but there can be little doubt that behind segm. 10 the flow of blood is backwards. In this, as in other earthworms (see discussion in Stephenson, 1930, p. 172), the direction of flow in the anterior part of the ventral vessel is probably forwards since it would appear to be a distributing rather than a collecting vessel.

As in the majority of Megascolecids, a subneural vessel is wanting.

The blood sinus in the wall of the alimentary canal makes its first appearance with the calciferous glands of segm. 7. The supra-intestinal vessel which here, as in other Oligochaets, is to be regarded as a differentiation of the sinus, begins also with the first pair of calciferous glands from which it receives a tributary on each side. As in the case also of tributaries from the remaining pairs of calciferous glands, this vessel is formed by the union of a number of transverse vertical channels which run in the outer wall of the gland along the lines of insertion of the primary dividing lamellae. These main channels are subdivided and connected with each other by intricate ramifications to form an oesophageal plexus. In segm. 8 the supra-oesophageal again receives a pair of tributary vessels from the calciferous glands; so also in segms. 9, 10, and 11. In segm. 9 there is in addition, at least in the specimen investigated, a median ventral communication with the sinus immediately in front of the third pair of calciferous glands. In segm. 12 the supra-oesophageal divides into left and right halves each of which receives a tributary from the oesophageal sinus. Beyond this each branch continues for a short distance and then disappears.

The blood is obviously pumped out of the supra-oesophageal and therefore out of the oesophageal sinus by the action of the hearts in segms. 11 and 12. As already mentioned these receive blood by tributary vessels from the supra-oesophageal; in segm. 11 a pair of such vessels (Pl. 2, fig. 6, COMM.) arises from the supra-oesophageal immediately above the point of entry of the tributary vessels from the last pair of calciferous glands. In segm. 12 each branch of the supra-oesophageal sends a main vessel to the heart of its side.

The oesophageal sinus receives blood from the gizzard and chromophil glands anteriorly, from the septa and body wall intersegmentally, and from the body wall posteriorly. Blood from all these parts flows first into sections of the interrupted extra-oesophageal vessels (Pl. 1, figs. 1, 2 etc., E.OE.V.). These first appear on the sections as large ventro-lateral vessels on each side of the gizzard from which they receive a tributary. Although the serial sections were not carried so far forwards it was observed on dissections that the main stem of the extra-oesophageal originates anteriorly from the pharyngeal (salivary) glands. In segm. 6 the extra-oesophageals receive on each side a large tributary vessel from the chromophil glands. These glands, like the pharyngeal glands, therefore receive blood from the dorsal aorta and return it to the oesophageal sinus by way of the extra-oesophageal vessels.

In each of segms. 7, 8, and 9 the extra-oesophageal is connected with the sinus in the wall of the calciferous gland to which it distributes blood (Pl. 1, fig. 4; Pl. 3, fig. 11, COMM.). At intersegms. 7/8 and 8/9 but apparently not at 9/10 it receives tributary vessels from the anterior faces of the septa and body wall (Pl. 2, fig. 5, S.V.). In segm. 10 the extra-oesophageal disappears into the vascular plexus of the fourth pair of calciferous glands; it reappears in the posterior part of this segment, being reorganised in relation to a lateral vein which comes in from the anterior face of septum 10/11 on each side. This short section of the extra-oesophageal loses itself again in the anterior part of segm. 11 where it branches into the wall of the fifth pair of calciferous glands. Blood brought in from septum 10/11 and adjacent regions of the body wall is thus distributed both forwards and backwards, to the fourth and fifth pairs of calciferous glands respectively. The extra-oesophageal is finally reorganised again at the posterior end of segm. 11 where it receives a tributary vessel from the anterior face of septum 11/12 and the body wall; it distributes blood to the last pair of calciferous glands and oesophageal sinus. In segm. 12 it receives a large vessel from septum 12/13; in segm. 13 it receives another large lateral vessel which runs into it from more posterior regions of the body wall (Pl. 2, fig. 8, E.OE.V.). Beyond this the extra-oesophageal rapidly diminishes and disappears in the oesophageal plexus.

The vascular system of *Balanteodrilus,* as described above, presents a number of interesting features. No really adequate account of the blood vessels is available for any Acanthodriline earthworm although the position of the last pair of hearts is recorded for the majority of species since it is a character of systematic importance. Smith and Barrett (1903) have given a short but informative account of the vascular system and course of the circulation in the common North American species *Diplocardia communis,* and this would appear to be the most complete of the published descriptions.

The arrangement of the blood vessels in the anterior region of *Balanteodrilus* resembles that of *Diplocardia* in a general way but there are important differences. In *D. communis,* as in some other species of this genus, the dorsal vessel is segmentally doubled from segm. 6 backwards. This peculiarity is not infrequent in other earthworms, both as a normal feature and as a developmental aberration. In *Balanteodrilus* the dorsal vessel is single in all specimens studied. In both genera a subneural vessel is wanting but its absence probably characterises all the less highly evolved members of the Megascolecidae. As in most species of *Diplocardia,* but not in *D. mississippiensis* according to Smith (1924), there is a well-developed supra-oesophageal vessel; in *D. communis* this lies in segms. 9-14, inclusive, whereas in *Balanteodrilus* it extends farther forwards and less far backwards, in segms. 7-12, inclusive. This difference is undoubtedly correlated with the different position of the calciferous glands and of the first intestinal segment in the two genera.

D. communis has well-developed extra-oesophageal vessels running on each side from segms. 9-13, inclusive. In *Balanteodrilus* the extra-oesophageals extend farther forwards since they return blood from the pharyngeal glands; on the other hand they are segmentally interrupted in segms. 10 and 11.

In calling these vessels "extra-oesophageals" I have followed Stephenson; Smith and Barrett use the term "lateral longitudinal" vessels. It would appear from their relations to the oesophageal vascular plexus that they should more properly be called oesophageal portal veins.

According to Smith and Barrett the extra-oesophageals are connected with the body wall, as they also are in *Balanteodrilus.* These authors make no mention of tributary vessels running into the supra-oesophageal from the body wall, such as one finds in the latter genus.

The number and relations of the lateral hearts is of greater systematic interest. In *D. communis* there are three pairs of intestinal hearts in segms. 10-12, respectively; these receive blood both from the dorsal aorta and from the supra-intestinal vessel. A similar condition prevails in *D. floridana,* while in *D. mississippiensis* there is a fourth pair of hearts in the thirteenth segment (Smith, 1924). In the more anterior segments, from segm. 9 to segm. 7 (*D. floridana, D. mississippiensis*) or segm. 5 (*D. communis*), there are only dorso-ventral commissural vessels.

In the South African Acanthodrilinae there are regularly three or four pairs of intestinal hearts, in segms. 10-12 or 10-13 respectively. The fact that *Balanteodrilus* possesses only two pairs of hearts is undoubtedly of taxonomic interest.

The course of the circulation in *Balanteodrilus* has largely been deduced from the direction of the valves. Unfortunately Smith (1924) and Smith and Barrett (1903) have not described the location of the valves in the species of *Diplocardia* which they investigated. Eisen (1896), who has given a brief account of the vascular system in "*Aleodrilus*" (=*Diplocardia*) *keyesi,* describes three or four pairs of circular valves along the course of the hearts, giving them a moniliform appearance. In *Balanteodrilus,* valves are present only at the entrance and exit. Such a difference is described in *Pheretima* by Bahl (1921) for different hearts in the same worm; in this species the intestinal hearts resemble those of *Balanteodrilus* while the dorso-ventral hearts are like those of *D. keyesi.*

The direction of the blood flow is essentially the same in *Balanteodrilus* as in *D. communis.* The only details open to dispute are: (1) the direction in the anterior part of the ventral vessel, which is probably forwards as described by Smith and Barrett, and (2) the direction in those vessels which enter the supra- and extra-oesophageals from the septa and body wall. Smith and Barrett believed that blood was distributed to the clitellar regions from the lateral longitudinal vessels, but it seems much more probable that the important tributary vessels which enter the extra-oesophageals in segms. 12 and 13 are returning blood to the oesophageal sinus.

Subfamily Octochaetinae

Genus *Dichogaster* Beddard

This genus was formerly included in the subfamily Diplocardiinae but Michaelsen (1933) has shown that all the micronephridial genera formerly placed here belong quite naturally among the Octochaetinae. Furthermore, in a recent investigation (Pickford, 1937) I have given reasons for transferring the two remaining meganephric genera to the Acanthodrilinae; the Diplocardiinae have therefore ceased to exist as a subfamily.

Dichogaster affinis (Michaelsen)

(Figs. 15, 16)

MATERIAL

1. Balaam Canche Cave, Chichen Itza; mud by pool, 90 m. from mouth (Loc. 8); July 10, 1936, A. S. Pearse leg.: 1 semi-mature specimen, damaged posteriorly, alcohol.

2. Muruztun Cave, Tizamin; on floor of a cave 11 m. deep and 120 m. long, in debris (Loc. 195); August 12, 1936, A. S. Pearse leg.: 1 quite immature specimen probably referable to this species, alcohol.

SYSTEMATIC DESCRIPTION

In spite of the fact that it is not fully sexual, the semi-mature specimen throws an interesting new light on the systematics of this species; an abridged description is therefore appended.

Length.—The specimen now measures about 15 mm.; since only the extreme posterior end appears to be damaged it is improbable that the complete animal exceeded 2 cm. at the most.

Diameter.—Ca. 1 mm.

Color.—Completely unpigmented; blood vessels show clearly through the semi-transparent skin, especially at the anterior end.

Prostomium.—Epilobic.

Clitellum.—Not developed.

Copulatory papillae.—Wanting.

Dorsal pores.—Present from intersegm. 5/6 backwards.

Spermathecal and female pores.—Not visible.

Prostatic pores.—Two pairs on segms. 17 and 19 respectively; in the line of the ventral pair of setae.

Seminal grooves.—Not developed.

Setae.—Fairly closely paired; *aa* about equal to *bc*, *dd* slightly more than ½*u*.

Gizzards.—In segms. 6 and 7.

Calciferous glands.—Three pairs in segms. 15, 16, and 17 respectively; those of segm. 15 only half the size of the other two which are about equal.

Intestine.—Begins in segm. 19.

Typhlosole.—Present.

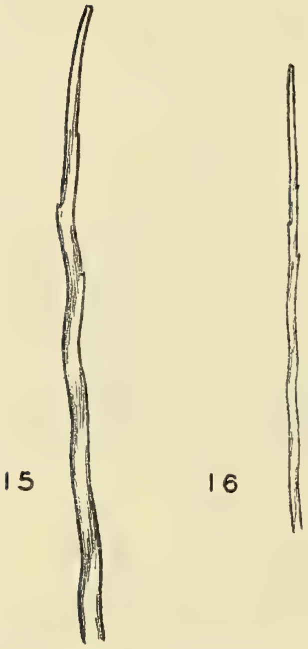
Hearts.—Three pairs in segms. 10, 11, and 12 respectively.

Seminal vesicles.—Wanting (? undeveloped).

Nephridia.—Four pairs of saccular micronephridia in each segment.

Prostates—Gland straight and tubular, duct short.

Penial setae (Figs. 15 and 16).—Setae of the *a* and *b* bundles slightly dissimilar; in each bundle there is a single full-grown seta. Setae of the *a* bundles are slightly longer and markedly stouter than those of the *b* bundles although the form is otherwise somewhat similar; the stem is slightly curved, the distal third is undulating. These undulations appear in mounted preparations to lie in one plane but properly speaking they are caused by a spiral turning of the stem; on the *a* setae the undulations are much more pronounced than on the *b* setae, but in both they form about four and a half turns of a spiral, i.e., on each side one can count four complete undulations. The last undulation on one side, and the last two on the other are marked by conspicuous teeth situated at the point of convexity; on the *b* setae these teeth are much smaller than on the *a* setae and can be seen clearly only with an immersion lens. Both types of setae terminate in a truncation.



Figs. 15, 16—*DICHOGASTER AFFINIS* (MICHAELSEN)

15: Left anterior penial seta *a* of specimen from Chichen Itza, × 800.

16: Left anterior penial seta *b* of specimen from same, × 800.

Dimensions of penial setae.—The following measurements refer to the left anterior bundle: length, a=0.32 mm., b=0.29 mm.; maximum diameter near base, a=6.6μ, b=3.6μ; diameter immediately below beginning of undulation, a=2.7μ, b=1.8μ.

Spermathecae.—Two pairs in segms. 7 and 8 respectively, situated approximately in the line of the ventral setae; the duct is stout and ovoid, it receives a slightly club-shaped, tubular diverticulum about half way down on its anterior face, the diverticulum projects upwards in the direction of the ampulla; the ampulla is obviously not fully developed, it is rather irregularly tubular in shape.

The immature specimen from the second locality was not identified with certainty but appears to belong to this species; it is certainly referable to the genus *Dichogaster.*

DISCUSSION

On account of the presence of a single fully-formed penial seta in each bundle it is hard to regard the specimen described above as either immature or sexually regressive. In the former case one would expect to find in each bundle both precursory and growing reserve setae of the adult type; in the latter case one would expect only growing setae in preparation for the next sexual phase. The appearance suggests rather that the specimen is an otherwise mature worm which, for environmental reasons, has failed to develop a clitellum and other secondary sexual characters. Such inhibition is known to result from parasitism (Sollas, 1911) and from inadequate nourishment (Avel, 1928). Too much significance should therefore not be attached to the absence of seminal vesicles, poor development of the spermathecae, etc.

Stephenson (1931) has described a species of *Dichogaster, D. sinuosus,* from Burma, which, in a later paper (1931*a*), he regards as closely related to *D. affinis.* The only important difference lies in the penial setae which in *D. affinis* are smaller, supposedly only of one type and, according to Stephenson, unornamented. He appears to have overlooked an observation by Michaelsen (1908) on a specimen of this species from Haiti, in which the penial setae were ornamented. Speaking of the penial setae Michaelsen states: "Dieselben zeigten nämlich auf den konvexen Hervorragungen der Schlängelung des distalen Endes je einen deutlichen Zahn. Dieser Unterschied hängt wohl damit zusammen, dass das untersuchte Stück von Cap Haitien etwas kräftiger war als die Originalstücke und folglich auch seine Penialborsten etwas stärker sind und ihre Skulptur besser erkennen lassen."

The semi-mature specimen described above is unquestionably similar to *D. sinuosus,* excepting for its smaller size. The absence of seminal vesicles can hardly be regarded as important since the specimen is not fully sexual; moreover in another species of this genus, *D. bolaui,* the presence or absence of seminal vesicles is at most of varietal significance. In accordance with the smaller size of the worm the penial setae of the specimen under discussion are both shorter and more slender than those of *D. sinuosus,* otherwise they are essentially similar. On the other hand their small size brings them into the range of those of *D. affinis* (length 0.3 mm., diameter 1.6μ), in fact the *b* setae are of almost identically these dimensions.

The penial setae of *D. affinis* are undulating, as in *D. sinuosus,* and the fact that the distal end terminates in a small knob rather than in a truncation can hardly be regarded as important. Apart from their smaller size the only remaining penial setal differences concern the question of ornamentation and of dimorphism.

With regard to the latter, the dimorphism is rather slight and could easily have been overlooked; in fact the older authors would undoubtedly have supposed the setae to be alike since they were accustomed to observe only well-marked differences. With regard to ornamentation, as indicated above, Michaelsen himself has later considered the penial setae of *D. affinis* to be ornamented; the number of teeth is presumably variable. Stephenson records four or five for the larger setae of *D. sinuosus* and three for the smaller. In my specimen there are only three on both *a* and *b* setae. It is perfectly possible that ornamentation may be lacking in some specimens of *D. affinis;* in any case, in view of the close agreement of all other characters, the presence or absence of these small teeth could only rank as a varietal difference.

In view of these facts it is evident that *D. sinuosus* is not a valid species.

Stephenson (1931*a*) also discusses the possible relationships between *D. sinuosus* and *D. floresiana* (Horst). It seems highly probable that the latter species is also identical with *D. affinis* but the original description is incomplete and at the present time I can add nothing to Stephenson's presentation of the problem.

Many species of *Dichogaster* have been described from Central America and it is obvious that a thorough revision, based on extensive new material, should be undertaken. None of these appears in any way to resemble *D. affinis* and presumably this widely distributed tropicopolitan peregrine is not endemic to this region.

Dichogaster bolaui (Michaelsen)

MATERIAL

1. Hoctun Cave, Hoctun; near mouth (Loc. 92); July 8, 1936, A. S. Pearse leg.: 1 immature specimen, alcohol.

2. Sazich Cave, Calcehtok; at bottom of a cave about 25 m. deep (Loc. 182); August 6, 1936, A. S. Pearse leg.: 1 mature and 1 immature specimen, alcohol.

SYSTEMATIC DESCRIPTION

The following abridged description of the mature specimen is given as a basis for comparison with other members of this highly variable species.

LENGTH.—Ca. 26 mm.

DIAMETER.—Maximum behind clitellum, 3 mm.; in clitellar region slightly less.

COLOR.—Slightly pigmented with red-brown dorsally at the anterior end.

PROSTOMIUM.—Epilobic.

CLITELLUM.—Saddle-shaped on segms. 13-20 inclusive, extending ventrally to setal line *a*.

COPULATORY PAPILLAE.—Absent.

FEMALE PORES.—A single ventral pore on segm. 14.

DORSAL PORES.—Present from intersegm. 20/21 backwards; anterior extent uncertain.

PROSTATIC PORES.—On segms. 17 and 19 in the line of the ventral pair of setae.

MALE PORES.—In the seminal grooves on segm. 18.

GIZZARDS.—Two muscular gizzards in segms. 7 and 8 respectively; septum 7/8 is wanting.

NEPHRIDIA.—In four rows on each side.

TESTES AND SPERMIDUCAL FUNNELS.—Two pairs free in segms. 10 and 11 respectively.

SEMINAL VESICLES.—Two very small pairs depending from septa 10/11 and 11/12 into segms. 11 and 12 respectively.

PENIAL SETAE.—Quite typical, showing the characteristic dimorphism of the species; length, a=0.33 mm., b=0.37 mm.; diameter, in middle of proximal half of stem, $a=5\mu$, $b=7.5\mu$; in middle of distal half of stem, $a=4\mu$, $b=5.5\mu$. The *a* seta of the left anterior bundle has four teeth towards the distal end, two of these lie side by side; the *a* seta of the left posterior bundle also has four teeth, one below the other. The *b* setae terminate in a perfectly characteristic broadened spatula.

DISCUSSION

D. bolaui is a highly variable species, many of its forms having received varietal names while others were originally described as distinct species. Some of the variable characters are discussed by Stephenson (1931) in a paper in which he established the probable synonymy of *D. malayana* (Horst) and *D. bolaui.* Almost at the same time (Pickford, 1932) I had occasion to review the named varieties of *D. bolaui,* and also the status of certain related species. In this paper I concluded that *D. rugosa* (Eisen) scarcely differed from *D. bolaui* except in its pigmentation and that it was very doubtful whether it should stand as a distinct species.

The specimens described above are in close agreement with *D. rugosa.* Even the immature specimens are pigmented with red-brown at the anterior end, the clitellum has the same extent, the nephridia are in four rows and other internal characters present no discrepencies in so far as they are described by Eisen. Unfortunately Eisen's original description of *D. rugosa* (1896) is in some respects unsatisfactory; he describes the oviducts twice on the same page (they open by a single median pore as frequently in *D. bolaui*) and omits to mention whether seminal vesicles were present or absent. Septum 7/8 may have been absent since its presence can only be indirectly inferred from the statement that the anterior pair of spermathecae are confined to their somite. The ornamented type of penial setae is stated to have had five teeth, but this is known to be a most variable character in *D. bolaui.* The description of the smooth type is difficult to reconcile with the figure; it is said to be forked and without a flare between the prongs but the figure shows a kind of clumsy trident, and Michaelsen's description (1900) in the Tierreich Oligochaeta is obviously based in part on Eisen's figure.

There can be no doubt that *D. rugosa* is at best a variety of *D. bolaui.* Apart from its pigmentation it shows no important differences; the fact that the nephridia are in four instead of in three rows, as in typical *D. bolaui,* is apparently not of much systematic importance since var. *octonephra* (Rosa) also has four and var. *decanephra* Michaelsen has five.

Incertae sedis

MATERIAL

San Bulha Cave, Merida; on floor among stones and debris, near mouth (Locs. 105-106); July 13, 1936, A. S. Pearse leg.: 1 very immature specimen, alcohol.

OBSERVATIONS

This specimen is probably not a Megascolecid. It appears to be a very young specimen of some rather large species, but it is altogether without determinable characters.

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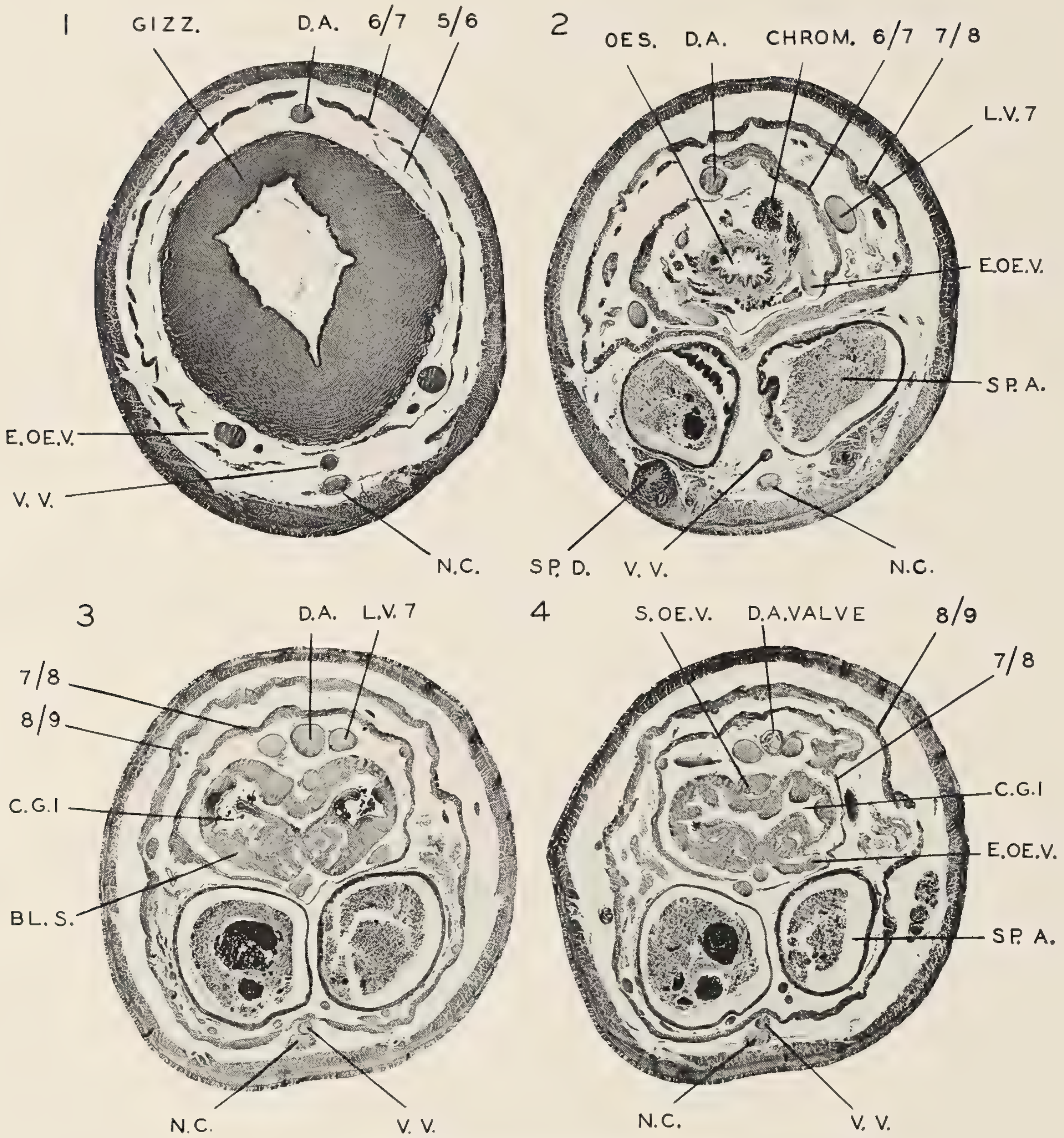
PLATES

ABBREVIATIONS USED IN PLATES 1, 2, AND 3.

BEGIN. C.G. 1—Beginning of first pair of calciferous glands.
BL.S.—Oesophageal blood sinus.
C.G. 1, C.G. 3—First and third pairs of calciferous glands.
CHLOR.—Chloragogen cells.
CHROM.—Chromophil glands.
CIL.EP.—Ciliated epithelium.
COMM.—Connections between supra- or extra-oesophageal vessels and oesophageal blood sinus.
CUT.—Cuticle.
D.A.—Dorsal aorta.
END C.G. 1—End of first pair of calciferous glands.
E.OE.V.—Extra-oesophageal vessel.
GIZZ.—Gizzard.
GR.—Groove in floor of oesophagus.
INT.—Intima of oesophageal blood sinus.
L.H. 11, L.H. 12—Left intestinal hearts of segments 11 and 12.
L.V. 7, L.V. 8, L.V. 9—Dorso-ventral hearts of segments 7, 8, and 9.
MES.—Mesentery suspending ventral vessel in segment 10.
N.C.—Nerve cord.
OES.—Oesophagus.
OV.—Ovary.
OV.D.—Oviduct.
RET.—Subepithelial reticular tissue.
R.H. 11, R.H. 12—Right intestinal hearts of segments 11 and 12.
S.OE.V.—Supra-oesophageal vessel.
SP.A.—Spermathecal ampulla.
SP.D.—Spermathecal duct.
SP.F. 10—Spermiducal funnels of segment 10.
SP.M.—Masses of sperm morulae.
S.V.—Septal vessel entering extra-oesophageal.
S.V. 11, S.V. 12—Seminal vesicles of segments 11 and 12.
VA.—Valves.
V.D.—Vasa deferentia.
V.V.—Ventral vessel.
X—Crystals of calcium fluoride.
5/6, 6/7, 7/8, 8/9, 9/10, 12/13, 13/14—Septa.

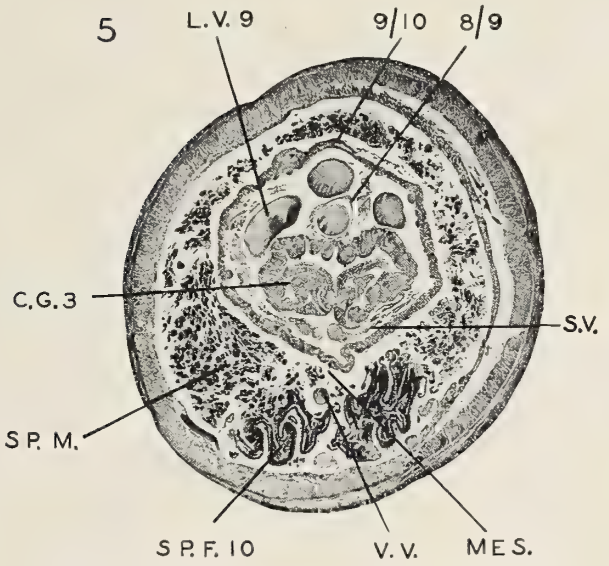


BALANTEODRILUS PEARSEI n. g., n. sp.

(Microphotographs of transverse sections through anterior region of paratype.)

1: X. S. passing through posterior half of gizzard, × 20.
2: X. S. passing through oesophagus and chromophil glands in segment 6, × 20.
3: X. S. passing through middle of first pair of calciferous glands in segment 7, × 20.
4: X. S. passing through end of first pair of calciferous glands and through valves in dorsal aorta, × 20.

5



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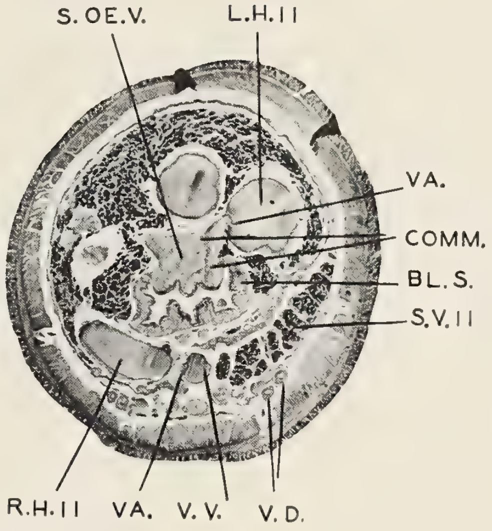

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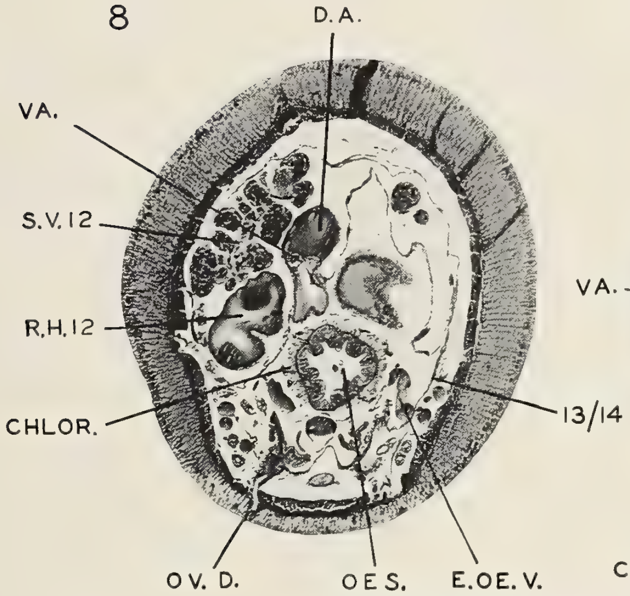

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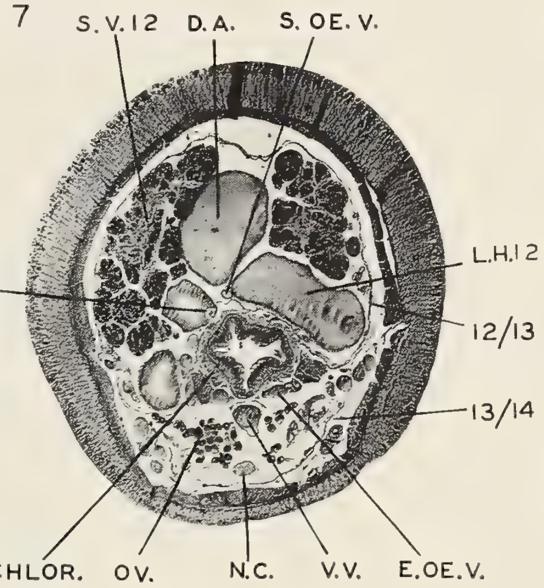


BALANTEODRILUS PEARSEI n. g., n. sp.

(Microphotographs of transverse sections through anterior region of paratype—*continued.*)

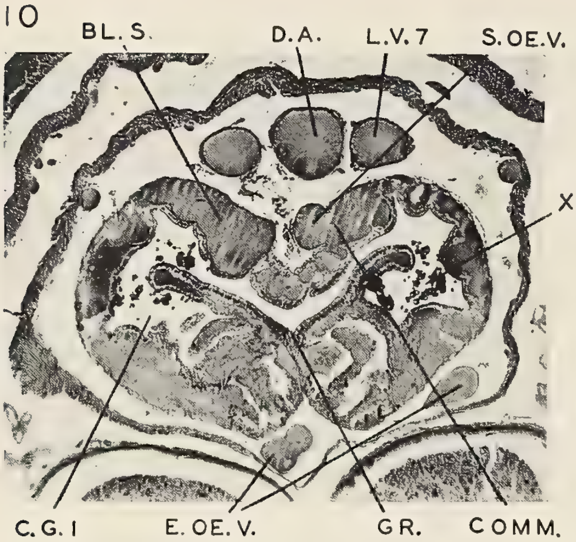
5: X. S. passing through third pair of calciferous glands in segment 9, × 20.

6: X. S. showing communication of supra-oesophageal vessel with first pair of intestinal hearts and with oesophageal blood sinus in segment 11, × 20.

7: X. S. passing through last pair of intestinal hearts in segment 12 and through ovaries in segment 13, × 20.

8: X. S. passing through origin of median-ventral vessel which comes from dorsal aorta and bifurcates to supply the last pair of intestinal hearts in segment 12, × 20.

10



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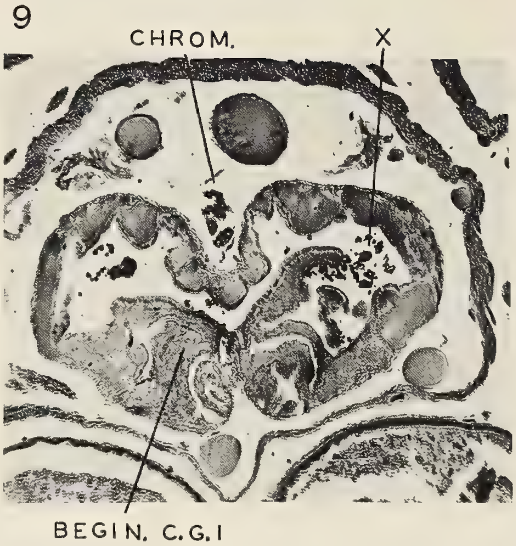

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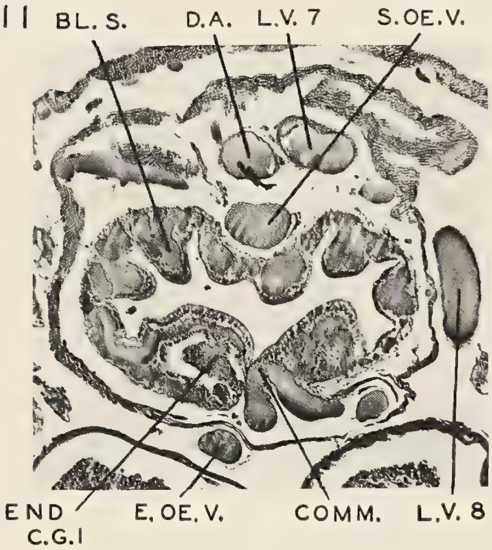

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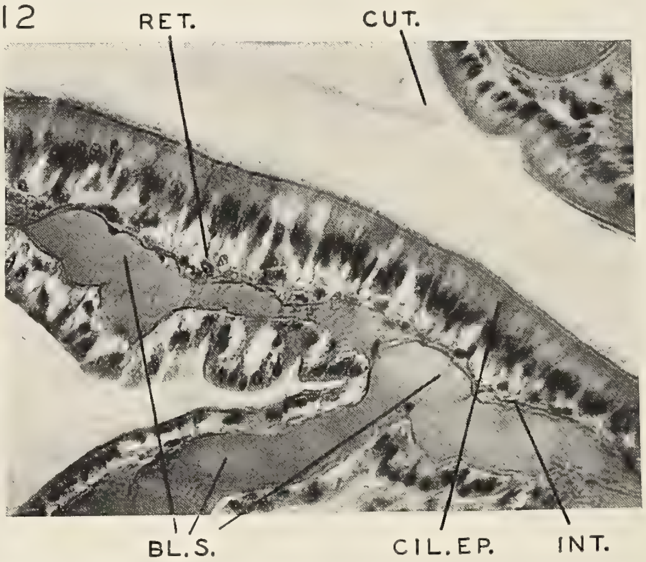


BALANTEODRILUS PEARSEI n. g., n. sp.

(Microphotographs of transverse sections through anterior region of paratype—*concluded.*)

9: X. S. oesophagus at beginning of first pair of calciferous glands, × 40.
10: X. S. oesophagus in middle of first pair of calciferous glands, × 40.
11: X. S. oesophagus at end of first pair of calciferous glands, × 40.
12: X. S. through lateral wall of first pair of calciferous glands showing ciliated epithelium, blood sinus, etc., × 400.

VII

ARACHNIDA OF THE ORDERS PEDIPALPIDA, SCORPIONIDA AND RICINULIDA

Ralph V. Chamberlin and Wilton Ivie
University of Utah

This is a report upon material representing the three orders Pedipalpida, Scorpionida, and Ricinulida (Ricinulei). Of much interest was the securing of both male and female of a new species, *Cryptocellus pearsei,* in the last mentioned order, which consists of probably the rarest of all arthropods in number of individuals and localities known. Of seven species previously known from America (Brazil, Central America, and West Indies), only one is known from more than one specimen, and none from more than one sex, all excepting *C. simonis* being based on females. In addition to *C. pearsei,* a new species based upon a female and probably from Barro Colorado Island, Panama, is herein described.

Pedipalpida

The two species representing this order in the collection are apparently among the most common arachnids occurring in the caves. The first of these, *Tarantula fuscimana* (C. L. K.), is a widespread form occurring from Colombia through Central America to Mexico as well as in Cuba, the Bahamas, etc., where probably introduced. In the material from the Yucatan caves it is abundantly represented in various stages of growth.

TARANTULIDAE

Tarantula fuscimana (C. L. Koch)

Phrynus fuscimanus C. L. Koch, Arach., 15:67, fig. 1463, 1848.
Admetus fuscimanus C. L. Koch, Übers. Arach., 5:81, 1850.
Neophrynus fuscimanus Kraepelin, Abh. Ver. Hamburg, 13:25, 1895.
Phrynus mexicanus Bilimek, Verh. Ges. Wien, 17:231, 1867.
Tarantula viridiceps Pocock, J. Linn. Soc., 24:540, 1893.
Tarantula laevifrons+*T. azteca*+*T. macrops* Pocock, Ann. Nat. Hist., ser. 6, 14:279-281, 1894.

Localities.—Chichen Itza: Balaam Canche Cave under stones, by Temple Pool 260 m. from mouth, and on wall near mouth, June 10, 12, 13; Xtoloc Cenote Cave, on walls, June 24.

Merida: San Isidro Cave, on walls and roof near mouth, July 3; San Bulha Cave, on walls and roof and under stones and debris on floor, July 13.

Kaua: Kaua Cave, 8 m. down, June 16; Oxolodt Cave, June 18.

Tohil: Chac Mol Cave, June 27.

Motul: San Bulha Cenote Cave, inner end, July 9.

Oxkutzcab: Puz Cave, high up near mouth, July 20; Ziz Cave, near mouth, July 24; Gongora Cave, 10 m. from mouth, July 16; Ebizt Cave, near drip pool, July 18; Loltun Cave, near Nakeb mouth, July 26.

Tekax: Sabacha Cave, near mouth, July 30; Xmahit Cave, 6 m. deep, July 31.

Hoctun: Hoctun Cave, in organic debris on floor at far end, July 7.

Calcehtok: Spukil Cave, on walls and under stones, August 5; Xkyc Cave, August 7.

Tizamin: Muruztun Cave, middle, August 12; Xconsacab Cave, August 11.

SCHIZOMIDAE

Schizomus cavernicolens n. sp.

(Figs. 4-7)

COLOR.—In general dusky fulvous; the sternum, coxae of legs beneath and the sides of the abdomen lighter, clearer yellow.

STRUCTURE.—Head without true eye spots but in some with a pale area on each side, large in some and small, more ocellus-like, in others. Cephalic sternum longer than wide. Palpus less than half the length of the body. Trochanter of palpus deep, its anterior inferior angle produced. Femur larger than wide nearly in ratio 21:11. Patella with dorsal margin two and three-fourths times as long as article is thick. Tibia twice as long as tarsus. Coxa of first legs terminating considerably proximad of the outer angle of the endite. Proportions of articles as shown in Figure 5. Fourth legs as shown in Figure 6. Last joints of abdomen and the flagellum as drawn (Fig. 7). Length of body, from base of chelicerae to base of flagellum, 4.2 mm.

LOCALITIES.—Calcehtok: Sazich Cave. Three young specimens and one adult "near B" (Lot 182), August 6; Xkyc Cave, one specimen (holotype) and two specimens "at B in debris" (Lot 186), August 7.

Chichen Itza: Xtoloc Cenote Cave, one specimen taken under stone, June 24.

Oxkutzcab: Gongora Cave, three specimens (Lots 109 and 111).

Tohil: Chac Mol Cave, one specimen taken June 27 under stones at top.

Merida: San Bulha Cave, two specimens taken in debris on floor, July 13 (Lot 106); San Isidro Cave, one specimen, July 4 "in hole by inner pool."

Kaua: Kaua Cave, at mouth, one specimen, June 16.

SCORPIONIDA

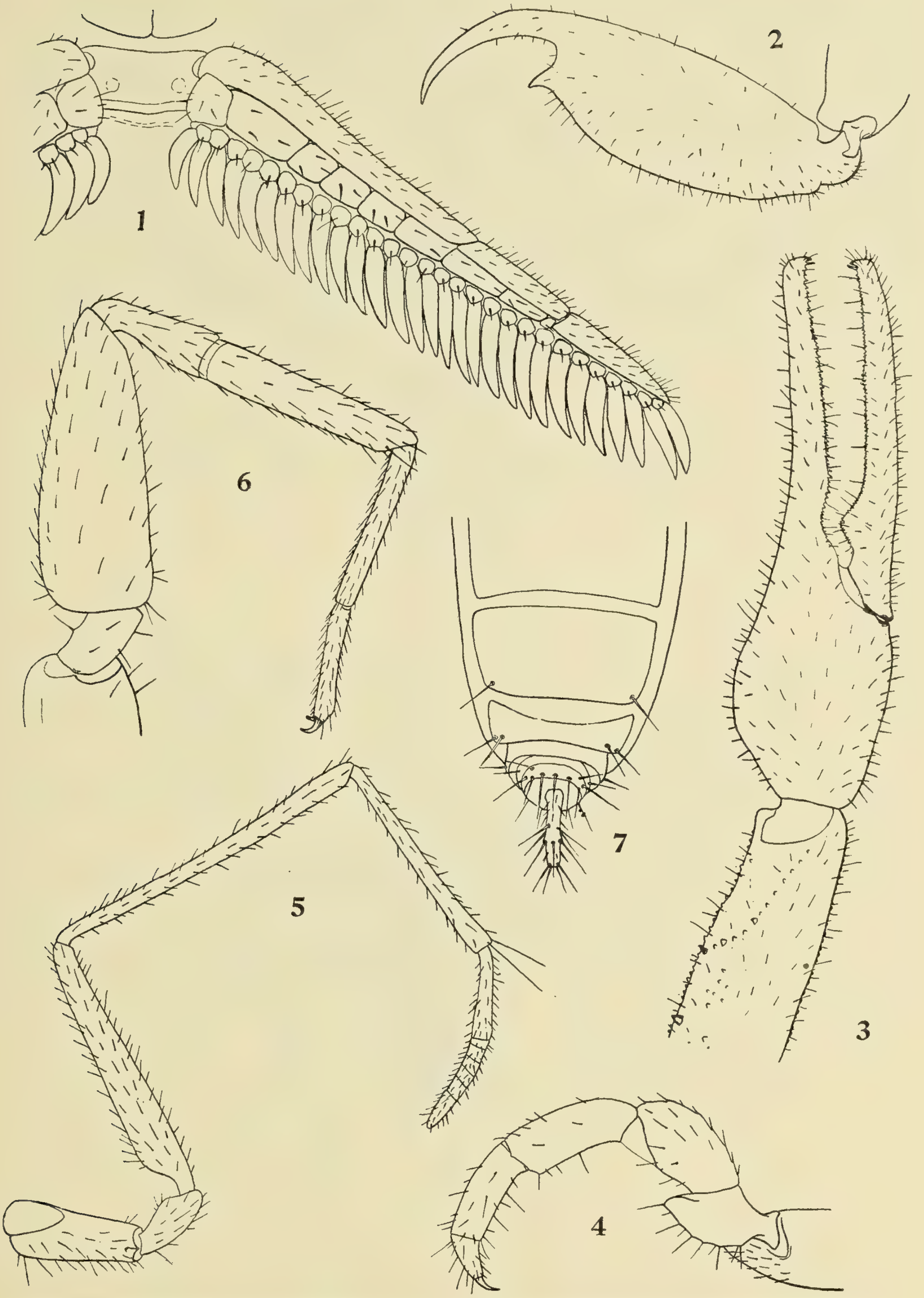
BUTHIDAE

Centrurus yucatanus n. sp.

(Figs. 1-3)

COLOR.—Truncus above dark reddish brown, uniform legs light yellow, the cauda and the hand of pedipalps a somewhat darker yellow.

STRUCTURE.—Granulation of the truncus moderate. Ventral plates shining, but rugose, the fourth showing also four low longitudinal ridges, a submedian pair and one tangent to inner end of the spiracle on each side. The fifth plate shows four keels corresponding to the broader ridges on the fourth, the two inner keels



Figs. 1-3—*CENTRURUS YUCATANUS* n. sp. Figs. 4-7—*SCHIZOMUS CAVERNICOLENS* n. sp.

1: Comb, left half. 2: Caudal end, lateral view. 3: Left palpus, distal portion, ventral view. 4: Left palpus, ectal view. 5: First leg. 6: Fourth leg. 7: Caudal end of abdomen, dorsal aspect.

being smooth and complete, the outer ones not reaching the caudal end and showing granular thickenings at intervals. Cauda long and slender. Keels of the cauda typically granular or subserrate, those of the fifth joint weaker but with granules well developed. Second and third segments with ten distinct keels. Spine beneath the sting well developed, a little decurved at tip (Fig. 2). Legs and pedipalps with well-developed longitudinal granular ridges. Hand of the pedipalp decidedly broader than the tibia; its ridges well developed, three of them continuing upon the immovable finger, the median one of these smooth throughout, the lateral ones broken over proximal portion; a fourth ridge ectad of these three more weakly developed and not extending upon the finger; the ridge in line with the movable finger smooth. Movable finger once and a half the length of the portion of the hand proximad of it; with a well-developed lobus and nine oblique rows of granules (Fig. 3). Comb with 28-29 teeth (Fig. 1). Length, about 70 mm.

Locality.—Oxkutzcab: Loltun Cave. One adult male and one young specimen, taken July 26, 1936 (Lot 154).

Closest to *C. gracilis* (Latr.) and related forms.

Ricinulida

RICINOIDIDAE

Cryptocellus pearsei n. sp.

(Figs. 8, 9, 14-17)

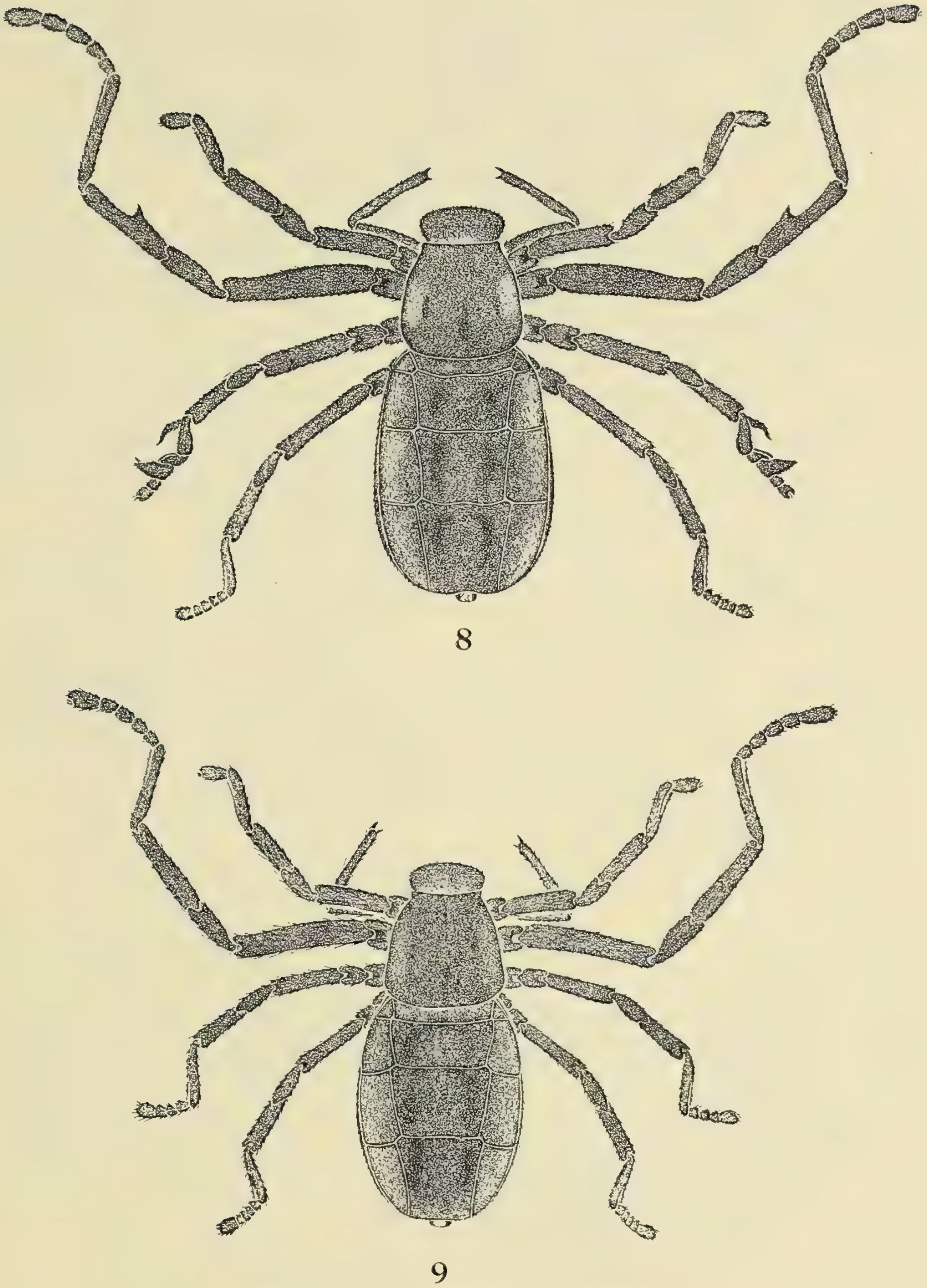
Color.—*Female.* General color brownish red. Hood uniform. Carapace with sides more whitish. Abdomen dark brown with still darker spots on the median sclerites. Legs bright brownish red, becoming lighter distally. Venter of abdomen even darker than dorsum.

Male. Similar to female, but somewhat lighter, especially on carapace and abdomen; the abdomen bright reddish like the legs and carapace. The light patches on sides of carapace more distinct than in female.

Structure.—The general structure is shown by the figures. The second leg is only slightly stouter than the others. Tibia II of male modified in that it has an antero-ventral conical process near the middle of its length. Distal part of leg III in the male modified as shown by the figure. The sutures between the abdominal sclerites are pale and distinct. Tubercles on legs, hood, abdomen, etc., very small but numerous.

Measurements.—

	Male	Female
Length (natural position)	4.60 mm.	4.30 mm.
Carapace:		
Length	1.43	1.38
Width	1.50	1.47
Hood:		
Length	.60	.57
Width	1.05	1.00
Abdomen:		
Length	3.20	3.00
Width	2.20	2.20
Tibia-patella:		
I	1.33	1.20
II	2.10	1.95
III	1.30	1.25
IV	1.33	1.20



Figs. 8, 9—*CRYPTOCELLUS PEARSEI* n. sp.
8: Male. 9: Female.

Type locality.—Balaam Canche Cave, Chichen Itza, Yucatan. Male holotype. A. S. Pearse, collector.

Other locality.—Oxolodt Cave, Kaua, Yucatan. Female allotype. In bat feces. A. S. Pearse, collector.

Cryptocellus relictus n. sp.

(Figs. 10-13)

Female:

Color.—Light reddish brown, with darker markings on abdomen as shown in the figure; legs I, III, and IV, and pedipalps lighter, becoming light orange distally, leg II darker than the other legs.

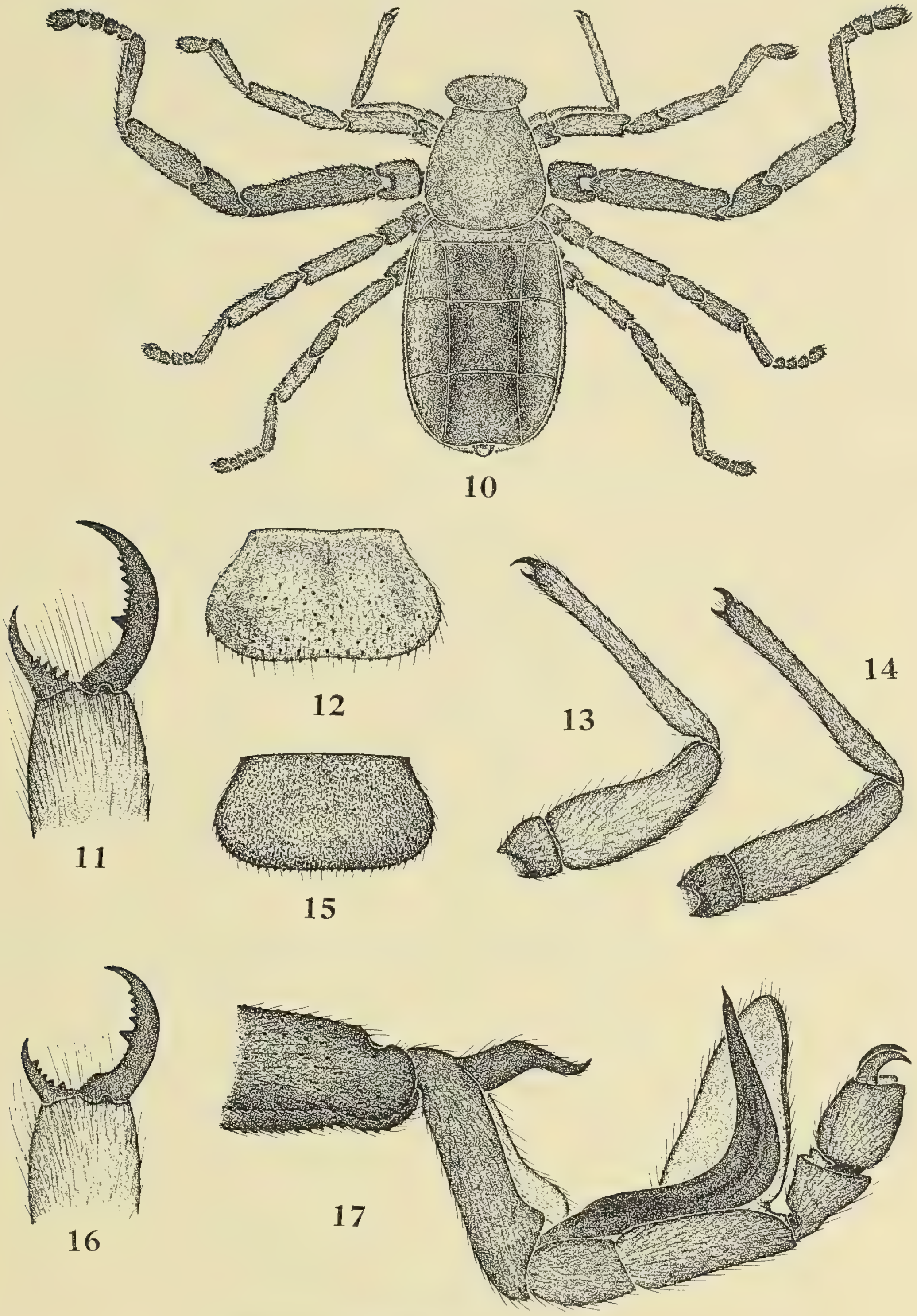
Structure.—See Figure 10. Leg II much stouter than the others. The type specimen is peculiar in that leg II has five tarsal segments on one side and only three on the other side; the three segments are the abnormal condition. Tubercles on legs, hood, etc., small and not abundant. Abdomen depressed from above as usual. Sutures between abdominal sclerites not distinct.

Measurements.—

	Female
Length	3.60 mm.
Carapace:	
Length	1.67
Width	1.50
Hood:	
Length	.73
Width	1.10
Abdomen:	
Length	3.00
Width	2.00
Tibia-patella:	
I	1.20
II	2.10
III	1.30
IV	1.23

Type locality.—Panama (probably Barro Colorado I.). Female holotype.

As compared with *C. pearsei* n. sp., the size is about the same, leg II is noticeably stouter throughout, the hood and abdominal sclerites are different in details, as illustrated; the color is lighter.



Figs. 10-13—*CRYPTOCELLUS RELICTUS* n. sp.

10: Female.
11: Left chelicera of female, posterior view.
12: Hood of female.
13: Left pedipalpus of female.

Figs. 14-17—*CRYPTOCELLUS PEARSEI* n. sp.

14: Left pedipalpus of female.
15: Hood of female.
16: Left chelicera of female, posterior view.
17: Third leg of male, anterior view.

VIII

A NEW GENUS AND THREE NEW SPECIES OF FALSE SCORPIONS FROM YUCATAN CAVES

(ARACHNIDA—CHELONETHIDA)

Joseph C. Chamberlin
Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture
Corvallis, Oregon

In addition to the descriptions of species, there are included under the various systematic categories certain morphological and other observations and notes of more than merely specific interest.

Of interest from the standpoint of higher classification are the emended or amplified definitions of the subfamilies Syarininae and Chitrellinae of the Syarinidae and the Lamprochernetinae and Chernetinae of the Chernetidae. The morphology of the three included species has been worked out and illustrated from the point of view of usefulness in studies of comparative morphology.

As a preliminary contribution to the study of inter- and intra-specific variability, rather extensive biometric measurements are given for a small series of one of the species (*Lustrochernes minor*), where fairly abundant material made this possible. This is a subject that needs a careful and extensive investigation in view of the great reliance placed on proportional measurements and biometrical indices as specific characters in this order.

Finally, certain immature stages are described and discussed for two of the included species, *Pachychitra maya* and *Parazaona cavicola.* These are the only two species that show any modification or characteristic which might be expected in permanent cave-inhabiting organisms. This is merely a lighter pigmentation, tending toward pallidness, in the appendages and body. The lack of eyes in *P. maya* might possibly be correlated with the cavernicolous environment (the only other member of the subfamily Chitrellinae to which it pertains has four weakly developed eyes), but even this seems doubtful. *P. cavicola* and *L. minor* belong to the family Chernetidae, most, if not all, members of which are typically eyeless or with non-corneate eye "spots."

Order CHELONETHIDA (Pseudoscorpions)

Suborder DIPLOSPHYRONIDA CHAMBERLIN

Superfamily NEOBISIOIDEA CHAMBERLIN

Family SYARINIDAE CHAMBERLIN

Subfamily Syarininae Chamberlin

1930. *Syarininae* Chamberlin, Ann. and Mag. Nat. Hist., (10) 5:39.
1931. *Syarininae* Chamberlin, Stanford Univ. Pubs., Univ. Ser., Biol. Sci., 7:219.
1932. *Syarininae* Beier, Das Tierreich, 57:163.

Diagnosis (emended).—Subterminal tarsal setae simple and acute, nondentate; femoral articulation of leg IV strongly oblique. Galea present and branched; outer curve of movable finger of chelicera not smoothly rounded, but with a distinct notch or emargination at the point of galeal origin. All tactile setae of chela distinctly on the fingers, none definitely caudad of the digital articulation. Coxal area narrowest across the fourth coxae, which are scarcely larger or broader than the third (see Chamberlin, 1931, p. 84, fig. 19, E).

Subfamily Chitrellinae Beier

1930. *Chitrinae* Chamberlin, Ann. and Mag. Nat. Hist., (10) 5:40.
1931. *Chitrinae* Chamberlin, Stanford Univ. Pubs., Univ. Ser., Biol. Sci., 7:219.
1932. *Chitrellinae* Beier, Das Tierreich, 57:165. (New name; type genus *Chitra* preoccupied.)

Diagnosis (emended).—Subterminal tarsal seta variously dentate (Fig. 1, F); femoral articulation of leg IV weakly oblique to vertical; basifemur short, scarcely longer than trochanter. Galea present or absent; if present it is a slender unbranched stylet, while the outer curve of the movable finger is smoothly rounded and not markedly depressed at the point of galeal origin (Fig. 1, C); flagellum of five to seven unilaterally serrate blades. Certain basal tactile setae of fixed finger of chela caudad of articulation of movable finger and on bulb of chela (e.g., Fig. 1, B). Antero-lateral angle (condylar angle) of each anterior coxa (I and II) often sclerotic and more or less spinosely produced. Coxal area with subparallel sides; not especially narrowed across the fourth coxa; fourth coxae much larger and broader than third (see Chamberlin, 1931, p. 218, fig. 57).

Remarks.—In addition to the type genus *Chitrella* and *Pachychitra* n. g., the also monotypic genus *Pseudoblothrus* Beier properly pertains to this subfamily and not to the Neobisiinae (family Neobisiidae) to which Beier has erroneously assigned it, evidently on the basis of its superficial similarity to *Blothrus* (Beier, 1932, p. 135). I have examined metatopotypes of its only included species *P. roszkovskii* (Redikorzev) and am certain of the validity of the present assignment. These three genera may be separated by means of the following key.

1. Setae *IT* and *ET* subterminal and paired; *IT* only slightly caudad of *ET* and much more closely associated with *ET* than *IST;* seta *SB* nearly as close to *B* as to *ST*—not forming a compact submedian group of 3 setae with *ST* and *T;* seta *IB* on dorsum of distal part of hand and distinctly caudad of *EB, ESB* and *ISB* 2

Setae *IT* and *ET* not paired, *IT* more closely associated with *IST* and much caudad of *ET;* seta *SB* closely grouped with *ST* and *T* to form a compact submedian group of 3 setae (Fig. 1, B); seta *IB* dorsal on base of fixed finger and distinctly distad of the group *ISB, ESB* and *EB* (Fig. 1, B) .... *Pachychitra* n. g. (Yucatan)

2. Seta *IST* scarcely caudad of *EST* with which it is closely associated; *IT, ET, IST* and *EST* forming a rather compact nearly terminal group widely separated from *ISB;* palps and legs excessively attenuated, "Blothrus-like"; femoral articulation of leg IV vertical; (monotype a true cave species) .... *Pseudoblothrus* Beier (Crimea)

Seta *IST* much caudad of *EST*, about median on the finger and nearly as close to *ISB* as to *EST;* palps and legs slender but of normal facies, not blothroid; (monotype a free living species) .... *Chitrella* Beier (Western North America)

Pachychitra n. g.

ORTHOTYPE.—*Pachychitra maya* n. sp. Yucatan.

DIAGNOSIS.—Carapace, palps, and tergites smooth and polished; carapace nearly square, about as broad as long, and with a weakly developed and rounded epistomal process. Tergites and sternites entire. Lamina exterior absent; one accessory cheliceral seta present between *b* and *es;* galea a slender unbranched stylet (Fig. 1, C). Chaetotaxy of chela as illustrated (Fig. 1, B), very different from that of *Chitrella.* Compare the chaetotaxal pattern shown for *Chitrella* by Chamberlin (1931, p. 140, fig. 36, C, under the name *Chitra cala*) with the pattern for *Pachychitra* given herewith.

Pachychitra maya n. sp.

(Fig. 1)

HOLOTYPE.—Female (JC-897.01001) collected July 22 at Oxkutzcab, Yucatan, near mouth of first cave on San Roque Road (Lot 140). Two immature specimens (protonymph, JC-897.02001, and tritonymph, JC-897.02002), collected on same date and in same cave but at its inner end, are confidently assigned to this species (Lot 139).

DIAGNOSIS.—*Adult.* Epistomal process of carapace small and rounded but distinct; eyes or eye spots completely lacking; carapacal chaetotaxy 4-6, (26); the three anterior tergites bordered by eight acute setae (remainder of abdomen lost from type). Chelicerae moderately developed, with a slender unbranched galea in female and juvenile examples at least (Fig. 1, C); fixed finger with 21 minute, evenly spaced and developed marginal teeth; movable finger with 10 large marginal teeth; serrula exterior with 29 ligulate teeth; serrula interior with 24 or 25 similar teeth; exterior seta of chelicera very short and small, much shorter than the accessory seta. Palps robust, the chela a typical reddish brown; basal palpal segments, legs, and carapace much lighter in color than chela (newly moulted or possibly pallid by reason of environment?); general appearance as illustrated (Fig. 1, A). Palpal proportions: trochanter 1.85 times as long as broad; femur 2.6-2.7 times as long as broad, broadest basally and subequal to the tibia; tibia with a pronounced pedicel, 2.0 times as long as broad; chela very robust and suddenly and about equally swollen exteriorly and interiorly, 2.46 times as long as broad; hand nearly square, but little broader than deep (1.08 times) and about as long as fingers; chaetotaxy, dentition, and venom apparatus of chela as illustrated (Fig. 1, B, D, E); fixed finger with 46, movable finger with 58 teeth, closely spaced and nearly truncate except distally, where they are acute. Femoral articulation of leg I only slightly distad of median and but slightly mobile, although condyles are well developed; tibia I 4.2 times as long as deep; femur of leg IV (greatest length of combined subsegments) 2.7 times as long as deep; tibia of leg IV 4.2 times as long as deep. The combined length of the tarsal segments of leg I is greater than the tibial length, while in the case of leg IV the total tarsal length is less than that of the tibia.

Measurements (holotype) (mm.).—Total length not ascertainable (abdomen lost), but probably about 2.6. Carapace, .64 long and about same width. Palps: trochanter, .332×.179; femur, .557×.204; tibia, .564×.279; chela, .954×.388 broad and .358 deep; hand, .484 long (with pedicel .565); fingers, .485 long. Leg I: femur (dorsal length), pars basalis, .238×.141; pars tibialis, .222×.136; tibia, .328×.077; metatarsus, .138 long; telotarsus, .226 long. Leg IV: femur (greatest length of both subsegments), .574×.212; tibia, .475×.115; metatarsus, .161 long; telotarsus, .254 long.

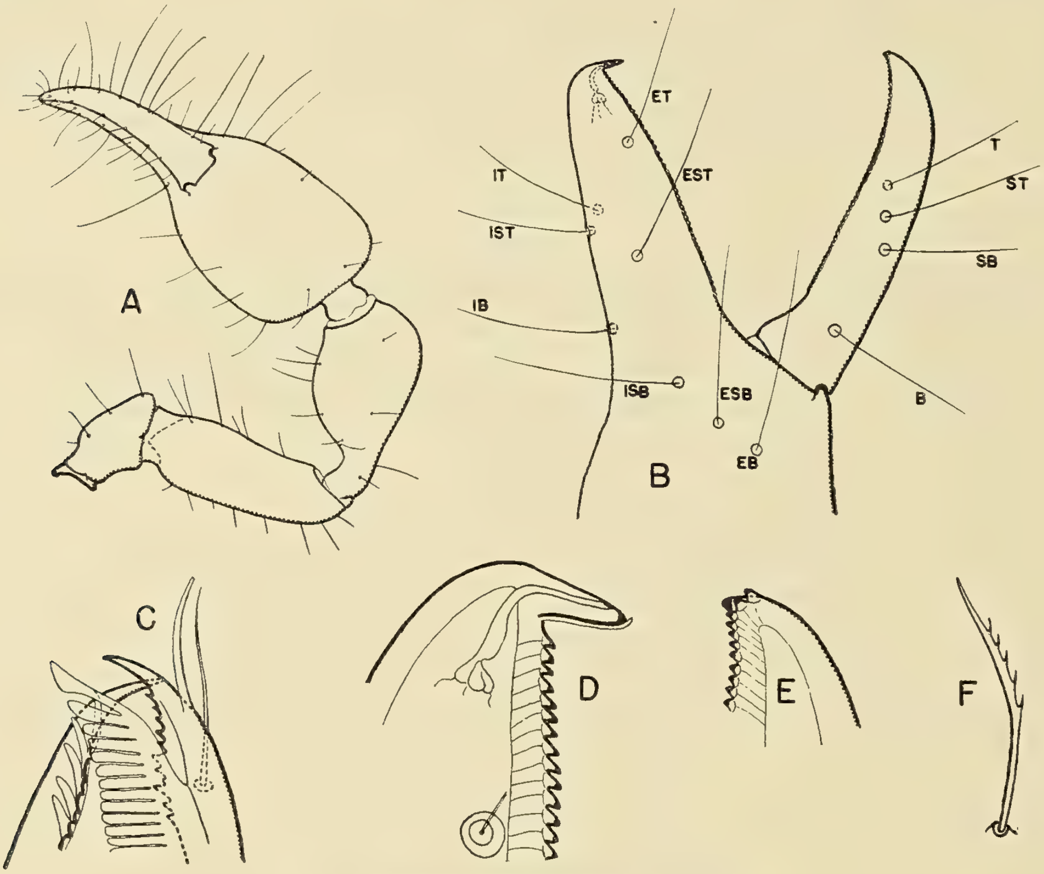


Fig. 1—*PACHYCHITRA MAYA* n. g., n. sp.
(Drawn from holotype.)

A: Ventral aspect of left cheliped.
B: Exterior aspect of right chela.
C: Tip of chelicera showing galea.
D: Tip of fixed finger of chela showing venedens, venom duct, and marginal teeth.
E: Tip of movable finger of chela.
F: Subterminal tarsal seta (foretarsus).

Tritonymph.—The tritonymph recorded above is unquestionably conspecific. As is always the case, the chaetotaxy of the chela is imperfect; in this specimen seta *ST* (?) is absent from the movable finger while *IB* is missing from the fixed finger; otherwise the chaetotaxy is as in the adult; fixed finger with 44, the movable finger with 33 marginal teeth, the venom apparatus as in the adult; facies and coloration of palps as in the adult; palpal proportions closely similar to those in the adult; femur shorter than carapace, as long as tibia, and 2.8 times as long as broad; tibia

2.1 times as long as broad; chela slightly broader than deep, 2.6 times as long as broad, and 1.7 times as long as femur or tibia; hand, including pedicel, about as long as fingers. Galea and flagellum as in adult; both serrula interior and serrula exterior with about 25 teeth; chelicera with two accessory setae (always?), otherwise as in adult.

Measurements (mm.).—Length, 2.0. Carapace, .49 long and about the same width. Palps: femur, .426×.153; tibia, .426×.202; chela, .725×.278 broad and .269 deep; fingers .390 long; hand without pedicel .344 long, with pedicel .393 long.

Protonymph.—In spite of the immaturity of the specimen, this determination is almost certainly correct. Carapacal epistoma present as in adult; carapace longer than broad. Chelicerae of same facies as in the adult; galea as in adult; galeal seta absent; flagellum of 5 blades, as in adult; serrula exterior with about 17 or 18 teeth (cannot all be counted with certainty); serrula interior with 12 or 13 teeth; setae *is, sb,* and *es* plus 1 accessory (or *b*?) seta present. Palps in general sparsely beset (e.g., 6 or 7 on entire hand) by long acuminate setae; robust; in general facies, including the strongly pedicellate tibia, much as in the adult; palpal proportions (*in situ*): trochanter 1.98 times as long as broad; femur 1.3 times as long as trochanter, scarcely longer than tibia (1.04 times) and 2.1 times as long as broad; tibia 1.7 times as long as broad; chela longer than tibia plus femur and 2.9 times as long as broad; fingers 1.4 times as long as hand. Chela: venedens receptor developed on movable finger, which has 23 marginal teeth, including those forming venedens receptor; fixed finger with 15 marginal teeth; venedens broken from specimen but evidently as in adult; movable finger with a single tactile seta which is slightly proximad of median (probably *T*); fixed finger with 3 tactile setae, 1 basal and exterior (*ESB* or *EB*), 1 sub-basal and nearly dorsal (probably *ISB*), and 1 exterior and slightly distad of median (probably *ET*). Legs segmented as in the adult, but much more robust and almost embryonic in appearance; intertarsal articulation scarcely differentiated; pseudotactile setae of leg IV present as in adult; subterminal seta denticulate. Leg I: femur (dorsal length of both subsegments) 1.5 times as long as tibia; total tarsal length (both segments) 1.3 times as long as tibia. Leg IV: femur (greatest length of both subsegments) 2.6 times as long as deep and 1.5 times as long as tibia; total tarsal length (both segments) 1.2 times as long as tibia.

Measurements (mm.).—Total length, 1.07. Palps: femur, .184×.088; tibia, .177×.103; chela, .375×.131 broad and .137 deep; fingers, .224 long; hand, .158 long.

Remarks.—The chaetotaxy of the chela of the protonymph is essentially the same as that shown for the protonymph of *Chelifer cancroides* L. by Vachon (1934, Bull. Soc. Zool. France, 59:157).

The finding of this species is of especial interest in extending the range of the subfamily, which at the time of its original description, comprised but a single western American species. Further collecting, especially from humus and soil environments in tropical and subtropical America, will almost certainly result in the discovery of other species and probably other genera as well.

Suborder MONOSPHYRONIDA CHAMBERLIN

Superfamily CHELIFEROIDEA CHAMBERLIN

Family CHERNETIDAE CHAMBERLIN

Subfamily Lamprochernetinae Beier

1932. *Lamprochernetinae* Beier, Zool. Anz., 97:258.
1932*a*. *Lamprochernetinae* Beier, Das Tierreich, 58:81.

DIAGNOSIS (addenda).—In addition to the characters employed by Beier in defining this subfamily, it may be noted that the pleural membrane of the abdomen is generally smoothly plicate (about as in Fig. 2, E) or at most semitessellate, and the fourth tibia bears one or more pseudotactile setae in addition to the usual basal pseudotactile seta of the tarsus (Fig. 2, F). The genital area of the female differs from that in the Chernetinae in that the setae, instead of being diffusely scattered over the genital operculum, are generally much reduced in number and are always definitely concentrated into a small and very compact central cluster, which may also be flanked by smaller lateral clusters (e.g., Fig. 2, D, as compared with Fig. 4, C). In addition, rather definite sclerotic areas generally occur on the operculum, often forming characteristic patterns.

Finally, it may be noted that, although the vestitural setae of the palps, carapace, and tergites are, as stated by Beier (1932, 1932*a*), always long and "pointed," they are very often not truly acuminate but are terminally minutely denticulate (Fig. 3, A and B).

Lustrochernes minor n. sp.

(Figs. 2, 3)

HOLOTYPE.—Male (JC-897.05001); allotype female (JC-897.05002); topoparatypes, 4 females and 3 nymphs (JC-897.05003-9), all from Gongora Cave, Oxkutzcab, Yucatan, July 17, from bat feces (Lot 114); paratypes, 7 males, 5 females, and 3 nymphs (JC-897.06001-15) from Xkyc Cave, Calcehtoc, Yucatan, August 7, from organic debris (Lot 186).

DIAGNOSIS.—Small species, female 2.2-2.8, male 1.7-2.2 mm. long. Carapace 1.1-1.2 times as long as broad; nongranular and polished; eye spots present but no true eyes; median furrow broad, deeply impressed, and .53-.61 of carapacal length from its anterior margin; posterior furrow weakly developed and scarcely visible. Chelicerae: flagellum of 3 blades, of which the anterior-most only is moderately dentate; setae *b, sb,* and *es* all terminally denticulate; serrula exterior with 18 or 19 teeth; lamina interior with 3 dentate subapical lobes (one specimen, male, JC-897.06002, shows 4); galea well developed in both sexes (slightly less so in the male) and moderately branched, but not basally divided, into two main branches which later subdivide (Fig. 2, G and H). Tergites: 1 entire, 2 weakly divided, 3-10 distinctly divided by a narrow membranous stripe which is nearly but not quite linear, 11 entire. Pleural membrane evenly striate (Fig. 2, E). Tergal chaetotaxy: 14-16 marginal setae in female, 12-14 in male. Chaetotaxy of median sternites essentially as for the tergites but marginal setae more numerous (18-24 in the female and 16-18 in the male). Pseudotactile setae occurring on last two abdominal segments. Palps (Fig. 2, A and B) robust, distinctly but weakly granular along posterior aspect of trochanter, inner face of femur and tibia, and interiorly and exteriorly on hand at base of fingers; dorsal tubercle of trochanter moderately developed in female, distinct and conical in male. Palps moderately differentiated sexually, especially as regards the tibia, which is proportionally much deeper in the male than in the female owing to a pronounced ventral swelling which is

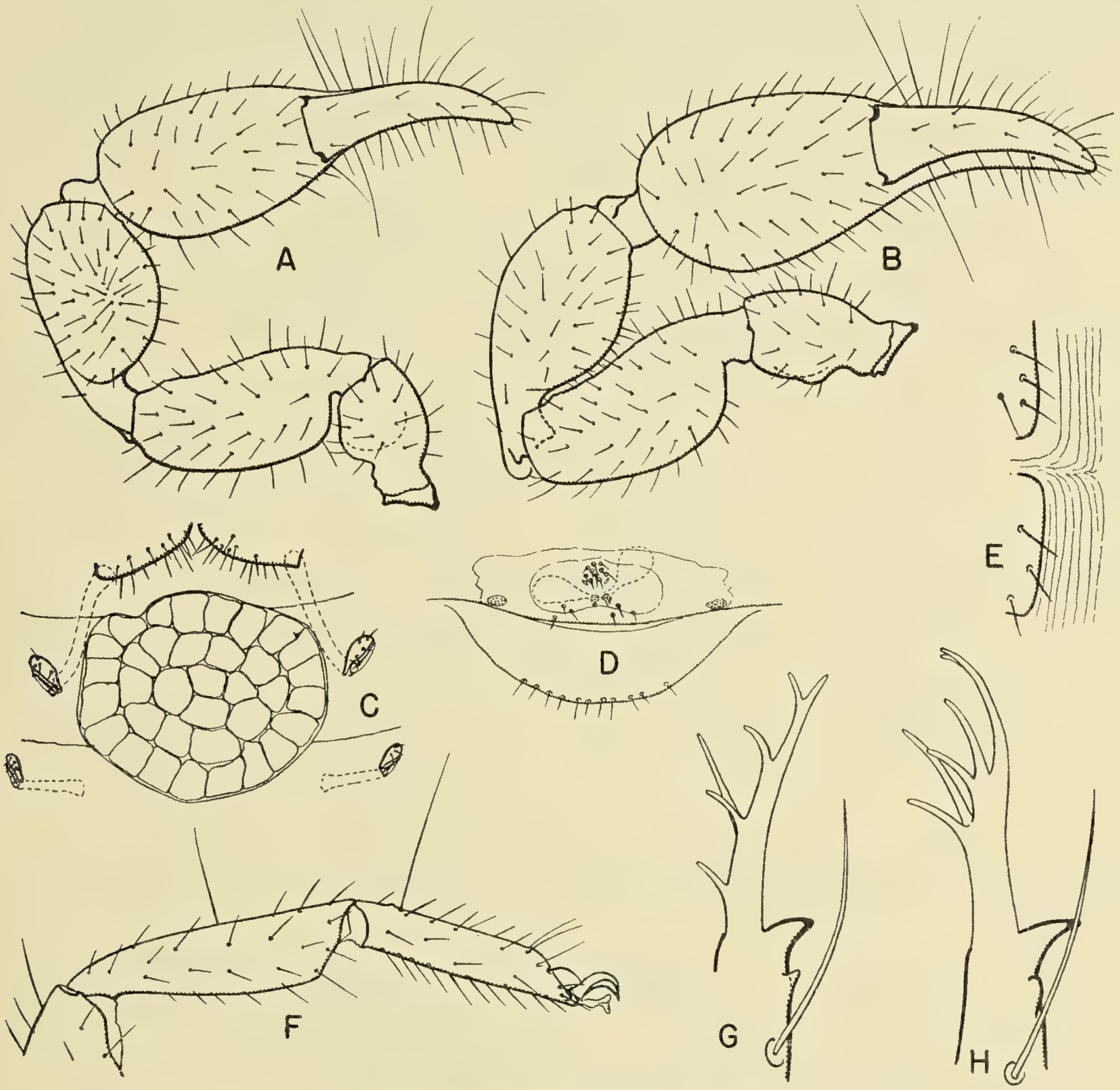


Fig. 2—*LUSTROCHERNES MINOR* n. sp.
(Drawn from holotype and paratypes as indicated.)

A: Ventral aspect of right cheliped of male (JC-897.05001).
B: Same of female (JC-897.05003).
C: Larval disc or "egg mass" attached to base of female abdomen (JC-897.06004).
D: Genital area of female (JC-897.06003).
E: Pleural membrane of abdomen showing plications (female, JC-897.05003).
F: Lateral aspect of tibia and miotarsus of fourth leg showing pseudotactile setae (male, JC-897.06002).
G: Galea, or spinneret, of male (JC-897.06002).
H: Galea, or spinneret, of female (JC-897.06004).

slightly to distinctly more pilose than the rest of the segment (Fig. 3, F and G); trochanter of normally oriented palp 1.8-2.0 times as long as broad; femur 2.0-2.3 times as long as broad, 1.3-1.5 times as long as trochanter and .84-.90 as long as tibia; tibia shorter than length of carapace, 2.1-2.2 times as long as broad in the female and 2.1-2.4 times as long in the male (this varies considerably owing to the great depth of this segment, which makes accurate and consistent orientation for purposes of measurement difficult); tibia 1.5-1.6 times as long as its depth in the male and 1.85-1.90 times as long as deep in the female; (depth of tibia .86-.87 of its breadth in the female and .69-.80 of its breadth in the male); chela 1.6-1.7 times as long as tibia, 2.7-2.8 times as long as broad in the female and 3.0-3.2 times as long as broad in the male, deeper than broad in both sexes, its breadth .93-.95 its depth in the female and .88-.90 in the male; hand (without pedicel) 1.2 times as long as the fingers in the female and 1.07-1.11 in the male; fingers 1.27-1.34 times as long as the chela is broad in the female and 1.44-1.60 times in the male; chela with chaetotaxy, dentition and pattern of sense-spot distribution as illustrated (Fig. 3, C, D, and E); no sense-spot areas distally on the movable finger in either sex; sense-spot distribution: fixed finger (basal patches), 5-8 exteriorly and 16-18

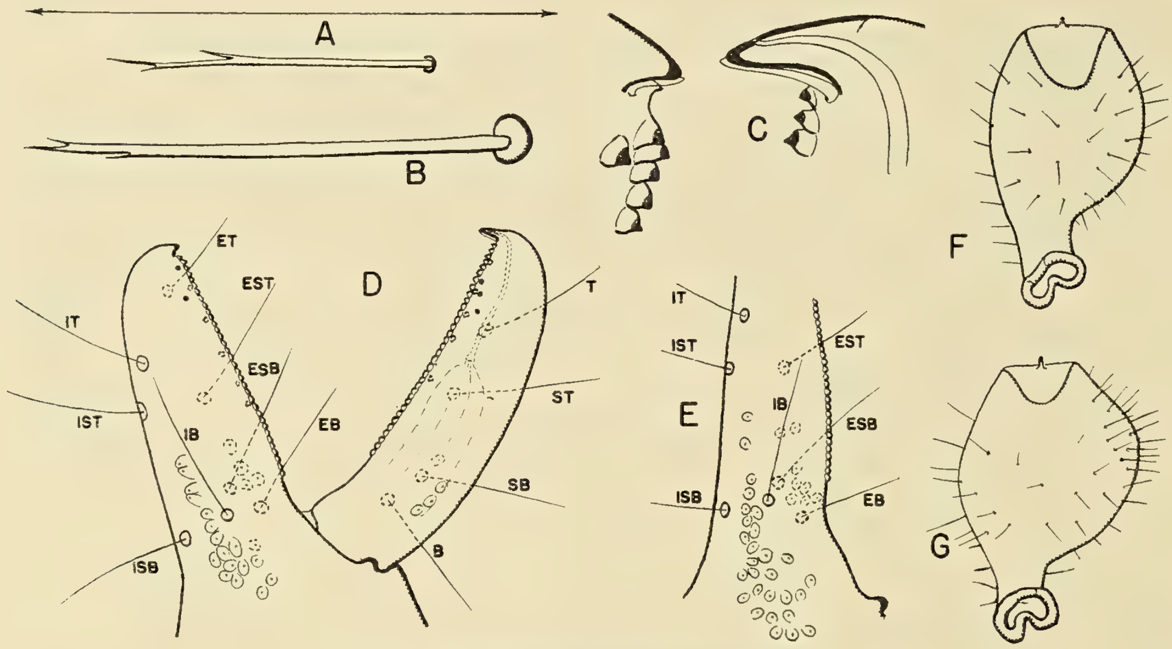


Fig. 3—*LUSTROCHERNES MINOR* n. sp.
(Drawn from holotype and paratypes as indicated.)

A: "Pointed" seta from palpal femur. Arrow indicates relative breadth of femoral pedicel (female, JC-897.05003).
B: Same of a tergal seta.
C: Tips of fixed and movable fingers of chela showing dentition and debouchement of venom duct (female, JC-897.05003).
D: Interior aspect of left chela of female, showing chaetotaxy, dentition, and distribution of sense spots, etc. Dotted structures, except for internal venom apparatus, are exterior. Exterior accessory teeth are indicated by dotted paradental circles. (JC-897.05003.)
E: Interior aspect of base of fixed finger of left chela of male, showing sense-spot areas, etc. (JC-897.06002).
F: Inner aspect of left tibia of female showing ventral expansion (JC-897.05003).
G: Same, and on same scale of enlargement, for male (JC-897.05001).

interiorly in the female (Fig. 3, D), 5-7 exteriorly and 21-27 interiorly in the male (Fig. 3, E); movable near base (both sexes), 1-4 exteriorly and 2-3 interiorly; accessory teeth apparently somewhat variable; 2-3 subapical teeth interiorly and subproximally on each finger; exteriorly with 4-6 evenly spaced teeth; nodus ramosus about midway between *T* and *ST* in the female (Fig. 3, D) but distinctly nearer to *ST* than *T* in the male; vestigial venom ducts do not occur in the fixed finger, although a lamina defensor is developed (Fig. 3, C); about 33-36 (one male specimen with 37 and 38) marginal teeth on each finger. Legs showing no developments of unique interest; fourth tibia with a slender pseudotactile seta placed .5-.6 of its length from the base; fourth tarsus with the pseudotactile seta .20-.22 of the tarsal length from its base (about as far from the base of the segment as the tarsal breadth) (Fig. 2, F). Leg I (both sexes unless otherwise noted): femur (dorsal length of combined segments), 2.9-3.2 times as long as deep and 1.2-1.3 times as long as tibia; tibia 1.00-1.06 times as long as tarsus and 3.3-3.6 times as long as deep; tarsus 4.8-4.9 times as long as deep in female and 5.0-5.2 times as long as deep in male. Leg IV: femur (greatest length of combined segments) 1.21-1.27 times as long as tibia and 3.2-3.4 times as long as deep; tibia 1.2-1.3 times as long as tarsus, 3.9-4.0 times as long as deep in female and 4.0-4.2 times as long as deep in male; tarsus 4.7-4.9 times as long as deep. Genital area of male showing no apparent distinguishing characteristics; of typical chernetoid type; genital area of female characterized by a minute central cluster of 10 or 12 closely grouped setae; median cluster flanked postero-laterally by secondary clusters of 3-5 setae; the seminal receptacles are pyriform sacs without extensive tubular development (Fig. 2, D). Vestitural setae of palps, carapace, and tergites long and, under low magnification, apparently acuminate. Actually they are all more or less denticulate terminally (Fig. 3, A and B).

Measurements.—The measurements taken for the various specimens studied in detail are given herewith in tabular form to indicate the degree of variability found (Table 1).

Remarks.—This distinctive little species, the smallest yet assigned to the genus, seems most closely related to the Ecuadorian species *Lustrochernes nitidus* (Ellingsen). It differs therefrom in the larger number of sense spots at the base of the fixed finger; in the smaller size (femur .42-53 mm. as compared with .65 in *nitidus*); in the more robust femur; in the ventrally swollen tibia of the male; in the more abundant armature of accessory teeth; and in the chela, which is deeper than wide rather than wider than deep. It will run to *L. nitidus* (Ellingsen) or *L. similis* (Balzan) in With's key (1908, Trans. Zool. Soc. London, 18:292) and to *L. propinquus* Beier or *L. reimoseri* Beier in Beier's key (1932, Das Tierreich, 58:88), but it differs from all these species in many respects.

Two of the females included in this collection carried a flat circular disc of about 35 developing embryos (Fig. 2, C), indicating that this species, like most chernetids, is active during the period of "gestation."

The coloration of all available specimens of this species is typical of the usual free-living forms. It is not at all pallid, as one would expect in a normal or permanent cave inhabitant.

TABLE 1

Measurements of a Series of Specimens of Lustrochernes minor, n. sp.

Measurement*	Male (holotype) 897.05001	Male 897.06001	Male 897.06002	Female (allotype) 897.05002	Female 897.05003	Female 897.06003
Total length	1.93	1.70	2.16	2.33	2.84	2.80
Abdominal breadth	.69	.69	.95	1.15	1.23	1.40
Carapace:						
Length	.57	.56	.64	.64	.67	.67
Breadth	.50	.48	.56	.57	.57	.61
Palps:						
Trochanter, L & B	.320 x .175	.304 x .167	.344 x .187	.369 x .197	.358 x .195	.407 x .205
Femur, L & B	.460 x .225	.427 x .202	.534 x .230	.516 x .238	.505 x .238	.534 x .242
Tibia, L & B	.525 x .252	.467 x .228	.594 x .250	.582 x .270	.561 x .262	.598 x .272
Tibia, depth	.344	.287	.361	.312	.304	.315
Chela, L & B	.853 x .284	.774 x .262	.935 x .296	.966 x .351	.930 x .348	1.010 x .374
Chela, depth	.328	.296	.335	.388	indet.	.394
Hand, L, and fingers, L	.456 & .418	.418 & .378	.505 & .473	.538 & .459	.522 & .443	.570 & .480
Leg I:						
Femur, L & D	.344 x .115	.296 x .102	.370 x .126	.392 x .130	.385 x .131	.400 x .138
Tibia, L & D	.274 x .079	.258 x .077	.312 x .085	.312 x .087	.308 x .087	.336 x .098
Tarsus, L & D	.275 x .052	.258 x .049	.295 x .059	.306 x .064	.304 x .061	.320 x .066
Leg IV:						
Femur, L & D	.463 x .149	.443 x .131	.508 x .157	.541 x .169	.557 x .164	.576 x .174
Tibia, L & D	.377 x .095	.366 x .087	.418 x .103	.441 x .114	.437 x .107	.463 x .115
Tarsus, L & D	.312 x .064	.312 x .064	.333 x .069	.344 x .074	.344 x .071	.367 x .077

*Abdominal breadth approximate because of great extensibility. L = length; B = breadth; D = depth. Femoral lengths: leg I, dorsal length of both subsegments; leg IV, greatest length of both subsegments. The lengths of hand and chela are exclusive of the pedicel.

Subfamily Chernetinae Beier

1932. *Chernetinae* Beier, Das Tierreich, 58:105.
1933. *Chernetinae* Beier, Zool. Jahrb. Abt. System. Ökol. u. Geogr. Tiere, 64:509.

Diagnosis (addenda).—The genital area of the female is characteristic in this subfamily. The opercular setae comprise a diffuse median cluster but are never densely concentrated as in the Lamprochernetinae (e.g., Fig. 4, C). In addition, the pleural membrane of the abdomen is never smoothly plicate with linear parallel striations, but is always "wrinkled" (the striations wavy, irregular, and merging more or less with each other), hispidose semituberculate, or otherwise modified. A pseudotactile seta does not occur on the fourth tibia.

Parazaona cavicola n. sp.

(Fig. 4)

Holotype.—Female (JC-897.04001); paratypes, female (JC-897.03002) and tritonymph (JC-897.03001). Holotype collected July 13, probably from debris (or the walls) of San Bulha Cave, Yucatan. Paratypes collected June 16, from the mouth of Kaua Cave, Kaua, Yucatan.

Diagnosis.—Medium-sized species, the adult female 3.6-3.9 mm. long. Coloration of all available material light, tending to become pallid; chela a medium light reddish brown, much darker than the rest of the palps. Carapace and palps evenly granulate except for the chela, which is mostly smooth although having distinct granulations at base of fingers; granulations otherwise evenly distributed over the parts noted; maxillary disc smooth, the rest granular. Carapace slightly longer than broad and slightly shorter (.98-.99) than tibia, broadest basally and arcuately narrowed in front; with two transverse furrows which are only weakly impressed, especially the posterior one; anterior furrow slightly distad of middle; eyes and eye spots absent. All tergites and sternites except the eleventh divided by an almost linear membranous stripe; posterior (ninth and tenth) abdominal segments transverse, not recurved around the eleventh. Pleural membrane almost evenly and very densely striate, but striations serrately wrinkled (wavy) and often convergent, not as in the Lamprochernetinae. No pseudotactile setae noted on the tenth or eleventh abdominal segments (all setae broken off in available material), but they may occur. Carapacal and tergal setae relatively short and denticulo-clavate or spatulate (Fig. 4, G and H); tergites 1-3 uniseriate, with 12-14 marginal setae; median tergites biseriate, with about 4 discal and 14 marginal setae; median sternites with 10-12 acuminate marginal setae. Chelicerae of normal appearance; galea with about 5 minute terminal and subterminal branches (Fig. 4, A and B); serrula exterior with 21-23 blades; setae *sb* and *b* terminally denticulate; seta *et* acuminate and unusually long, almost as long as cheliceral breadth; flagellum definitely 3-bladed, anterior blade only, marginally serrate; with 3 dentate subapical lobes. Palps moderately slender (Fig. 4, D); all segments except chela very light reddish brown, almost pallid; chela a medium light reddish brown; trochanter almost, or quite, twice as long as broad, with definite processes; femur much shorter than tibia (.89), about 1.6 times as long as trochanter and 2.9-3.1 times as long as broad; tibia almost as slender as femur and but little broader, 2.9 times as long as broad; chela scarcely if at all broader than deep, nearly cylindrical, 1.6 times as long as tibia, and 3.2-3.3 times as long as broad; hand much longer than fingers (1.27-1.35) and distinctly longer than femur (1.05-1.06 times). Vestitural setae of palps short, thickened, and denticulate (Fig. 4, F). Chaetotaxy dentition and venom apparatus of chela as illustrated (Fig. 4, E and J); 55-60 marginal teeth on each finger; venedens and receptor venedens typically developed; vestigial venom duct penetrating vestigial venedens of fixed finger (in these specimens at least) (Fig. 4, E); nodus ramosus almost even with seta *T;* about 7 sense spots present interiorly at the base of fixed finger while 2 or 3 occur similarly, exteriorly; sense spots apparently lacking on movable finger (Fig. 4, J); 11-13 regularly spaced accessory teeth exteriorly and paradentally on each finger and with 1-3 apically and interiorly (Fig. 4, J). Legs show nothing of unique interest; pseudotactile setae of tarsus IV .33 of distance from its base. Leg I: femur (dorsal length of combined subsegments) 1.38-1.42 times as long as tibia and 3.4 times as long as deep; tibia scarcely as long as tarsus (.97-.99), 4.1-4.2 times as long as deep; tarsus 6.0-6.2 times as long as deep. Fourth femur (greatest length of combined subsegments) as long as palpal femur, 3.08-3.14 times as long as deep and 1.19-1.22 times as long as tibia; tibia 1.35-1.41 times as long as tarsus and 4.3-4.8 times as long as deep; tarsus 5.2-5.4 times as long as deep. Genital area of female typical, genital setae comprising a diffuse cluster of 35 or 36 setae; seminal receptacles tubular but of large diameter and not much coiled as in some chernetines (Fig. 4, C).

Measurements (mm.).—Female holotype: Total length, 3.95. Abdomen 1.8 broad. Carapace 1.23 long. Palps: trochanter, .689×.354; femur, 1.123×.394; tibia, 1.263×.443; chela, 1.985×.624 broad; hand, 1.180 long; fingers, .876 long. Leg I: femur (dorsal length of combined subsegments), .825×.246; tibia, .590×.144; tarsus, .606×.098; leg IV: femur (greatest length of combined subsegments), 1.164×.377; tibia, .951×.197; tarsus, .672×.131. Female paratype: Total length,

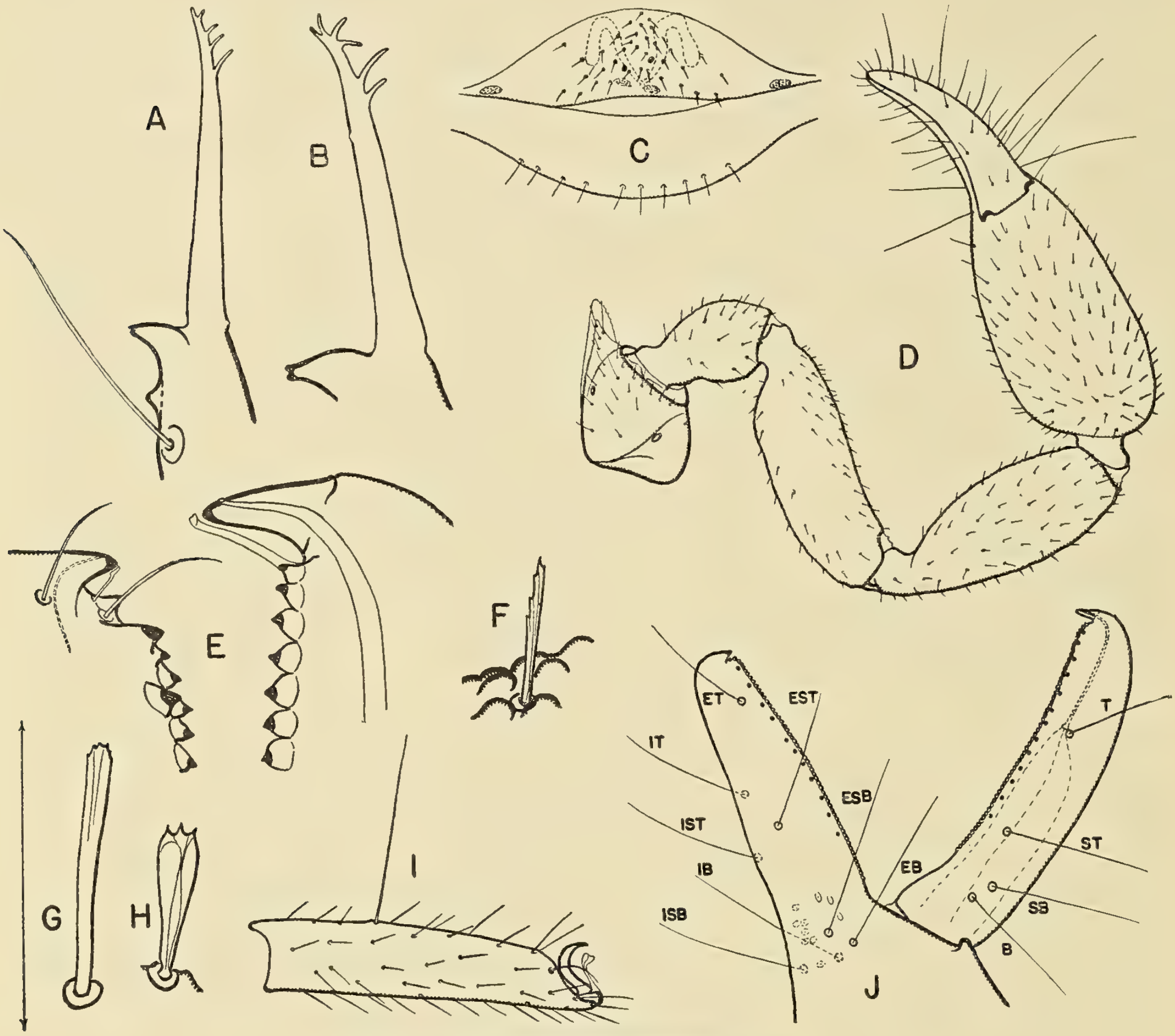


Fig. 4—*PARAZAONA CAVICOLA* n. sp.
(Drawn from holotype and paratypes as indicated.)

A: Galea of tritonymph.
B: Galea of adult female (JC-897.03001).
C: Genital area of female (JC-897.04001).
D: Ventral aspect of left cheliped (JC-897.04001).
E: Tip of fingers of chela, showing dentition and debouchement of venom duct (JC-897.03002).
F: Vestitural setae from inner margin of palpal femur (same scale as G and H).
G: Posterior tergal seta.
H: Posterior carapacal seta. Arrow indicates one half relative breadth of femoral pedicel.
I: Fourth miotarsus showing pseudotactile seta (JC-897.03002).
J: Exterior aspect of right chela showing chaetotaxy, dentition, sense-spot areas, etc. (JC-897.03002).

3.61; abdomen, 1.6 broad; carapacal length indeterminable. Palps: trochanter, .705×.350; femur, 1.163×.377; tibia, 1.300×.443; chela, 2.122×.64-.66; hand, 1.240 long; fingers, .975 long. Leg I (as above): femur, .853×.257; tibia, .618×.146; tarsus, .640×.107. Leg IV (as above): femur, 1.170×.374; tibia, .985×.230; tarsus, .728×.134.

Tritonymph.—This large nymph agrees remarkably closely with the adult except for the typically reduced chaetotaxy of the chela and the smaller size. The carapace is longer than broad (1.1); the hand is almost exactly as broad as deep. The palpal proportions are in all cases within the range of those already noted for the adult. The proportions of the legs are for the most part similar to those in the adult. Only the proportions that differ from those already given for the adult are here noted. Leg I: femur 3.16 times as long as deep; tibia, .88 as long as tarsus; tarsus 3.6 times as long as deep. Leg IV: tibia 1.28 times as long as deep; tarsus 4.85 times as long as deep. Chelicerae much as in adult female; galea as in the adult; seta *sb* absent; serrula interior with 18-19 blades. Venom apparatus as in the adult. Chaetotaxy of chela essentially as in adult except that *SB* and *IST* are absent; sense-spot areas of fixed finger reduced, 2-3 spots interiorly and only 1 exteriorly; 52 marginal teeth on each finger of chela.

Measurements (mm.).—(Body not cleared in potassium hydroxide.) Total length, 3.14. Abdominal breadth, 1.3. Carapace, .90 long and .82 broad behind. Palps: trochanter, .515×.259; femur, .815×.270; tibia, .915×.314; chela, 1.460× .436 broad and .430 deep; hand, .865 long; fingers, .648 long. Leg I: femur (as above), .623×.197; tibia, .444×.121; tarsus, .500×.095. Leg IV: femur (as above), .841×.264; tibia, .672×.152; tarsus, .533×.110.

Remarks.—The material at hand agrees very closely in all respects except for the fact that the holotype (from San Bulha Cave) has 21 instead of 23 teeth in the serrula and the fourth tibia is much more slender than in the Kaua Cave specimen (4.8 instead of 4.3 times as long as deep). It is doubtful if any significance can be attached to those differences, at least in the absence of extensive material.

This species is quite distinct from any thus far assigned to the genus. The almost equally slender femur and tibia are unique. All previously described species are from South America.

IX

ARANEIDA FROM YUCATAN

Ralph V. Chamberlin and Wilton Ivie
University of Utah

Twenty-five species of spiders are represented below, these falling into the families and genera indicated in the following list:

THERAPHOSIDAE
  Eurypelma sp. (immature)
DIPLURIDAE
  Evagrus sp. (immature)
BARYCHELIDAE
  Zygopelma meridana n. g., n. sp.
OONOPIDAE
  Wanops coecus n. g., n. sp.
SCYTODIDAE
  Loxosceles yucatana n. sp.
  Scytodes fusca Walckenaer
  Scytodes meridana n. sp.
  Scytodes itzana n. sp.
GNAPHOSIDAE
  Zelotes mayanus n. sp.
CLUBIONIDAE
  Anachemis sp. (immature)
  Trachelas sp. (immature)
DICTYNIDAE
  Titanoeca tizamina n. sp.
ULOBORIDAE
  Uloborus signatus Cambridge
PHOLCIDAE
  Physocyclus globosus (Taczanowski)
  Spermophora speophila n. sp.
  Anopsicus pearsei n. g., n. sp.
  Metagonia maya n. sp.
  Metagonia yucatana n. sp.
  Metagonia viabilis n. sp.
  Modisimus inornatus Cambridge
THERIDIIDAE
  Spelobion spukilum n. g., n. sp.
ARGIOPIDAE
  Nesticus pallidus Emerton
  Nesticus mayanus n. sp.
  Micrathena sagittata (Walckenaer)
  Leucauge loltuna n. sp.

It will be noted that eight of the twelve families are represented by single species. The Pholcidae, as indicated by the number of species and individuals collected, is obviously the dominant family.

Of chief general interest among the species are two that have become wholly blind and otherwise so modified as to necessitate separation into new genera and to indicate a probably long history of cave life. It is interesting that they belong to two families for which eyeless forms have not previously been recorded, namely, the Oonipidae and the Pholcidae. Belonging to the first of these families is *Wanops coecus* (Figs. 1, 2) and to the second *Anopsicus pearsei* (Figs. 17, 18).

Family THERAPHOSIDAE

Eurypelma sp. (immature)

Localities.—Oxkutzcab: Gongora Cave, 10 m. from mouth, July 13 (Lot 109) and interior, July 16 (Lot 111). Chichen Itza, Balaam Canche Cave, near mouth, June 11 (Lot 11).

Family DIPLURIDAE

Evagrus sp. (immature)

Locality.—Tekax: Xmahit Cave, 6 m. deep, one specimen taken July 31 (Lot 169).

Family BARYCHELIDAE

Zygopelma n. g.

Structure.—Carapace low, with the fovea large and recurved as in *Nemesia*, etc. Eyes in a compact group on a convex tubercle which is but little wider than long, separated from the anterior margin by a space but little greater than the diameter of a lateral eye. Anterior row of eyes decidedly procurved, the laterals much larger than the medians. Posterior row with line of centers moderately recurved, that of posterior margins strongly recurved as the median eyes are much smaller than the laterals and than the anterior medians. Lateral eyes on each side subequal and contiguous or very nearly so. Rastellum composed of numerous stout, curved teeth which dorsad grade into stout setae. Labium free, much wider than long, distally truncate, bearing no teeth. Endites of palpi much longer than wide, without distinct distal process; at proximal end with a series of few (in genotype 3) conical teeth. Sternum on each side with three small, circular impressions, one opposite base of coxae of legs I, II, and III. Tarsi I and II heavily scopulate, the scopulae entire; III also scopulate but with long setae intermixed, these more numerous along middle line; IV with numerous setae beneath, the scopular hairs few. Tarsi lacking a true median claw; lateral claws with a series of distinct teeth extending from base nearly to middle of length. Superior spinnerets with basal article decidedly longest and stoutest; the terminal article small, sub-hemispherical.

Genotype.—*Z. meridana* n. sp. Apparently close to *Trichopelma* but differing in having the lateral eyes contiguous and the thoracic fovea distinctly recurved.

Zygopelma meridana n. sp.

Structure.—Carapace with integument yellow, appearing dusky from coat of hair excepting in a triangular area along middle of cephalic region back of eye tubercle, which bears stout and long setae of which about seven of the largest form a series along the mid-dorsal line. Sternum and legs yellow. Abdomen above whitish yellow; a blackish band across anterior end, followed by an interrupted median longitudinal band of brown, each side of which are five narrow and interrupted cross lines of the same color; sides and venter of similar light ground color.

Anterior lateral eyes with diameter to that of anterior and posterior medians about as 11:7:5. Anterior median eyes nearly their radius apart and about same distance from the laterals. Posterior median eyes less than radius from laterals, widely separated from each other, the interval about equal to that occupied by anterior median eyes.

Inner margin of furrow of chelicera with 8 stout teeth over entire length, outer margin also with about 8 minute teeth over posterior portion alone. Palpal claws smooth. Tarsal claws each with three teeth on basal portion. Tarsus of palpus completely scopulate and with a stout spine at base on each side; tibia scopulate at distal end, bearing three seriate spines along anterior (mesal) side and two along posterior side of ventral surface. Tarsus and metatarsus of legs I and II densely scopulate throughout length, and tibia over distal half; tarsus without spines, metatarsus with three ventral spines in posterior series and two in the anterior, one of the latter at each end. Tarsus III scopulate throughout but with stout setae intermixed especially distally and along median line; metatarsus scopulate over distal half and bearing numerous setae and stout spines. On leg IV scopulae replaced by more numerous setae, the spines on metatarsus numerous as on III.

Measurements.—

	Female
Length	17.5 mm.
Carapace:	
Length	7.6
Width	5.8
Tibia-patella:	
I	5.2
IV	7.0

Locality.—Merida: San Isidro Cave, at mouth under stone. One female (Lot 70).

Family OONOPIDAE

Wanops n. g.

Evidently related to *Oonops*. Cephalothorax smoothly convex, highest point about one-third distance from base. Eyes wanting. Sternum large, ovate. Palpus of male very small, tarsus not enlarged. Legs exceptionally long for this family, with many long spines. Abdomen soft.

Genotype.—*Wanops coecus* n. sp.

Wanops coecus n. sp.

(Figs. 1, 2)

Color.—Entirely pale whitish.

Structure.—As given under generic diagnosis. Eyes entirely missing; their former position slightly roughened and discolored. Legs with many long spines, five pairs on under side of tibia I.

Measurements.—

	Male
Length	1.80 mm.
Carapace:	
Length	.80
Width	.60

Legs:	I	II	III	IV
Coxa	.25	.20	.18	.22
Trochanter	.10	.10	.09	.10
Femur	1.00	.87	.73	1.07
Patella	.60	.47	.28	.40
Tibia	1.04	.62	.60	1.07
Metatarsus	.93	.60	.50	.73
Tarsus	.33	.33	.32	.33
Total	4.25	3.19	2.70	3.92

Locality.—Chichen Itza: Balaam Canche Cave, "under laundry stone", 95 m. from mouth, June 10. One male (Lot 7).

Family SCYTODIDAE

Loxosceles yucatana n. sp.

(Fig. 3)

Color.—Carapace, endites, labium, legs, and palpi orange, without distinct markings, palpi more reddish brown beyond patella. Sternum lighter than the other parts. Chelicerae reddish brown. Abdomen usually greenish gray. (Color usually much lighter in immature and freshly moulted specimens.)

Clothed with darker hairs, especially on carapace, femora of legs, and abdomen.

Structure.—Typical. Median eyes less than a diameter from the nearest lateral eyes, and nearly two diameters from the margin of the clypeus. Embolus of palpus slender.

Measurements.—

	Male	Female
Length	5.5 mm.	7.8 mm.
Carapace:		
Length	2.7	3.2
Width	2.3	2.9
Tibia-patella:		
I	6.3	5.9
IV	(missing)	5.7

Localities.—Kaua: Kaua Cave, male holotype, female allotype and immature paratypes, taken near mouth, June 16 (Lot 24).

Chichen Itza: Xtoloc Cenote Cave, immature, in bat feces and in dirt on floor, June 24 (Lots 46 and 47).

Merida: San Bulha Cave, in debris on floor, immature, July 13 (Lot 106).

Oxkutzcab: Ebizt Cave, near drip pool and in crevice near mouth, immature, July 18 and 19 (Lots 117 and 122); Ziz Cave, near mouth, immature, July 24; Puz Cave, near mouth, immature and female paratypes, July 20 and 21 (Lots 125, 128, and 136); Loltun Cave, near Nakab mouth, immature, July 26 (Lot 154).

Tekax: Sabacha Cave, under stones, immature (Lot 164); Cinquo de Mayas Cave, inner middle cave and near mouth, female paratypes, July 29 (Lots 158, 161).

Calcehtok: Xkyc Cave, "at B in debris," immature, August 7 (Lot 187).

This widely distributed spider was found outside caves and far underground. In dry caves (Ebizt, etc.) it spun flat webs over the dusty floor; under these lived cockroaches (*Holocompsa zapoteca* Sauss.) and other insects.

Scytodes fusca Walckenaer

One female:

Locality.—Oxkutzcab: Loltun Cave, near Nakab mouth, July 26 (Lot 154).

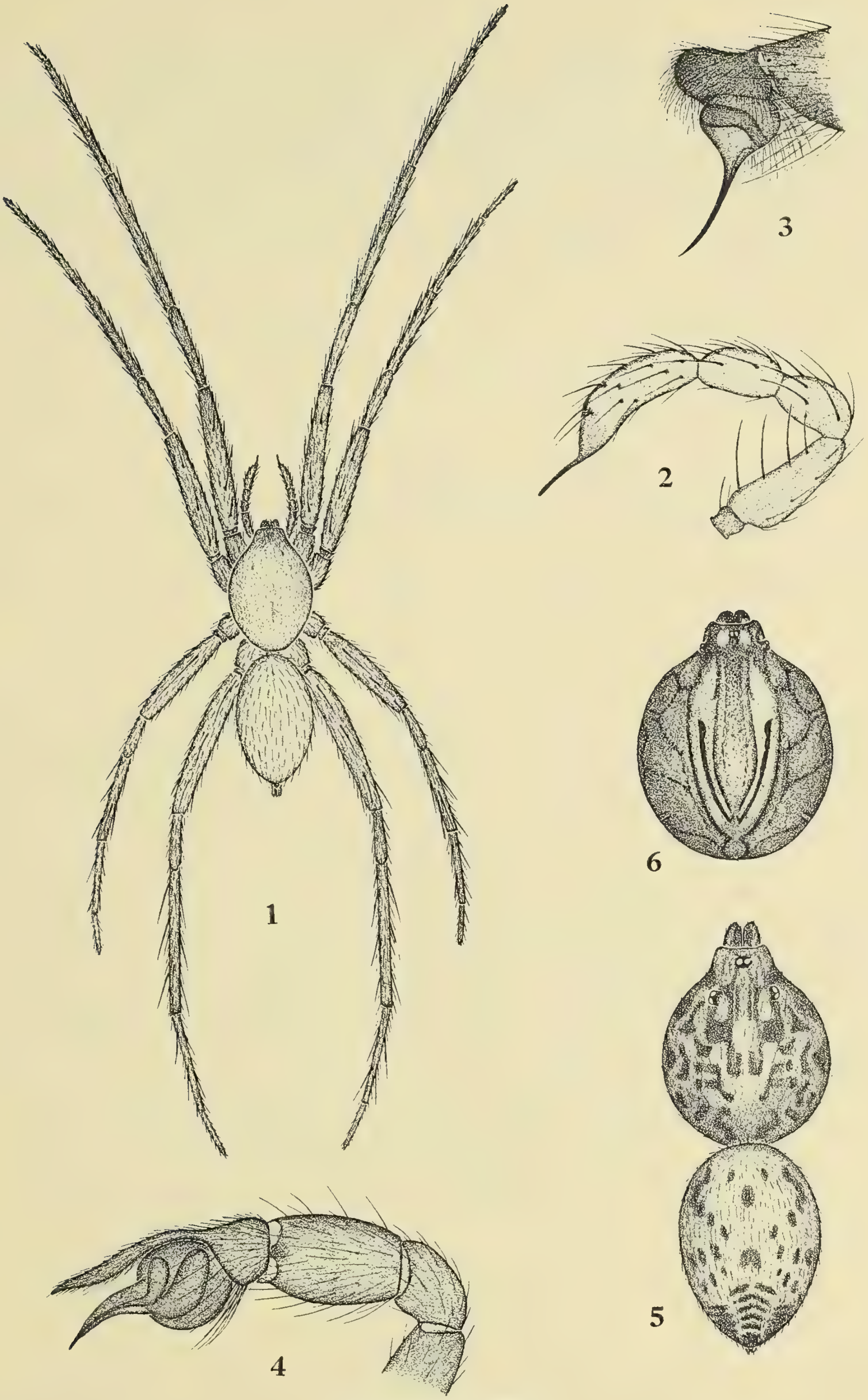
Scytodes meridana n. sp.

(Figs. 4, 5)

Color.—Carapace pale yellowish to white on top, somewhat darker on sides and in front, with dusky markings (pattern of markings shown by the figure).

Figs. 1-6—*ARANEIDA*

1: *Wanops coecus* n. sp., male, dorsal view.
2: Same, left palpus, ectal view.
3: *Loxosceles yucatana* n. sp., tip of left palpus, ectal view.
4: *Scytodes meridana* n. sp., left palpus, ectal view.
5: Same, dorsal view of immature male.
6: *Scytodes itzana* n. sp., carapace of immature specimen.



FIGS. 1-6—*ARANEIDA*
(*For description see opposite page.*)

Mouthparts light yellowish with light dusky markings. Legs light yellowish with light dusky specks and annuli. Sternum dusky with three large yellow spots along each side, and a median mark of yellow on anterior half. Abdomen pale gray or whitish, with blackish markings, as shown by the figure.

Structure.—The female is rather large, with long slender legs. Eyes in three diads, forming a triangle, the base of which is much less than twice the altitude. Eyes about equal. The one male at hand is rather small. Palpus as shown by the figure.

Measurements.—

	Male	Female
Length	5.1 mm.	9.0 mm.
Carapace:		
Length	2.4	4.0
Width	2.0	3.0
Tibia-patella:		
I	11.0	11.5
IV	7.6	8.5

Locality.—Merida: San Bulha Cave, on walls and roof and in debris on floor, July 13 (Lots 105 and 106), female holotype, male allotype, immature male paratype.

This species is close to *Scytodes intricata.*

Scytodes itzana n. sp.

(Fig. 6)

Immature:

Color.—Carapace varying in ground color from nearly white to light pinkish yellow on different areas, marked with black and dusky as shown in the figure. Sternum pale yellowish with dusky spots on margin, one opposite each coxa, and fine dusky specks over the rest of the surface, the latter tending to form a reticulate pattern. Mouthparts pale, with characteristic dusky markings on chelicerae. Legs whitish with black markings: two parallel stripes the full length of the femur on the under side (these may be partially broken up into spots); the distal ends of these stripes spread apart and contain a black spot between them; a series of spots along basal two-thirds of anterior face of femur, which may be more or less fused into a stripe; a broken annulus at base and another at middle of tibia, a broad distinct annulus at distal end of tibia; and a dusky annulus at distal end of metatarsus. (Abdomen discolored in the type.)

Structure.—Apparently shorter and proportionately broader than in the preceding species, and with much shorter legs. Triangle formed by eyes with a much shorter altitude, the base being more than twice the altitude.

Locality.—Chichen Itza: Xtoloc Cenote Cave, June 24 (Lot 47), immature holotype.

Family GNAPHOSIDAE

Zelotes mayanus n. sp.

(Fig. 7)

Female:

Color.—Carapace and chelicerae shiny brown, with indistinct dusky markings. Legs and abdomen lighter brown. Abdomen gray above, white beneath.

Structure.—In general, typical. Eyes close together, order of size: anterior lateral, posterior lateral, posterior median, anterior median. Posterior row straight, eyes scarcely more than a half-radius apart. Anterior row procurved, median eyes contiguous with the lateral, about a radius apart. Epigynum as figured.

Measurements.—

	Female
Length	3.80 mm.
Carapace:	
Length	1.50
Width	1.17
Tibia-patella:	
I	1.40
IV	1.40

Locality.—Tekax: Sabacha Cave, "mouth C, 20 m. deep," July 30 (Lot 165), female holotype.

Family CLUBIONIDAE

Anachemmis sp.

Young:

Localities.—Motul: San Bulha Cenote Cave, in bat feces, July 9 (Lot 95). Calcehtok: Xkyc Cave, "at D," August 6 (Lot 184).

Trachelas sp.

One immature:

Locality.—Calcehtok: Xkyc Cave, "below A, organic debris," August 7 (Lot 186).

Family DICTYNIDAE

Titanoeca tizamina n. sp.

(Figs. 8, 9)

Female:

Color.—Carapace orange-brown. Chelicerae chestnut. Labium and endites orange-brown, with whitish tips and dusky shadings. Sternum orange with dusky margins and a dusky wedge-shaped streak entering medially from the posterior point. Legs orange with more or less distinct dusky annuli—3 on femur, 1 on patella, 2 on tibia, and 2 on metatarsus—more distinct on under side. Abdomen mottled dark and light gray, the pattern above shown by the figure; venter dark gray with numerous small spots, streaks, and specks of pale gray.

Structure.—Typical, closely resembling that of *T. americana* Emerton.

Measurements.—

	Female
Length	4.5 mm.
Carapace:	
Length	2.0
Width	1.3
Tibia-patella:	
I	1.7
IV	1.8

Locality.—Tizamin: Muruztun Cave, middle part, August 12 (Lot 195). Female holotype, four female and several immature paratypes.

Family ULOBORIDAE

Uloborus signatus Cambridge

(Fig. 10)

Male, female, and immature:

LOCALITY.—Oxkutzcab: Loltun Cave, mouth, July 26 (Lot 154).

Family PHOLCIDAE

Physocyclus globosus (Taczanowski)

Males:

LOCALITY.—Merida: San Bulha Cave, in stones and debris on floor and on walls, July 13 (Lots 105 and 106).

Spermophora speophila n. sp.

(Figs. 15, 16)

Female:

COLOR.—Cephalothorax and appendages pale dull yellowish pink, chelicerae slightly darker. Abdomen light whitish gray, without markings.

STRUCTURE.—In general, of typical Pholcid shape. Size small. Carapace longer than wide; pars cephalica only weakly set off from the pars thoracica by cervical grooves. Eyes six, in two triads; the two anterior eyes larger than the posterior. Anterior eyes about one and one-half diameters apart. Posterior eye-row procurved; median eyes about two diameters apart. Legs moderately short for a Pholcid. Abdomen high and globose. Epigynum simple as shown by the figures.

MEASUREMENTS.—

	FEMALE
Length	1.60 mm.
Carapace:	
Length	.70
Width	.63
Tibia-patella:	
I	1.15
IV	1.35

LOCALITIES.—Tohil: Chac Mol Cave, under stones at top, June 27 (Lot 61), female holotype. Oxkutzcab: Gongora Cave, 10 m. from mouth and in interior (Lots 109 and 111), immature females.

Anopsicus n. g.

STRUCTURE.—Carapace low and round. Eyes entirely wanting. Legs moderately long. Abdomen high and rounding, somewhat compressed laterally.

GENOTYPE.—*Anopsicus pearsei* n. sp.

Anopsicus pearsei n. sp.

(Figs. 17, 18)

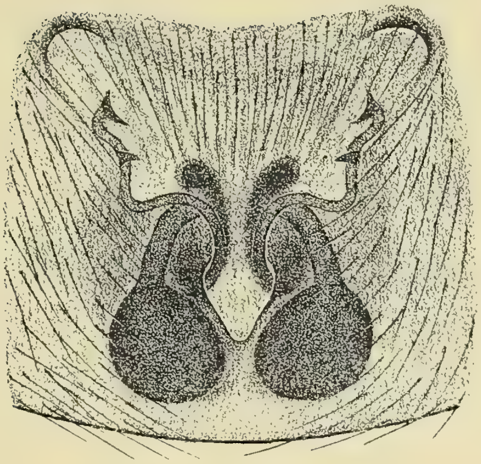
Female:

COLOR.—Cephalo-thorax and legs pale pinkish brown. Abdomen pale gray.

STRUCTURE.—Given under generic diagnosis.

FIGS. 7-14—*ARANEIDA*

7: *Zelotes mayanus* n. sp., epigynum.
8: *Titanoeca tizamina* n. sp., female.
9: Same, epigynum.
10: *Uloborus signatus* Cambridge, epigynum.
11: *Spelobion spukilum* n. sp., epigynum.
12: *Nesticus mayanus* n. sp., epigynum, ventral view.
13: Same, eyes, dorsal view.
14: *Leucauge loltuna* n. sp., epigynum.



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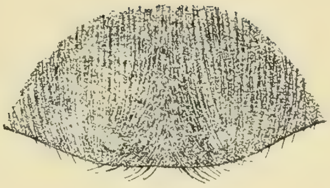

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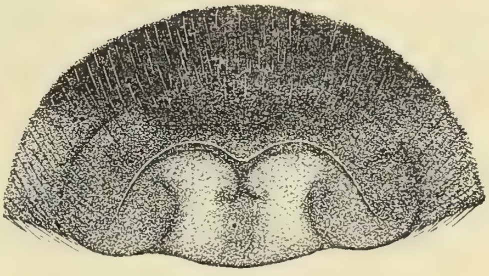

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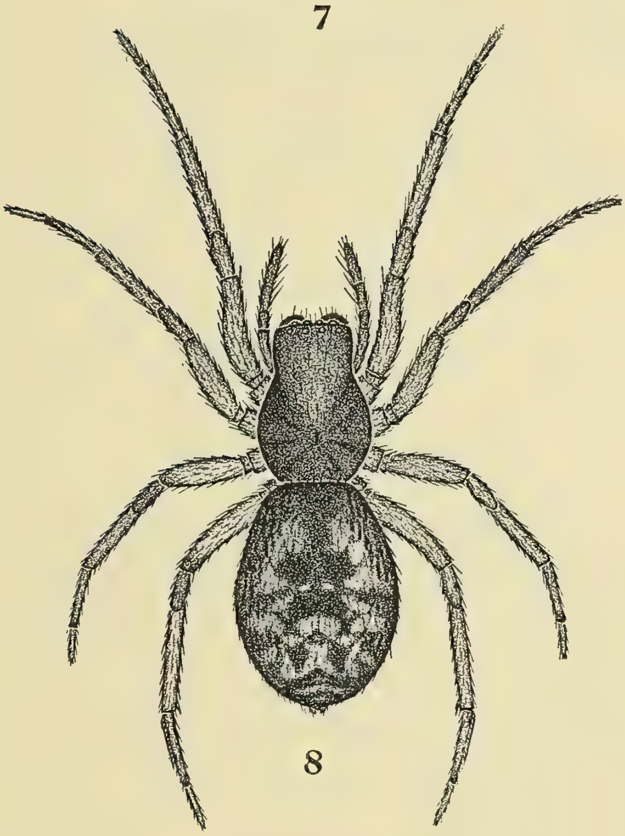

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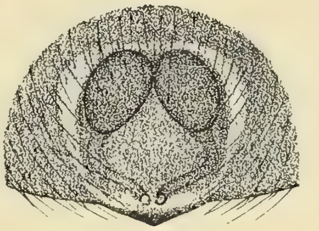

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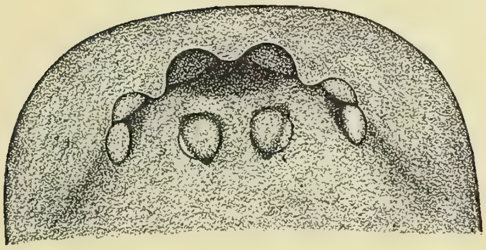

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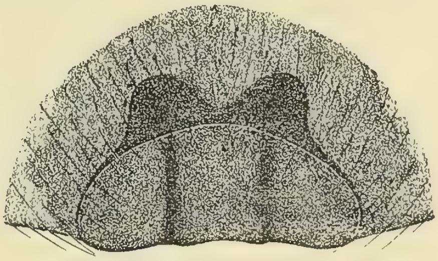

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Figs. 7-14—*ARANEIDA*

(For description see opposite page.)

MEASUREMENTS.—

	FEMALE
Length	1.8 mm.
Carapace:	
Length	.7
Width	.7
Tibia-patella:	
I	2.9
IV	3.4

LOCALITY.—Kaua: Oxolodt Cave, in piles of bat feces, June 18 (Lot 34). Female holotype, female paratype and immature paratypes.

Metagonia maya n. sp.

(Figs. 23, 24)

COLOR.—Pale whitish, with patella of legs and joint between tibia and metatarsus dusky. Darker specimens have the cephalothorax and legs tinted with yellowish and abdomen light gray.

STRUCTURE.—In general, typical. Abdomen with posterior hump broadly rounded, not coming to a conical point. Epigynum with a short process on the posterior margin. Palpus as illustrated.

MEASUREMENTS.—

	MALE	FEMALE
Length	2.0 mm.	2.5 mm.
Carapace:		
Length	.8	.9
Width	.85	.93
Tibia-patella:		
I	6.1	5.0
IV	3.3	3.4

LOCALITIES.—Tohil: Chac Mol Cave, on walls, June 27 (Lot 56A), male holotype and female allotype, male and female paratypes and immature.

Chichen Itza: Xtoloc Cenote Cave, under stones and in wall holes, June 24 (Lots 52 and 53).

Tixcacal: Luchil Cave, in web, July 6 (Lot 81).

Oxkutzcab: Gongora Cave, July 16 (Lots 109 and 111), 10 m. from mouth and interior.

Tekax: Chakxix, inner cave, August 1 (Lot 172).

Tizamin: Muruztun Cave, middle, August 12 (Lot 195).

Metagonia yucatana n. sp.

(Figs. 19-21)

COLOR.—Pale whitish, with patella and joint between tibia and metatarsus dusky.

STRUCTURE.—Abdomen with a conical hump posteriorly above spinnerets. Legs very long and slender. Epigynum with a long curving process on the posterior margin. Palpus as figured.

MEASUREMENTS.—

	MALE	FEMALE
Length	2.3 mm.	2.5 mm.
Carapace:		
Length	.8	.8
Width	.8	.8
Tibia-patella:		
I	6.7	5.1
IV	4.0	3.3

LOCALITY.—Oxkutzcab: Loltun Cave, near Nakab mouth, July 26 (Lot 154). Male holotype, female allotype, female and immature paratypes.

Metagonia viabilis n. sp.

(Fig. 22)

This species is similar in color and shape to *M. maya.* The size is somewhat larger. It differs mainly in having the process on the posterior margin of the epigynum longer.

LOCALITIES.—Oxkutzcab: Ziz Cave, inner part, July 24 (Lot 146), female holotype; Puz Cave, July 20, August 6, "between A and mouth" (Lot 183), female and immature.

Calcehtok: Xkyc Cave, "at D," August 6 (Lot 184), a female.

Modismus inornatus Cambridge

Male and female:

LOCALITY.—Tekax: Xmahit Cave, 6 m. deep, July 31 (Lot 169).

Family THERIDIIDAE

Spelobion n. g.

STRUCTURE.—Very small in size. Cephalo-thorax of moderate height, posterior declivity long, head region rather broad, convexly rounded and moderately elevated behind eye region. Eye area much wider than long; anterior row of eyes straight, the posterior slightly recurved, a little longer than the anterior; lateral eyes on each side subcontiguous; anterior median eyes smaller than others, well separated from each other and from the laterals; eyes of posterior row about equal in size, well separated and equidistant; area of median eyes subquadrate, scarcely narrower in front than behind. Labium broad, immovably united with sternum. Endites long, inclined toward each other. Sternum subcordate in general outline but with posterior end truncate and widely separating the posterior coxae. Legs of moderate length; tarsi relatively long, its paired claws dentate proximally.

GENOTYPE.—*Spelobion spukilum* n. sp.

Spelobion spukilum n. sp.

(Fig. 11)

Female:

COLOR.—Carapace, mouthparts, sternum, and legs orange. Abdomen whitish.

STRUCTURE.—Head stout and rounded, not especially elevated nor protruding. Clypeus vertical. Anterior median eyes smaller than the others. Anterior eye-row straight, the posterior slightly recurved. Posterior eyes equidistant, slightly less than a diameter apart. Anterior median eyes more than a diameter apart, less than a diameter from the side eyes. Quadrangle of median eyes about as broad in front as behind.

Sternum large, broad and truncate at posterior end, separating hind coxae by nearly two diameters. Abdomen sub-globose. Epigynum as figured.

MEASUREMENTS.—

	FEMALE
Length	1.00 mm.
Carapace:	
Length	.50
Width	.47
Tibia-patella:	
I	.57
IV	.57

LOCALITY.—Calcehtok: Spukil Cave, "near B under stone," August 5 (Lot 179), female holotype.

Family ARGIOPIDAE

Nesticus pallidus Emerton

LOCALITY.—Merida: San Bulha Cave, on walls and roof and in debris on floor, July 13 (Lots 105), one female.

Nesticus mayanus n. sp.

(Figs. 12, 13)

This species resembles other species of this genus (e.g., *N. pallidus* Emerton) in general size, shape, and color. The significant differences are in the eyes and the epigynum.

COLOR.—Entire cephalothorax and appendages light yellowish to brownish orange, varying with different specimens. Abdomen gray.

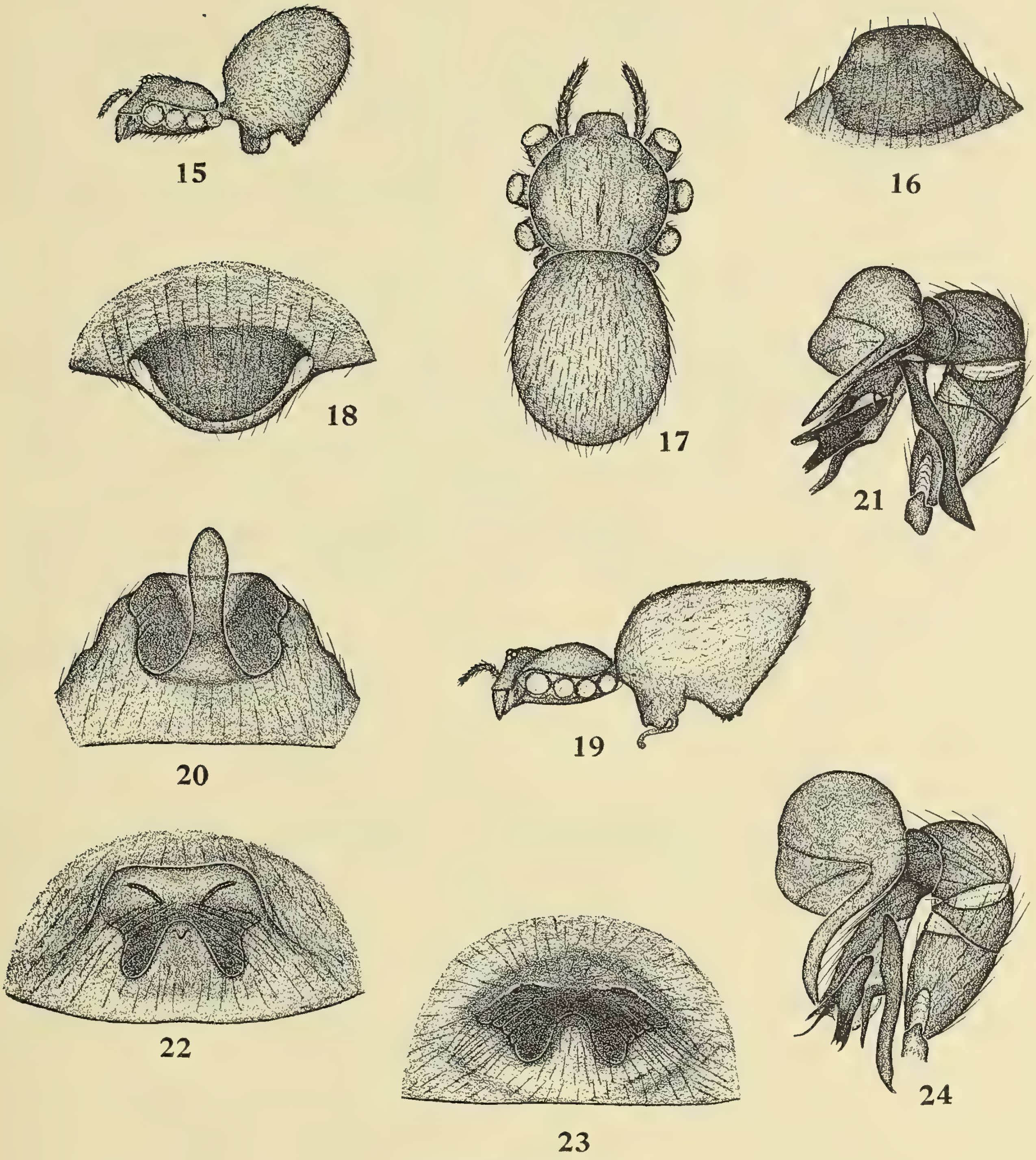
STRUCTURE.—Eyes small; anterior medians larger than the others. Posterior row procurved; posterior median eyes a little over a diameter apart, about one and one-half diameters from the side eyes. Anterior row nearly straight; anterior median eyes scarcely a radius apart, a little more than a radius from the side eyes.

MEASUREMENTS.—

	FEMALE
Length	2.9 mm.
Carapace:	
Length	1.3
Width	1.2
Tibia-patella:	
I	2.2
IV	1.5

FIGS. 15-24—*ARANEIDA*

15: *Spermophora speophila* n. sp., female, lateral view.
16: Same, epigynum, anterior view.
17: *Anopsicus pearsei,* n. sp., female, dorsal view.
18: Same, epigynum, ventral view.
19: *Metagonia yucatana* n. sp., female, lateral view.
20: Same, epigynum, posterior view.
21: Same, left palpus, ectal view.
22: *Metagonia viabilis* n. sp., epigynum, postero-ventral view.
23: *Metagonia maya* n. sp., epigynum, postero-ventral view.
24: Same, left palpus, ectal view.



Figs. 15-24—*ARANEIDA*

(For description see opposite page.)

Localities.—Hoctun: Hoctun Cave, mouth and middle, July 8 (Lot 92), female holotype and female paratype.

Kaua: Oxolodt Cave, in piles of bat feces, June 18 (Lot 34), female paratype, from orb web.

Micrathena sagittata (Walckenaer)

One female:

Locality.—Oxkutzcab: first cave on San Roque Road, near mouth, July 22 (Lot 140).

Leucauge loltuna n. sp.

(Fig. 14)

Female:

Color.—Carapace pale yellowish, with a dusky stripe along each side margin, and an irregular stripe along middle. Chelicerae light yellowish at base, reddish brown at distal end. Sternum, endites and labium dark reddish brown. Legs and palpi pale yellow basally, gradually darkening to brown distally, with dusky annuli at the joints. Abdomen silver, with longitudinal grayish green stripes as in *L. venusta*; the posterior point with blackish markings.

Structure.—Typical. Abdomen about twice as long as wide; a slight hump above at posterior end, which gives the end a square appearance when viewed from the side. Epigynum distinct.

Measurements.—

	Female
Length	6.0 mm.
Carapace:	
Length	2.2
Width	1.6
Tibia-patella:	
I	4.5
IV	2.8

Locality.—Oxkutzcab: Loltun Cave, near Nakab mouth, July 26 (Lot 154), female holotype and immature male paratype.

X

ACARINA OF YUCATAN CAVES

G. W. WHARTON
Duke University

INTRODUCTION

The known acarinids from Yucatan are few. Bequaert (1933) lists specifically *Sarcoptes scabei* (L.), *Ornithodorus talaje* (Guerin-Meneville), *Dermacentor variabilis* (Say), *Dermacentor nitens* Neuman, and *Amblyomma cajennense* (Fabricius). Pearse (1936) reports *Trombicula irritans* (Riley) and *Amblyomma dissimile* Koch. The above list includes all the species of Acarina known to occur in Yucatan previous to the present paper. Pearse (1936) also reports several genera *Orbatula, Dameosoma, Galumna, Macrocheles,* and *Trombidium.*

The present paper, although it more than doubles the number of species of Acarina reported from Yucatan, is probably in no wise a complete study of the mites occurring in the caves of the peninsula. It is rather an indication of the rich acarinid fauna which awaits further study.

The mites and ticks which attack man in this region are those which have been reported. *Sarcoptes scabei* causes the "itch"; *Trombicula irritans* is the common chigger; and all of the ticks reported (except *Amblyomma dissimile*) are known to attack man. Two of these pests are perhaps vectors of human disease. *Trombicula irritans* has been thought to carry a local type of typhus fever known as matlalzahuatl. It is significant that the name for this mite is tlalzahuatl. *Ornithodorus talaje* might carry relapsing fever as do several members of the genus. The importance of knowing more about the cave Acarina of Yucatān can not be over emphasized. The artifacts found in the caves indicate that they were used by the Maya as places of refuge, worship, and water reservoirs. The presence of many parasitic mites in these caves, any of which might conceivably be the vector of human disease, raises an important question. Has there been any epidemic disease among the Maya derived from cave mites? Sambon (1928) has evidence that trombid mites carry typhus fever throughout the world. The case against *Trombicula akamushi* (Brumpt) as vector of Japanese river fever has been proven by Nagayo *et al.* (1931). Caves offer especially favorable conditions for the trombid mites which occur in these caves frequently; in fact four new species and two new genera are described in this paper.

Apart from the importance of Acarina as pests and disease vectors, they are important in that they show certain adaptations to cave life which are of purely academic interest. This paper includes a discussion of the ecology of the Acarina found in caves, and the classification. The suggestion of the possible great economic importance of the group is made to emphasize the fact that the acarinids, especially the mites, deserve more study than is devoted to them, even though the interesting academic features be overlooked, and only the practical view point be considered.

TICKS

The ticks collected were taken mostly from members of the expedition, and probably do not properly belong to the fauna of the caves. Only three species were collected, and these have all been reported from Yucatan before.

Ornithodorus talaje (Guerin-Meneville) is represented in the collection by three specimens collected June 24 on the floor of Xtoloc Cenote Cave, two of which were in bat feces. Nuttall, Warburton, Cooper, and Robinson (1908) say: "The ticks infest old houses, retreating into the crevices of the walls. . . . . The talajas bite at night and disappear by morning." The habit of hiding in crevices and feeding intermittently, usually in the dark, adapts these ticks to caves. The presence of small mammals and birds in the caves provides the ticks with an ample food supply. Although the entrance of *O. talaje* into the caves is probably accidental, it seems logical to assume that they establish themselves and become tychotroglobionts.

Amblyomma dissimile (Koch) was found at six localities. In all, nine individuals were taken; one male, two females, and seven nymphs. On June 13 at Balaam Canche Cave a single nymph was taken. On June 15 one male, two females, and seven nymphs were taken from an undetermined species of turtle at Kaua. On July 11 one nymph was taken near the mouth of Yunchen Cave. On July 22 one nymph was collected near the mouth of the first cave on San Roque Road, Oxkutzcab. On July 31 a single nymph was collected near Xmahit Cave. One nymph was taken in a tow net from San Bulha Cenote, Motul, on July 9. This tick as an adult infests only cold-blooded animals, but in the immature stages is known to attack mammals. The distribution of *A. dissimile* is therefore dependent upon the distribution of its amphibian and reptilian hosts.

Amblyomma cajennense (Fabricius) was found most frequently. Seventeen individuals were taken from eight localities. Most of these were taken from persons. One female was taken from the turtle at Kaua on June 15, another near Sabacha Cave July 30. One male was collected near Ebizt Cave July 18, a second with six nymphs July 31 near Xmahit Cave, and a third August 7 near Xkyc Cave. One nymph was taken June 11 near Balaam Canche Cave, one July 20 at the inner end of Puz Cave, and four July 26 by a pool near the mouth of Loltun Cave. *A. cajennense* is not a cave animal, and its presence in caves is rare. The larvae usually occur on grass from which they gain access to their hosts. This habit would naturally exclude them from caves.

Larval ticks were taken from three localities; three from bat feces June 24 at Xtoloc Cenote Cave, four from the interpreter June 27 near Chac Mol Cave, and two from a bat *Artibeus jamaicensis yucatanicus* (Allen) July 23 at the second cave on San Roque Road, Oxkutzcab. The distribution of these larvae is dependent upon the activities of the hosts upon which they feed.

MITES

The mites from Yucatan caves are varied and numerous. Unfortunately the mites outside the caves are unknown, so there is now no way of determining whether or not a species is confined to underground life. Mites are rather easily desiccated and for this reason are benefited by the high humidity that prevails in caves. The numerous piles of bat and swallow dung with the small insects that live in them are excellent sources of food for free living mites, while the birds, bats, and other larger animals make excellent hosts for parasitic species.

Ten new species of mites, two new genera, two previously reported species, and ten undeterminable species were collected.

Atricholaelaps glasgowi (Ewing) is parasitic on rodents throughout North and Central America. On June 8 six females and one male were taken from a dead carcass of *Cuniculus paca nelsoni* (Goldman); and two nymphs were taken from Spukil Cave on August 5 in swallow feces.

Spinturnix ewingia n. sp. was taken July 23 from a bat, *Artibeus jamaicensis yucatanicus* (Allen) at the second cave on San Roque Road, Oxkutzcab. Only one specimen was found. The Spinturnicinae are found as bat parasites throughout the world, and so are as characteristic of caves as the bats themselves. The parasite is adapted to its host, however, rather than to caves.

Uropoda pearsei n. sp. was found in large numbers in bat feces on July 9 at San Bulha Cenote. Males, females, and nymphs were living on the same pile of dung. These mites probably live upon the organic matter present in the bat feces. They are probably found on decaying organic material outside of caves where there is a high relative humidity. Although nothing can be said about the tendency of *U. pearsei* to dry up, it has been the author's experience with other uropodids that they become desiccated rather easily.

Oribatella monospicus n. sp. was caught in a tow net July 9 at San Bulha Cenote. Only one specimen of this moss-mite was taken. It was undoubtedly in an unnatural habitat, so nothing can be said of its probable mode of life.

Scheloribates luchili n. sp. was likewise caught in a tow net July 6 at Luchil Cave. This single specimen was also in an unnatural habitat.

Galumna jacoti n. sp. was found on bat feces July 9 at San Bulha Cenote. Two specimens were taken. Galumnids are in general sensitive to desiccation. Jacot (1936) says, concerning soil mites, "Oribatid mites orient themselves vertically according to the moisture of their medium." It is probably true that *G. jacoti* is a scavenger in places of high humidity.

Hannemania nudosetosa n. sp. was taken from bats July 23 at the second cave on San Roque Road, Oxkutzcab, and on August 1 from bats at Chakxix Cave. Ten larvae were collected. This is the only species of the genus *Hannemania* that is known to attack anything but an amphibian. The high relative humidity perhaps explains the unique habitat of this hannemanian.

Trombicula myops Vitzhum was caught on bats August 1 at Chakxix Cave. Vitzhum (1931) describes the type from a bat *Molossus nasutus* Spix taken July 4 at Puerto la Cruz. The bats from which these larvae were taken are *Artibeus jamaicensis yucatanicus* (Allen) and *Peteropteryx canina canina* (Wied.).

Trombicula camilla n. sp. was found as an adult in four localities. Eight individuals were taken. Collections were made June 12 in Balaam Canche Cave, June 18 in Oxolodt Cave, July 4 in San Isidro Cave, and August 7 in Xkyc Cave. Adult trombiculids are ordinarily subsoil or litter dwellers. Their appearance in caves is therefore not surprising. Perhaps this is the adult of *Trombicula myops* but it is impossible to say until the life history has been worked out.

Erythraeus bisetosa n. sp. was taken July 3 at San Isidro Cave. The high humidity and large number of insects and spiders present in the caves make an ideal habitat for any erythraeid mite.

Platyseta yucatanicus n. g., n. sp. was taken August 6 at Sazich Cave. Its habits are probably similar to those of *Erythraeus bisetosa.*

Nine different unidentifiable parasitid mites were taken. These were all free living and probably preyed upon other small arthropods in the caves.

One unidentifiable uropodid nymph was taken. Its habits are similar to those of *Uropoda pearsei.*

SUMMARY

1. The ticks are probably accidental inhabitants of caves.
2. The mites live in caves because of the abundance of food and high relative humidity.
3. A list of the Acarina collected follows:

Suborder TROMBIDINA

Family TROMBIDIIDAE
  Trombicula myops Vitzhum
  Trombicula camilla n. sp.
  Hannemania nudosetosa n. sp.
  Monunguis streblida n. g., n. sp.
Family ERYTHRAEIDAE
  Erythraeus bisetosa n. sp.
  Platyseta yucatanicus n. g., n. sp.

Suborder IXODINA

Family ARGASIDAE
  Ornithodorus talaje (Guerin-Meneville)
Family IXODIDAE
  Amblyomma cajennense (Fabricius)
  Amblyomma dissimile Koch

Suborder PARASITINA

Family PARASITIDAE
 Subfamily Parasitinae
  Atricholaelaps glasgowi (Ewing)
 Subfamily Spinturnicinae
  Spinturnix ewingia n. sp.
Family UROPODIDAE
  Uropoda pearsei n. sp.

Suborder ORIBATINA

Family ORIBATIDAE
  Scheloribaets luchili n. sp.
  Galumna jacoti n. sp.
  Oribatella monospicus n. sp.

APPENDIX

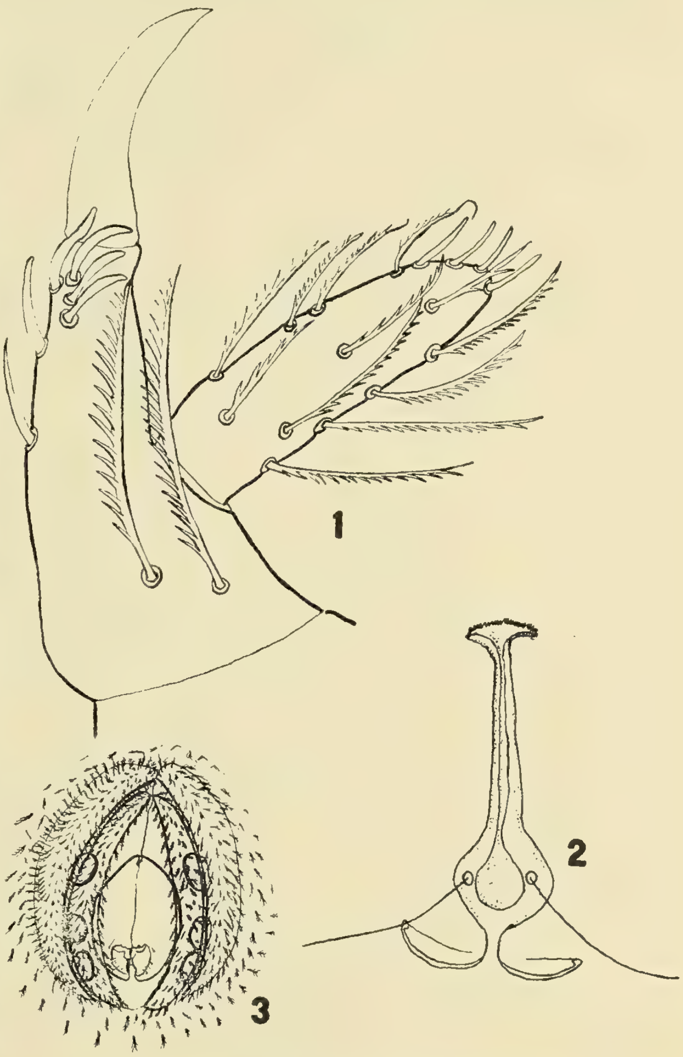
Descriptions of New Genera and Species

Trombicula camilla n. sp.

(Figs. 1-3)

Trombicula camilla is nearest to *Trombicula cavernarum* Ewing. However the palpal thumb of *T. cavernarum* is broader at the base and more tapering, the palpal fang is more slender, and the palpal spines straighter.

Adult. Large size. Length 3.5 mm., width 2.2 mm. Palpi extend to the third segment of the first pair of legs; palpal claw strong, half as long as the penultimate palpal segment which bears it; accessory spines four, curved, subequal, forming a comb; palpal thumb not swollen. Chelicerae slender; chelae sharp and slender, extending beyond second joints of palpi. Crista rod-like, expanded at anterior end and fringed, expanded at posterior and into a diamond-shaped pseudostigmatic area behind which it ends in two strongly diverging lateral arms. Pseudostigmata small situated at lateral angles of pseudostigmatic area; pseudostigmatic organs long and setiform. Eyes absent. Abdomen 2.5 mm. long; 2.2 mm. wide; setae moderate, barbed. Genital opening 0.5 mm. long, anterior end between hind coxae. Genital armature consists of a spathulate plate smaller than the genital opening with a small shovel-shaped plate at the base. Anal opening 0.2 mm. long, 0.2 mm. behind the posterior edge of the genital plate. Anterior legs slightly larger than posterior, about 2.5 mm. long. Tarsal claws simple, those on first leg small and subequal, those of the other legs larger and unequal.



Figs. 1-3—*TROMBICULA CAMILLA* n. sp.
1: Palp, × 325. 2: Crista, × 85. 3: Genitalia, × 70.

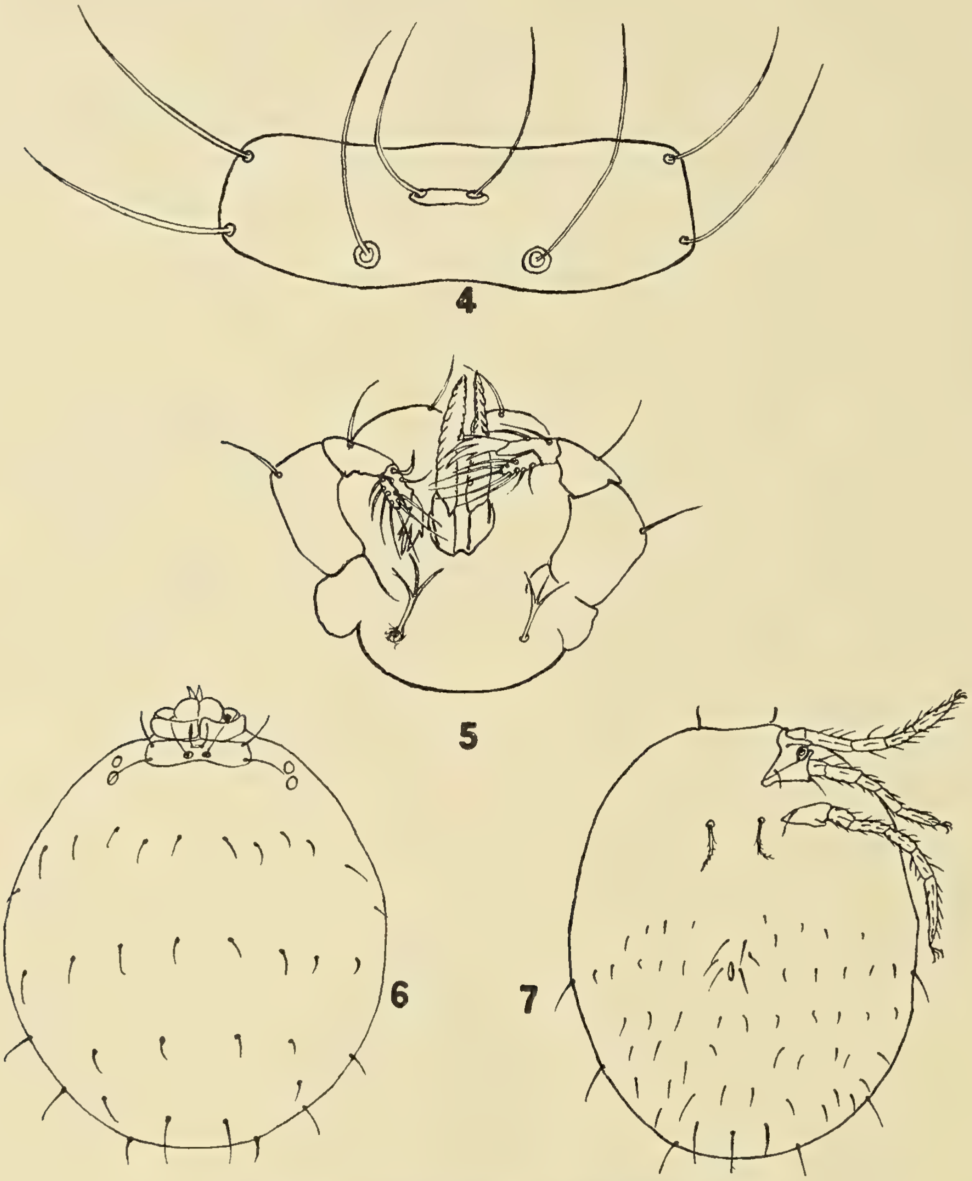
Type locality.—Oxolodt Cave, Yucatan.

Type specimen.—U. S. N. M. No. 1263.

Hannemania nudosetosa n. sp.

(Figs. 4-7)

Hannemania nudosetosa differs from all known members of the genus in that there are no spines present on the setae of the dorsal plate, and in that the dorsal plate is nearly rectangular in shape.



Figs. 4-7—*HANNEMANIA NUDOSETOSA* n. sp.

4: Dorsal shield, × 325.
5: Mouth parts, × 325.
6: Dorsal view, × 85.
7: Ventral view, × 85.

Larva. Small whitish terete mites resembling ticks. Capitulum 0.140 mm. broad, 0.105 mm. long; pair of ventral tri-branched setae at the base. Palpi four-segmented, simple hair on segments I and II; palpal claw five-pointed. Chelicerae with about seventeen recurved ridges or teeth on the ventral side, about ten above;

ultimate segment 0.05 mm. long; a pair of setae just above the chelicerae on the ventral side of the capitulum. Dorsal shield 0.17 mm. broad, 0.06 mm. long; six naked setae, one at each corner of the rectangular dorsal plate and a pair, anterior to and between the pseudostigmatic organs, set in an allantoid thickening of the dorsal plate 0.007 mm. wide; pseudostigmatic organs 0.009 mm. from the posterior margin, 0.01 mm. in diameter with a long flagelliform naked seta arising from the center. Dorsum 0.65 mm. long, 0.57 mm. broad; a pair of eyes on each side of the body at a level with the posterior portion of the dorsal plate; 4 rows of setae starting from 0.1 mm. behind the dorsal plate, first row with 12 setae, second row with 8 setae, third row with 4 setae, and the last row with 4 setae; in addition there are 4 marginal setae arranged symmetrically on the posterior third of the margin. Venter same size as dorsum. Coxae I and II contiguous; coxae III separated from coxae II by 0.05 mm.; hairs between coxae III plumose. Anus 0.2 mm. from posterior end; posterior half of venter clothed by small setae; stigma between coxae I and II. Legs six-segmented, coxa I with two hairs, coxae II and III each with one hair; other leg segments bear setae, tarsal claws in threes.

Type hosts.—*Artibeus jamaicensis yucatanicus* (Allen) and *Peteropteryx canina canina* (Wied.) (bats).

Type locality.—Cave near Oxkutzcab, Yucatan.

Type specimen.—U. S. N. M. No. 1264.

Erythraeus bisetosa n. sp.

(Figs. 8-12)

This species is nearest to *E. robustus* Banks except that the legs of *E. robustus* are stouter, and *E. robustus* has only one type of body seta.

Adult. Large, 1.6 mm. from posterior of abdomen to the tip of the crista, 1.2 mm. broad; abdomen truncate behind; setae on body of two types, one 0.04 mm. long, the other 0.14 mm. long. Legs long and slender, leg IV, four and one-half times the length of the body; tarsi swollen with two subequal claws at tip, entire limb clothed densely with barbed setae, interspersed with simple setae except on tarsi where the covering consists only of simple setae. Palpi sparsely setose, long simple seta on second segment; palpal thumb swollen; palpal claw small, slender. Crista rod-like 0.60 mm. long, expanded at either end to form a raised bulb-shaped pseudostigmatic area; pseudostigmata, four, a pair on each bulb, pseudostigmatic organs long and setiform; anterior bulb with four large setae. Eyes, two on each side in tandem, anterior eyes 0.08 mm. long, posterior eye 0.06 mm. long. Mouthparts needle-like; hypostome fringed at anterior end. Genital opening 0.6 mm. long, between coxae III and IV. Anal opening 0.1 mm. long and 0.05 from genital opening.

Type locality.—San Isidro Cave, Yucatan.

Type specimen.—U. S. N. M. No. 1265.

Platyseta n. g.

(Figs. 13, 14)

Erythraeidae with flat plate-like setae, one pseudostigmatic area with a single pair of pseudostigmata, a pair of sensilliary pits anterior to and nearly contiguous with the single pair of sub-spherical eyes, mouthparts not retractile, tarsi not swollen. This genus is closest to *Calyptosoma* Cambridge 1875 but differs from it in the number of eyes and the mouthparts.

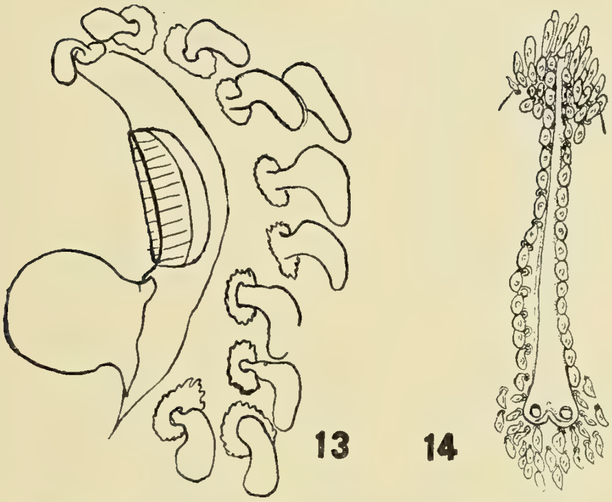
Figs. 8-12—*ERYTHRAEUS BISETOSA* n. sp.

8: Crista and eyes, × 85.
9: Anterior end of hypostome, × 325.
10: Large seta, × 325.
11: Small seta, × 325.
12: Palp, × 85.

Platyseta yucatanicus n. g., n. sp.

(Figs. 13, 14)

Adult. Large mite; length, 2.1 mm.; width 1.3 mm. Palpi reach to the level of the fourth segment of the first leg; palpal thumb slender, longer than the segment which bears it, not swollen; palpal claw strong, rounded at tip. Ultimate segment of chelicerae needle-like, as long as palpal thumb, arising at right angles ventral to the penultimate segment, bent sharply forward at point of origin; penultimate segment extends 0.004 mm. forward from the point of origin of the last segment. Crista rod-like, in a dorsal groove, expanded at posterior end into a heart-shaped pseudostigmatic area with two pseudostigmata. Pseudostigmata in the lobes of the heart, small; pseudostigmatic organs missing from the single specimen which is available. Eyes, one on each side just above and between the second and third legs on the side of the body, sub-spherical; a sensilliary pit anterior to and almost contiguous with each eye. Abdomen 1.5 mm. long; setae arising from pits, flat, blade-like, giving the mite a scaly appearance. Genital opening between coxae IV, 0.26 mm. long. Anal opening 0.21 mm. from genital plate, 0.09 mm. long, elliptical. Anterior legs slightly larger and stouter than posterior, about 1.8 mm. long; legs II and III shorter subequal; leg IV longer than II and III. Tarsi not swollen; two claws on each tarsus, claws on first pair of tarsi smaller than the others.



Figs. 13, 14—*PLATYSETA YUCATANICUS* n. g., n. sp.
13: Eye, × 325. 14: Crista, × 85.

Fig. 15—*SPINTURNIX EWINGIA* n. sp.
Right side dorsal view, left side ventral view, × 85.

Type locality.—Sazich Cave, Yucatan.

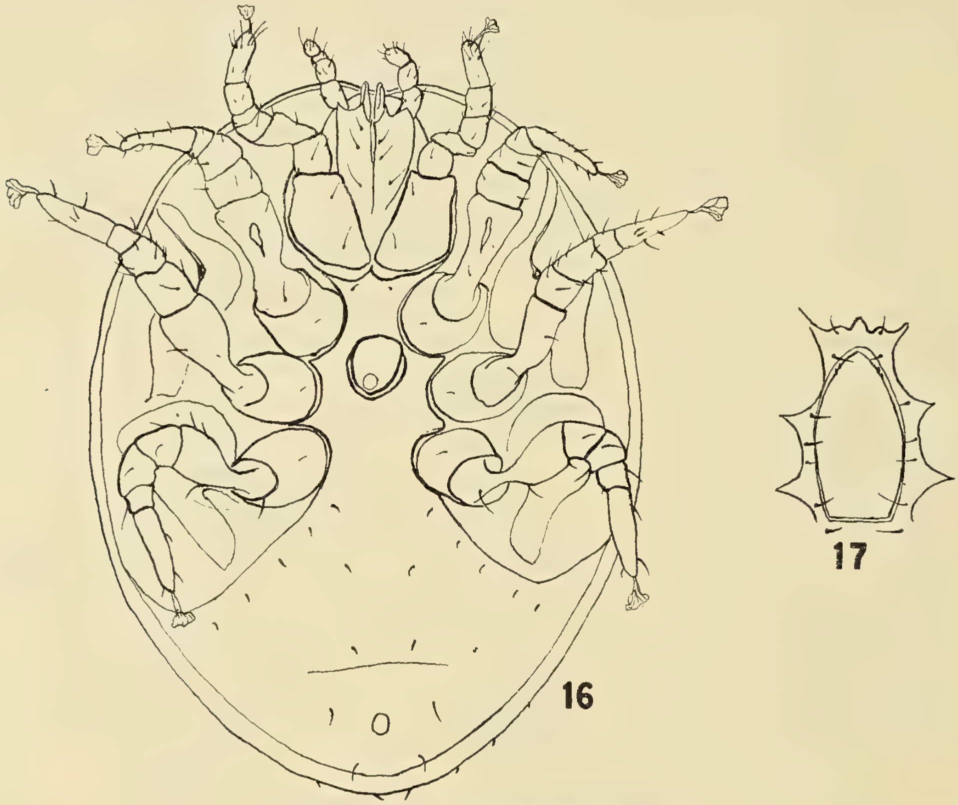
Type specimen.—U. S. N. M. No. 1266.

Spinturnix ewingia n. sp.

(Fig. 15)

Spinturnix ewingia is not close to any previously described species. It differs in many characteristics such as the position and number of setae, size, and position of the peritreme and stigma.

Adult male. Length 0.62 mm., width 0.37 mm. Palpi stout with a small sucker at the tip of the ultimate segment, extend to the level of the fourth joint of the first pair of legs. Chelae pointed, not toothed. Ventral plate with five pairs of spine-like setae, genital opening at the anterior margin of the ventral plate. Anal plate with seven pairs of setae, anal opening at posterior margin. Coxae large, nearly contiguous, evenly spaced. Legs stout, with spines. Caroncles and claws large; leg III smallest, leg II larger, legs III and IV largest and subequal. Dorsum with single dorsal shield, five pair of setae in a line with the peritreme, stigma in region between third and fourth coxae 0.02 mm. from the margin on the dorsal plate, peritreme extending forward on the dorsal plate up to the first coxa.



Figs. 16, 17—*UROPODA PEARSEI* n. sp.

16: Ventral view of male, × 85. 17: Genital plate of female, × 85.

Type host.—*Artibeus jamaicensis yucatanicus* (Allen).

Type locality.—Second cave on San Roque Road, Oxkutzcab, Yucatan.

Type specimen.—U. S. N. M. No. 1271.

Uropoda pearsei n. sp.

(Figs. 16, 17)

Uropoda pearsei is nearest *U. provocans* Banks but is much less setose than Banks' species.

Adult. Length 1.1 mm., width 0.8 mm. Camerostome 0.25 mm. broad, 0.27 mm. long, shield of camerostome with two pairs of small setae; chelae lightly toothed, palpi sparsely setose; hypostome four-pointed with three pairs of small setae arranged along the median line. Ventral plate entire, a pair of setae at its anterior margin, a **V**-shaped row of ten setae extending from coxae IV to the lateral margins, four pairs of setae extending from the middle of the **V** to the posterior margin, eight setae along the posterior margin. Genital opening of the male between coxae III, covering roughly circular, 0.08 mm. in diameter, penis a blunt rod. Genital opening of the female bullet-shaped, truncate behind, five setae on each side, it occupies most of the space between the coxae, length 0.25 mm., width 0.14 mm. Anal opening 0.03 mm. in diameter, 0.1 mm. from the posterior end. Leg I shortest, legs II, III, and IV larger and subequal. Femur II with a leaf-like ridge on the ventral side. Legs slightly setose. Peritreme and stigma on ridge between legs II and III.

Type locality.—San Bulha Cenote, Motul, Yucatan.

Type specimens.—Male and female, U. S. N. M. No. 1267.

Scheloribates luchili n. sp.

(Figs. 18-21)

Scheloribates luchili can be recognized by its exceedingly inconspicuous lamellar hairs.

Adult. Length 0.62 mm., width 0.31 mm. Rostrum rounded in front; cephalothorax 0.15 mm. long; its major bristles consisting of three pairs; rostral bristles well developed, extending beyond the rostrum, lamellar bristles minute directed toward the mid-line, interlamellar bristles missing in the single specimen which has been studied, scars of attachment present; pseudostigmata under pteromorphae; pseudostigmatic organs clavate directed anteriorly. Abdomen with three pairs of slit-like scars symmetrically disposed on the dorsum; pteromorphae narrow, 0.05 mm. wide; genital opening between coxae III and IV. Ovipositor bifurcate with six setae on each branch. Cover of genital opening 0.07 mm. long; anal opening 0.16 mm. from genital opening, covers of anal opening each with a single hair near the mid-line, cover 0.11 mm. long. Legs missing in part, femur II with a leaf-like expansion along its entire ventral surface. Chelicerae with strong-toothed chelae; palpi, insignificant, do not reach the tip of the rostrum.

Type locality.—Luchil Cave, Yucatan.

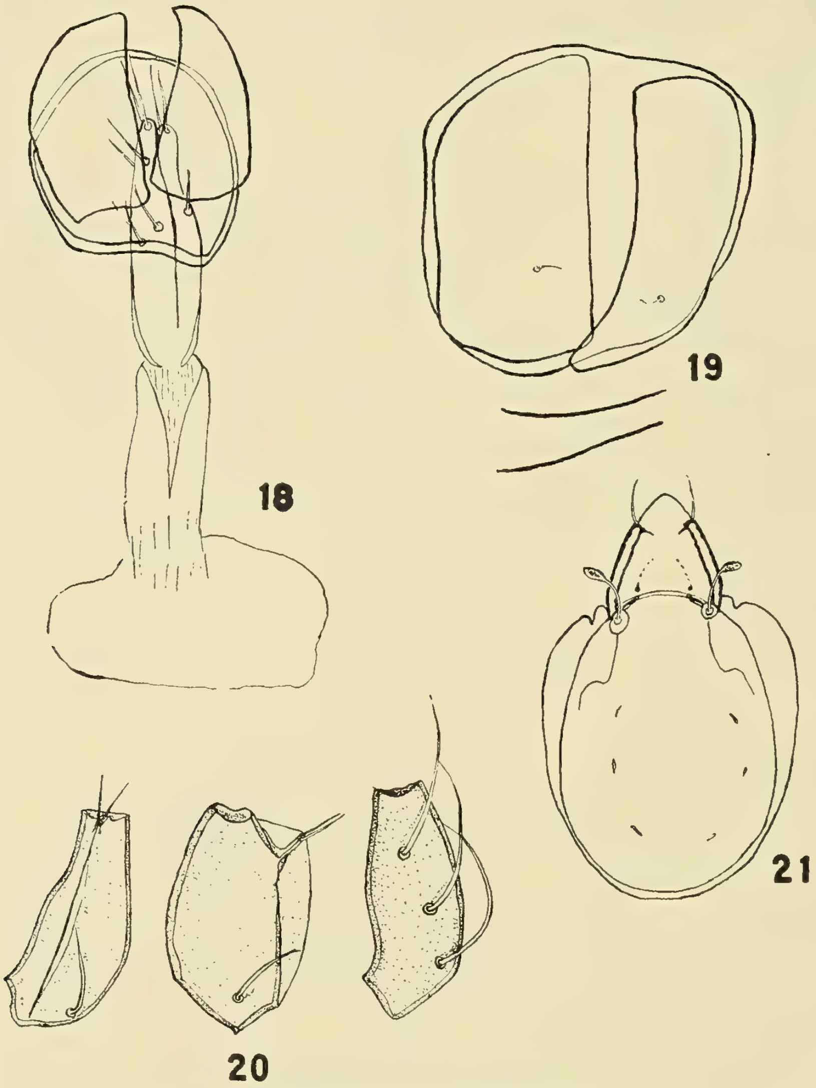
Type specimen.—U. S. N. M. No. 1270.

Oribatella monospicus n. sp.

(Fig. 22)

Oribatella monospicus can be readily recognized by the single-spiked lamellae, all other species have two spikes.

Adult. Length 0.55 mm., width 0.3 mm. not including the pteromorphae. Cephalothorax 0.15 mm. long; its three major pairs of bristles simple, rostral bristles arise in a line with the lamellar bristles and extend 0.1 mm. beyond the end of the rostrum, interlamellar bristles arise on the cephalothoracic abdominal suture and extend to the tips of the lamellar bristles; pseudostigmata at the posterior lateral angles of the cephalothorax, clavate pseudostigmatic organs. Abdomen 0.4 mm. long; a pair of large setae 0.1 mm. from the anterior margin of the abdomen near its lateral borders on the dorsal side; pteromorphae attached to the abdomen their



Figs. 18-21—*SCHELORIBATES LUCHILI* n. sp.

18: Genitalia of female, × 325.
19: Anus, × 325.
20: Views of femur II showing ventral leaf, × 325.
21: Dorsal view, × 85.

entire length, with seta 0.02 mm. from its anterior end and another in a line with the large abdominal setae; posterior margin of the abdomen with six long setae evenly spaced. Genital opening between coxae II and III; 0.07 mm. long, 0.08 mm. wide. Anal opening 0.08 mm. long, 0.08 mm. wide, 0.04 mm. from the posterior end. Legs setose; tarsi with two slender, lateral claws and one stout median claw. Palpi small, chelae-toothed.

TYPE LOCALITY.—San Bulha Cenote, Yucatan.

TYPE SPECIMEN.—U. S. N. M. No. 1269.

Galumna jacoti n. sp.

(Figs. 23, 24)

Galumna jacoti can be recognized by its trident-like hypostome, large three-toothed chelae, and its faint translamella.

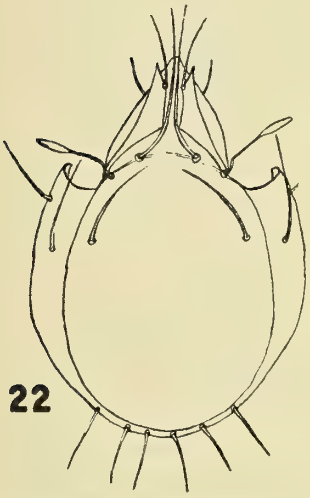
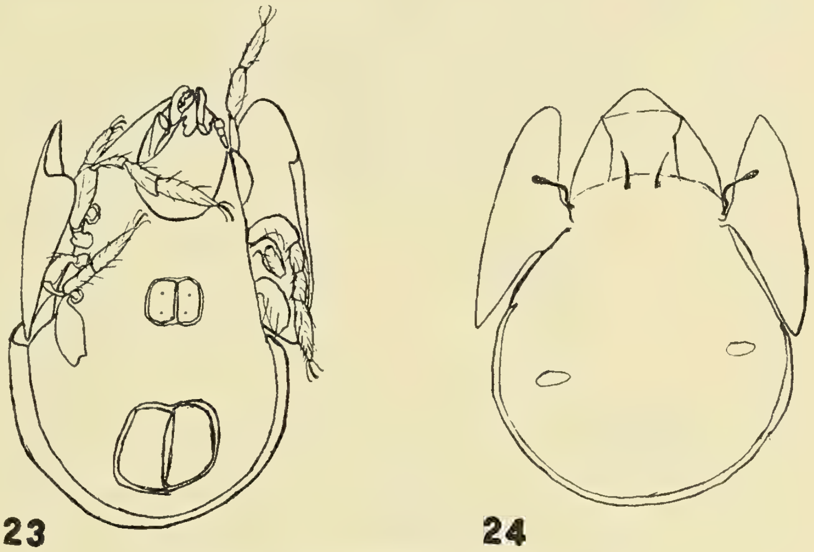


FIG. 22—*ORIBATELLA MONOSPICUS* n. sp.
Dorsal view, × 85.



FIGS. 23, 24—*GALUMNA JACOTI* n. sp.
23: Ventral view, × 85. 24: Dorsal view, × 85.

Adult. Length 0.65 mm., width 0.45 mm. Cephalothorax 0.13 mm. long, 0.02 mm. wide; lamellae 0.1 mm. from each other, 0.1 mm. long; no setae on cephalothorax; pseudostigmata at the posterior lateral margins of the cephalothorax; hypostome trident-shaped with a single tooth on the median side of each lateral spur, lateral spurs longer than median, palpi short, chelae large with three teeth on each segment. Abdomen 0.52 mm. long; a pair of median dorsal setae just behind the cephalothoracic abdominal suture; pteromorphae large wing-like, attached just behind the pseudostigmata; a pair of lateral dorsal spots in the middle of the abdomen. Genital opening between coxae IV, 0.05 mm. long, 0.07 mm. broad. Anal opening 0.05 mm. from the posterior end; 0.13 mm. long, 0.15 mm. broad.

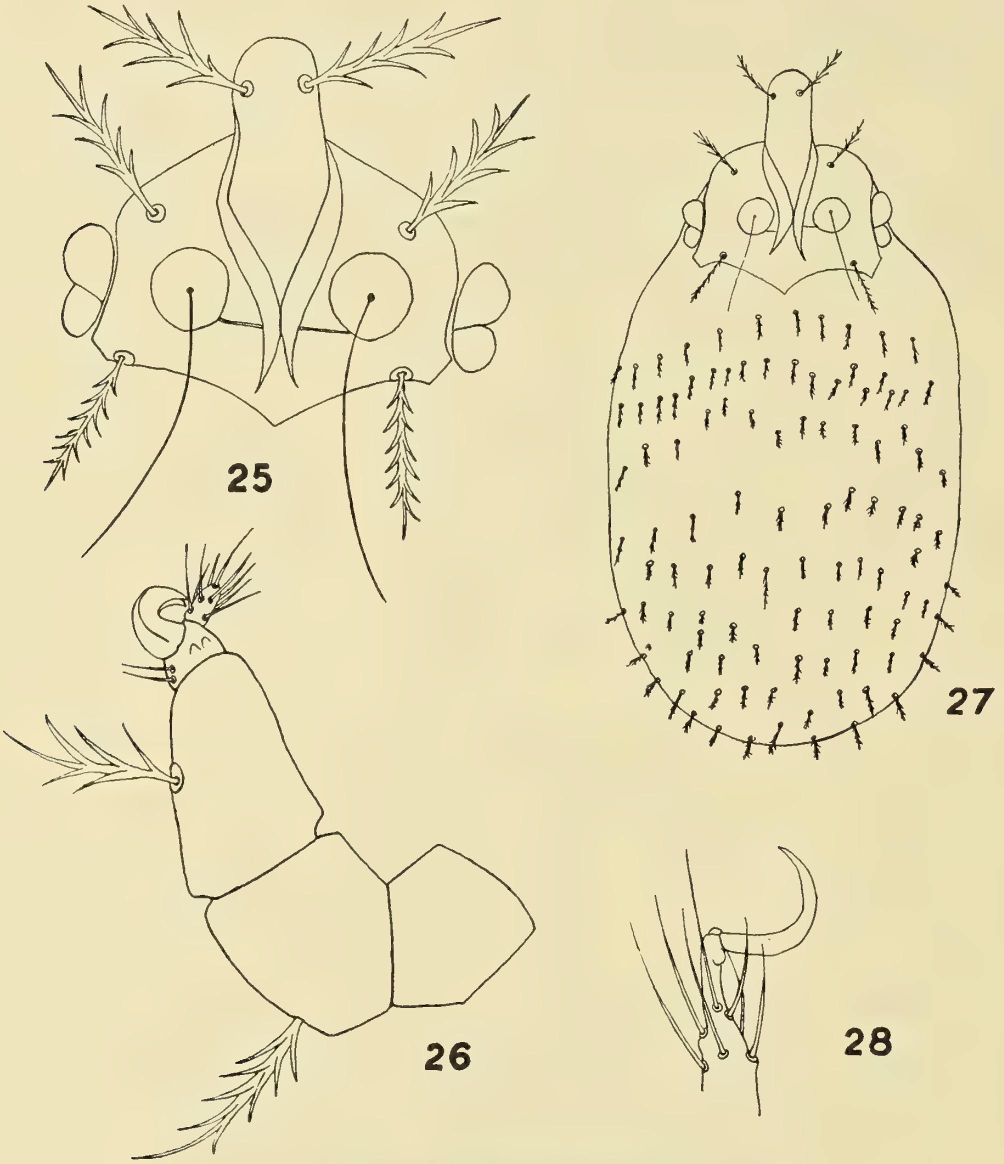
TYPE LOCALITY.—San Bulha Cenote, Yucatan.

TYPE SPECIMEN.—U. S. N. M. No. 1268.

Monunguis n. g.

(Figs. 25-28)

Trombidiidae with a single claw on each tarsus; femora divided; coxae each with a single seta; coxae I and II separate. A pair of setae on venter between coxae I and II; a transverse row of four setae on venter between coxae III; dorsal shield with rostrum, crista, one pair of pseudostigmata, and three pairs of setae; eyes, two on each side of the dorsal shield; dorsum with numerous setae not arranged in rows.



Figs. 25-28—*MONUNGUIS STREBLIDA* n. g., n. sp.

25: Dorsal plate, × 800.
26: Palpus, × 800.
27: Dorsal view, × 375.
28: Tarsal claw, × 800.

This genus is most closely related to *Rohaultia* Oudemans 1911 from which it differs by having a single pair of pseudostigmata and a single claw on each tarsus instead of two. It is similar to *Rohaultia* in that it possesses two pairs of eyes, a crista, a rostrum, divided femora, and a single seta on each coxa. The family Erythraeidae is separated from the family Trombidiidae by several characters, the most important of which is the presence, in Trombidiidae, or absence, in Erythraeidae, of the stigmata. If it were not for the presence of these stigmata in *Monunguis,* the genus would belong in the family Erythraeidae, since it has an elliptical body, many hairs on the dorsum, and erythraeid-like palps. Oudemans (1912) mentions that *Rohaultia* is likewise near the family Erythraeidae because of its two pairs of pseudostigmata, its crista, and its separated coxae I and II. It is probable that these closely related genera are intermediate between the two families. The genera become more closely related if we consider the anterior pair of pseudostigmata in *Rohaultia* to be homologous to the anterior pair of setae on the rostrum of *Monunguis,* as they most likely are. Further similarity is apparent in the mode of life of the two genera. The species of *Rohaultia* in the adult stage inhabit the damp mossy banks of springs; in the larval stage they are parasitic on tipulid flies. The adults of *Monunguis* are unknown but they probably live in the damp caves in which the larvae were found to be parasitic on the streblid flies which infest the bats there.

Monunguis streblida n. sp.

(Figs. 25-28)

Larva. Palps rather long; palpal thumb subterminal; palpal setae with barbs. Dorsal plate 0.07 mm. long, 0.06 mm. wide; porose. Pseudostigmata 0.02 mm. apart, anterior to a line drawn between the posterolateral setae. Eyes lateral to dorsal plate, anterior eyes larger. Dorsal abdominal setae 80 to 90, irregular in arrangement. Legs I shorter than legs II which are shorter than legs III. Chelicerae curve ventrally and extend beyond the anterior dorsal margin of the body. Length of body 0.23 mm.; width 0.13 mm.

TYPE HOSTS.—*Pterellipsis araneae* Coq. and *Trichobius dugesii* Towns.

TYPE LOCALITY.—Cinquo de Mayas Cave, Tekax, Yucatan.

TYPE SPECIMEN.—U. S. N. M. Lot 36—31564.

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XI

COPEPODA FROM YUCATAN CAVES

Copepods collected during the summer of 1936 were sent to Dr. C. B. Wilson, Massachusetts State Teachers' College, who kindly identified them. The following list has been prepared by A. S. Pearse, who added field notes. Numbers in parentheses refer to original tow-net collections. Though argulids, calanoids, and cladocerans were reported by Wilson[1] from the cenotes of Yucatan none of these are found in the present collections. Only harpacticids and cyclopids are represented. Among these no species is characteristic of caves except *Nitocra subterranea* Chappuis, which belongs in ground water and was first discovered in France.[2]

Order Copepoda

Suborder HARPACTICOIDA

Family CANTHOCAMPTIDAE

Nitocra subterranea Chappuis

Pool 111 m. from entrance, Balaam Canche Cave, Chichen Itza, June 10 (5).

Suborder CYCLOPOIDA

Family CYCLOPIDAE

Mesocyclops tenuis (Marsh)

Pool 64 m. from entrance, San Isidro Cave, Merida, July 4 (11).

Mesocyclops leuckarti Claus

Pool 111 m. from entrance, Balaam Canche Cave, Chichen Itza, June 9 (4), June 10 (5), some young; pool 262 m. from entrance, Balaam Canche Cave, June 22 (6); pool 64 m. from entrance, San Isidro Cave, Merida, July 4 (11); pool 25 m. from entrance, Luchil Cave, Tixcacal, July 7 (12); pool 165 m. from entrance, Hoctun Cave, Hoctun, July 7 (14), with young; San Bulha Cave (Cenote), Motul, July 9 (15); Yunchen Cave, Libre Union, July 11 (17); San Bulha Cave, Merida, July 13 (18); Xconsacab Cave, Tizamin, August 11 (21). This species is common and widely distributed in Yucatan, as Wilson (1936) has reported.

Macrocyclops albidus (Jurine)

San Bulha Cave (Cenote), Motul, July 9 (15). This species is found throughout North America.

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[1] Wilson, C. B., Copepods from the cenotes and caves of the Yucatan Peninsula, with notes on cladocerans. *Carnegie Inst. Wash.* Pub. No. 457, pp. 77-88 (1936).

[2] Chappuis, P. A., Noveau copepods cavernicoles. *Bull. Soc. de Stiinte din Cluj.*, 4:20-34 (1928).

Eucyclops serrulatus (Fischer)

Pool 25 m. from entrance, Luchil Cave, Tixcacal, July 7 (12); pool 165 m. from entrance, Hoctun Cave, Hoctun, July 7 (14), with young; San Bulha Cave (Cenote), July 9 (15); Yunchen Cave, Libre Union, July 11 (17); San Bulha Cave, Merida, July 11 (18); Xconsacab Cave, Tizamin, August 11 (21). Wilson (1936) reported this species from a wayside pool in Yucatan and states that it occurs in Mammoth Cave, Kentucky.

Eucyclops prasinus (Fischer)

Pool 64 m. from entrance, San Isidro Cave, Merida, July 4 (11); pool 25 m. from entrance, Luchil Cave, Tixcacal, July 7 (12). This species has been reported from several cenotes and pools in Yucatan (Wilson, 1936).

XII

A NEW SPECIES OF CYPRIDOPSIS FROM YUCATAN

Norma C. Furtos
Western Reserve University

Several specimens of a very small *Cypridopsis,* measuring not more than 0.38 mm. in length, were collected from Yunchen Cave, Libre Union, July 11, 1936. Upon first examination these appeared to be a variety of *Cypridopsis yucatanensis* Furtos, a form which is rather common in the cenotes of Yucatan. There is a striking correspondence with respect to the size of the two species, which is far below that found in any other species of fresh-water Ostracod. Moreover, there are certain superficial similarities in the shape of the valves, and the appendages of the two species agree rather well. However, after a detailed comparison, it is the opinion of this investigator that the *Cypridopsis* from Yunchen Cave is quite distinct from *Cypridopsis yucatanensis,* and represents a new species for which the name *Cypridopsis mexicana* is proposed.[1]

The holotype and paratypes of this new species have been deposited in the collection of the United States National Museum.

Cypridopsis mexicana n. sp.

Specific characters.—*Female,* from the side: stout, boldly arched, dorsal margin gibbous, with blunt angle at apex; height approximately ⅗ of length, highest in the middle; extremities broadly rounded, the anterior the broader; ventral margin sinuate behind the middle; left valve somewhat longer than the right, otherwise similar in proportions. Anterior margin of right valve with a row of short dark septa radiating between two narrow marginal bands; from the outer narrower band springs a broad hyaline border; anterior margin of left valve without septa and bands but with a similar hyaline border; posterior margin of each valve without septa or hyaline border; pore canals not present unless the septa of right valve represent such canals. From above: tumid, breadth equal to the height, broadest slightly behind the middle; left valve encloses the right and projects beyond the right at the anterior end; anterior extremity pointed, with sides sinuate to produce a beak-like appearance; posterior extremity broader than the anterior, forming an obtuse point, the sides convexly curved. Surface of valves smooth, with a few puncta, and hairless. Length 0.35-0.38, height 0.25-0.26, breadth 0.25-0.26 mm. Color undetermined due to action of preservative on pigment. Natatory setae of second antenna extend beyond tips of terminal claws by one-half length of the claws. Third masticatory process of maxilla with two smooth spines; terminal

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[1] Furtos, Norma C., On the Ostracoda from the cenotes of Yucatan and vicinity. *Carnegie Inst. Wash.* Pub. No. 457, p. 94, figs. 17-22 (1936).

segment of maxillary palp twice as long as width of base, slightly narrowed distally. Terminal claw of second thoracic leg smooth, geniculate near tip. Terminal claw of scratch-foot strong, smooth, two-thirds length of penultimate segment. Caudal ramus consists of a slender base terminating in a delicate flagellum.

Male slightly smaller than female, otherwise similar. Prehensile palps unequal, propodus of the larger twice as long as greatest width, narrower proximally, dactylus somewhat shorter than propodus, slender falciform. Propodus of smaller palp more cylindrical, three times longer than wide, dactylus small, hook-like, proximal portion of inner margin with a single tooth-like process. Ejaculatory duct cylindrical, armed with six crowns of thick spines. Penis with a triangular base, rounded apex, slender lateral lobe extending considerably beyond apex, and with a short spinous process on outer margin.

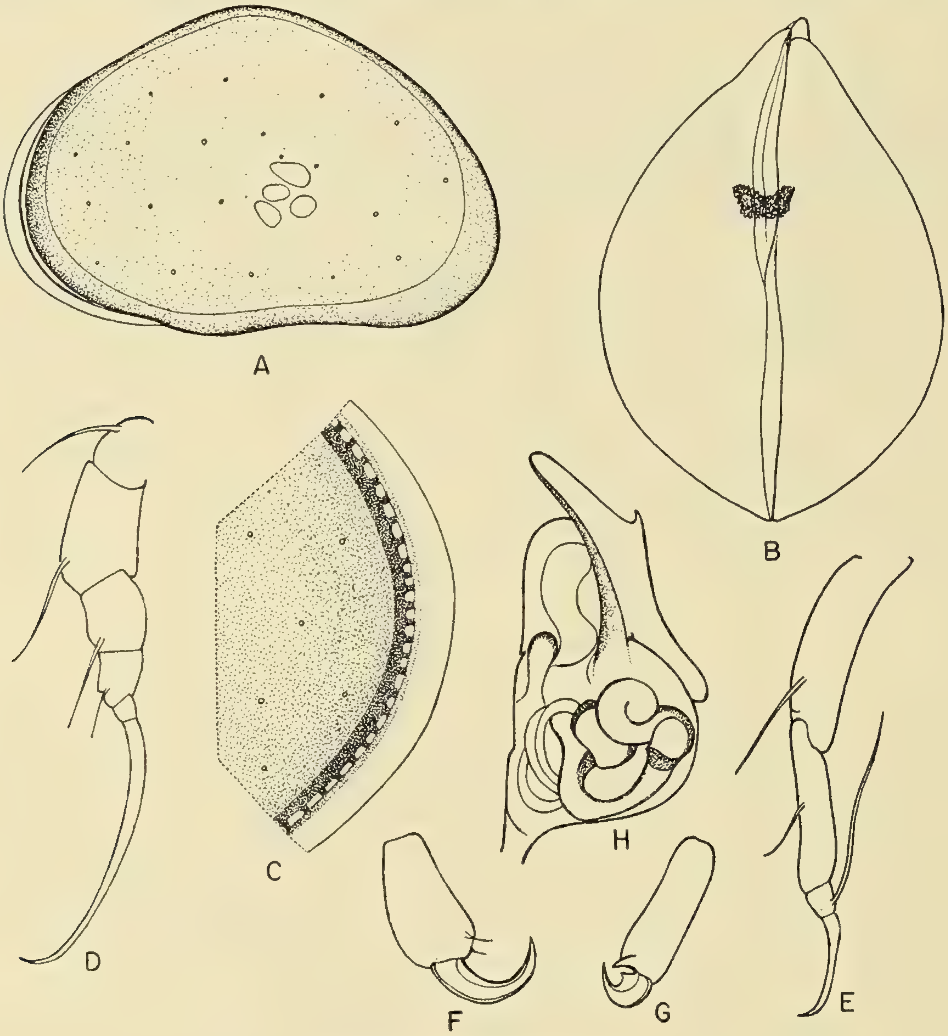


Fig. 1—*CYPRIDOPSIS MEXICANA* n. sp.

A: Left valve of adult female.
B: Adult female, viewed from above.
C: Anterior margin of right valve.
D: Second thoracic leg, female.
E: Scratch-foot, female.
F, G: Prehensile palps, male.
H: Penis.

TYPE LOCALITY.—Yunchen Cave, Libre Union, Yucatan. Holotype, U. S. Nat. Mus. No. 72455.

REMARKS.—This species is so small that for practical identification dissection is inconvenient. In general, the appendages of *Cypridopsis mexicana* correspond to those of *C. yucatanensis* with the following exceptions: the natatory setae of second antenna are shorter in *C. yucatanensis,* extending only slightly beyond the tips of the terminal claws, while in *C. mexicana* these setae are considerably longer. The larger prehensile palp of *C. yucatanensis* is more slender, with dactylus sharply geniculate. Such differences are difficult to demonstrate in view of the minute size of these appendages.

Careful observation of the valve characters will readily serve to distinguish the two species. The valves of *C. yucatanensis* when viewed from the side, show the dorsal margin smoothly arched, not angulated at the apex as in *C. mexicana;* the greatest height lies in front of the middle and the anterior extremity is distinctly narrower. Viewed from above, the difference is still more marked, the anterior extremity of *C. yucatanensis* does not show the sinuate sides with beak-like appearance, the greatest breadth of the valves lies in the posterior third, and the posterior extremity is very broadly rounded, with no indication of the characteristic point of *C. mexicana.* Finally, the character of the valve surface is quite different, that of *C. yucatanensis* being clearly pitted, while that of *C. mexicana* is exceptionally smooth.

XIII

LARGER CAVE CRUSTACEA OF THE YUCATAN PENINSULA

Edwin P. Creaser
U. S. Biological Survey

Of the crustaceans mentioned in this report, one new species of isopod was obtained and is described, two other new species remain undescribed because of the taxonomic confusion of the group or the paucity of material. However, sufficient material is at hand to indicate three sources from which this cave crustacean fauna has been derived. The first of these is from a marine habitat as evidenced by the presence of such forms as *Cirolana, Palaemon,* and *Antromysis.* The second source of faunal derivation is from a fresh-water habitat. The evidence of this lies in the occurrence of *Typhlatya* and *Caecidotea* in the caves. The third source of true crustacean fauna modified for cave life is from the land. The only complete example of this is the new blind isopod of the genus *Porcellio.*

Order Mysidacea

Antromysis cenotensis Creaser 1936

This species was originally described from specimens taken in Balaam Canche Cave near Chichen Itza, Yucatan. Dr. Pearse was successful in obtaining this species over a much wider area. His collection includes specimens from the following locations in Yucatan: Luchil Cave at Tixcacal; a well at the iron mill at Oxkutzcab; Kaua Cave and Oxolodt Cave at Kaua; Balaam Canche Cave at Chichen Itza; Chac Mol Cave at Tohil; San Isidro Cave at Merida; Hoctun Cave at Hoctun; San Bulha Cave at Motul; Yunchen Cave at Libre Union; well on the Calcehtok Hacienda near San Bernardo; and the Xconsacab Cave at Tizamin.

The wide range of this minute mysid shrimp as now known indicates the widespread nature and ramification of the underground channels. Some of the localities from which these crustaceans were taken are at least 125 miles apart.

Dr. Pearse tells me that these crustaceans are frequently brought up with the buckets of water from hacienda wells.

Order Isopoda

Family cirolanidae

Cirolana anops Creaser 1936

Dr. Pearse obtained these isopods in the following locations: Spukil Cave at Calcehtok; Xconsacab Cave at Tizamin; Chac Mol Cave at Tohil; Gongora Cave at Oxkutzcab; San Isidro Cave at Merida; San Bulha Cenote at Motul; and Kaua

Cave at Kaua. In addition to these localities where Dr. Pearse obtained this cirolanid isopod the species is also known from Amil Cave near Merida, Yucatan.

Dr. Pearse was successful in obtaining these isopods in a wire cone trap baited with meat and also by using a sponge in which a part of a dead bird had been buried.

Family ONISCIDAE

Porcellio pearsei n. sp.

Among the many interesting zoological discoveries made by Dr. Pearse in his investigations of the Yucatan caverns is the blind isopod crustacean described below. This description is based upon adult material from Balaam Canche Cave near Chichen Itza, Yucatan.

Male. Head length about one-half the width, anterior margin with three protuberances, the lateral ones most prominent. Eyes wanting. First pair of antennae rudimentary composed of three segments, terminal segment the smallest. Second antennae less than one-third total length of animal, composed of six segments. The two basal segments small, next two the largest, flagellum two-segmented with distal segment about one-half length of apical segment which is terminated with a spine.

Maxilliped with inner part composed of a large base tipped with two segments, one of which is truncate and spined, the other terminating acutely with a spine. Outer part of maxilliped smaller than inner, tapering and smooth and about as long as base of inner part. (The maxilliped apparently is a fine character for generic distinction.)

Outer part of first maxilla terminating with large curved teeth and with comb-like row of spines along apical lateral margin. Second maxilla with apex of two rounded lobes, outer lobe provided with friction or grinding edge.

Mandible without a palp, apical teeth strong and slightly curved. Inner lateral margin equipped with feathery setae.

Contour of body oval. Thoracic and abdominal segments with well-developed processes. Telson triangular.

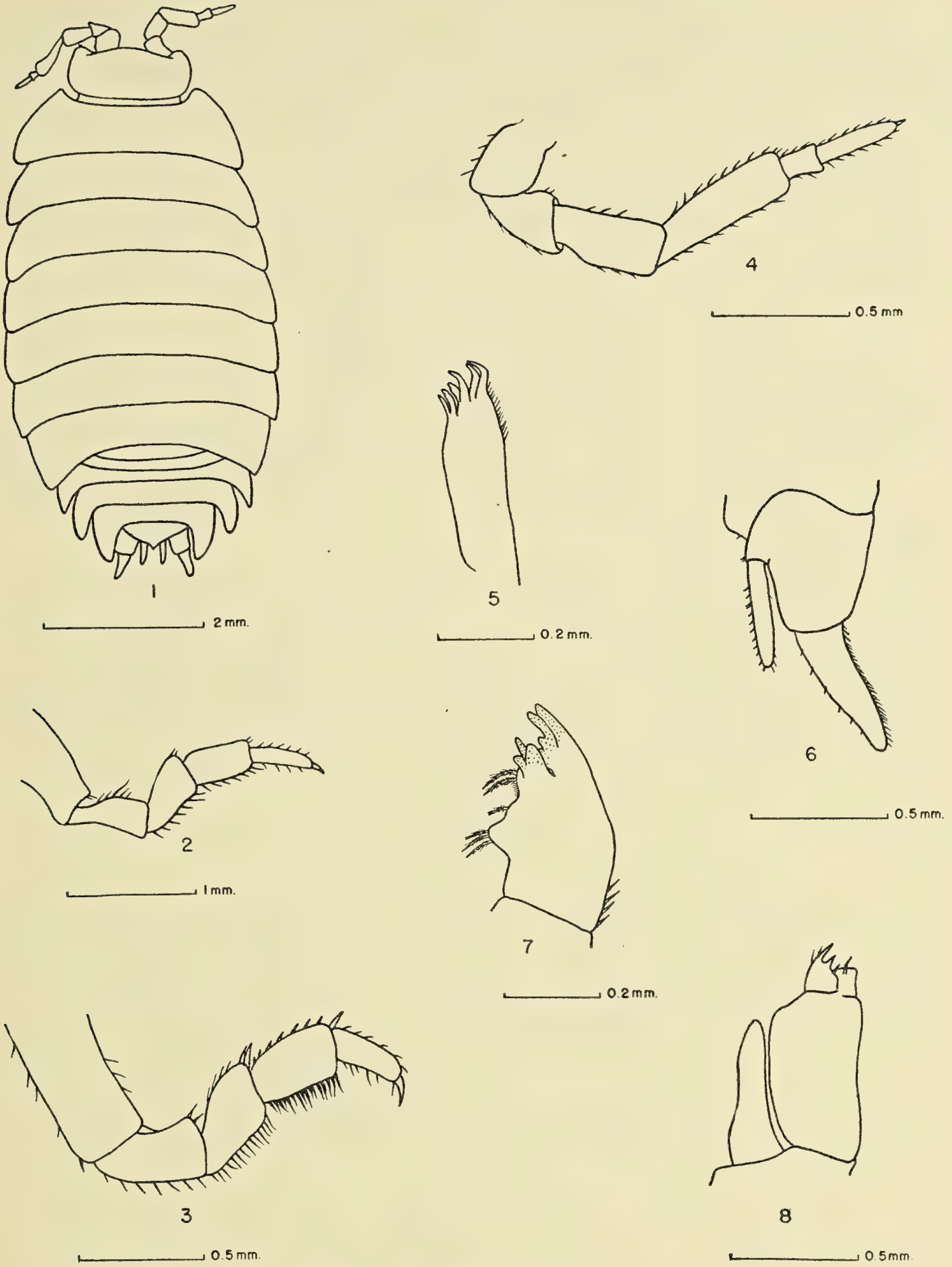
Uropod with inner part attached to base near the adjoining segment on the inner lateral margin. Outer part of uropod longer than inner part.

Female. Similar to the male with the usual sexual differences. I can discern no differences in the length of the uropods mentioned as a sexual difference in other species of this or related genera.

MEASUREMENTS.—I have seen a male from Sazich Cave at Calcehtok, Yucatan, which was 7 mm. long. The females are smaller than the males.

RELATIONSHIPS.—This new species resembles *Porcellio pubescens* Dollfus 1893 in the arrangement in size of the segments of the flagellum. This eyed species is known from Venezuela. Although poorly described the figure of the uropods indicate that this character as well as the condition of the eyes differs greatly from *Porcellio pearsei.*

TYPES.—The male type and the female allotype from Balaam Canche Cave near Chichen Itza, Yucatan, are deposited in the United States National Museum.



Figs. 1-8—*PORCELLIO PEARSEI* n. sp.
(Drawn with aid of camera lucida. Scales indicate enlargement.)

1: Adult male.
2: Seventh leg.
3: First ambulatory leg.
4: Second antenna.
5: First maxilla.
6: Uropod.
7: Mandible.
8: Maxilliped.

Localities.—Balaam Canche Cave near Chichen Itza, Yucatan, June 12, 1936; Sazich Cave near Calcehtok, Yucatan, August 6, 1936; Puz Cave near Oxkutzcab, Yucatan, July 20, 1936; Spukil Cave near Calcehtok, Yucatan, August 5, 1936; first cave on San Roque road near Oxkutzcab, Yucatan, July 22, 1936; San Bulha Cave at Motul, Yucatan, July 9, 1936.

This isopod was obtained under stones and rubbish in the caves mentioned. This new species is the first blind member of this genus to be discovered in North America. It apparently is rather widespread in its distribution throughout Yucatan.

Porcellionides Miers 1877

(*Metoponorthus* Budde Lund 1885)

A small isopod of this genus was taken in several localities by Dr. Pearse in his cave investigations. The species has reduced eyes and very little pigmentation. This pigmentation consists of a very light brown color in preserved specimens. In view of the reduced eyes and pigmentation it may best be considered as an incipient cave form. The second antennae have a very small first segment in the flagellum. This first segment is about one-half as long as the apical segment of the flagellum which bears a spine at the tip.

The status of the genus *Porcellionides* and its respective members is not at all certain at this time. Many species are very inadequately known and accordingly I hesitate naming these specimens. They are on deposit in the U. S. National Museum for future reference by workers on this group. I have seen specimens from the following locations: San Isidro Cave near Merida, Yucatan; Hoctun Cave near mouth at Hoctun, Yucatan; San Bulha Cave, Motul, Yucatan; Spukil Cave at Calcehtok, Yucatan; Ziz Cave at Oxkutzcab, Yucatan; Chac Mol Cave at Tohil, Yucatan.

Family ASELLIDAE

Genus *Caecidotea* Packard 1871

A single specimen of a species of this genus was found in Balaam Canche Cave near Chichen Itza, Yucatan, June 12, 1936. Unfortunately only a single immature female without uropods and antennae was obtained. In view of this the species cannot be described in a satisfactory manner. This genus is widely distributed in caverns over the United States. The generic affinities are with *Asellus*.

The occurrence of a species of this genus in the Balaam Canche Cave is interesting because this cave is one of two which the atyid shrimp *Typhlatya pearsei* has been found. *Typhlatya* like *Caecidotea*, very probably was derived from fresh-water forms.

Order Decapoda

Family ATYIDAE

Typhlatya pearsei Creaser 1936

This blind atyid shrimp is not widely distributed in the subterranean waters of the Peninsula of Yucatan. Dr. Pearse in his diligent search for cave life throughout Yucatan obtained this species in the summer of 1936 only from the type locality: Balaam Canche Cave 4.8 km. east, 0.8 km. south of Chichen Itza, Yucatan. The 1932 expedition also obtained a single specimen of this shrimp from Santa Elena Cave 4.8 km. south of Talcha, Yucatan.

Family PALAEMONIDAE

Palaemon morleyi Creaser 1936

The previous collection of this subterranean shrimp made in 1932 consisted of eight specimens from three localities. The caves in which these crustaceans were found at that time were the following: San Isidro Cave near Merida, Yucatan, Balaam Canche Cave near Chichen Itza, Yucatan and Amil Cave near Merida, Yucatan. A single large claw was found in Motul Cave at Motul, Yucatan. This differed from the claws on the small specimens in having a tooth on the immovable finger and an incision opposite it on the movable finger. The large series at my disposal now show that this is the normal condition and that the smooth inner margins of the fingers represent either juvenile or regenerated chelae.

This fine series of specimens also show considerable variation in the number of rostral spines. This variation is from 0 to 4 spines below and from 6 to 10 spines above. Since this variation occurs in individuals from a single locality no taxonomic significance is attached to this variation.

FOOD.—An examination was made of the stomach contents of three specimens taken from Hoctun Cave at Hoctun, Yucatan. This examination disclosed nothing but chitinous parts including one small claw of *Palaemon morleyi*.

LOCALITIES.—As has been previously noted in connection with the earlier paper (Creaser, 1936, p. 132) these subterranean crustaceans have a wide range in the Peninsula of Yucatan. This particular species is now known from the following localities: San Isidro Cave near Merida, Amil Cave southeast of Merida, Balaam Canche Cave near Chichen Itza, Chac Mol Cave near Tohil, Hoctun Cave at Hoctun, Yunchen Cave at Libre Union, Gongora Cave at Oxkutzcab, and Spukil Cave at Calcehtok. Shrimps were seen in a small pool in Xconsacab Cave, Tizamin, which probably belonged to this species.

METHODS OF CAPTURE.—Dr. Pearse was notably successful in capturing these crustaceans with a cage trap consisting of a wire screen with conical entrances. This was baited with meat.

ORIGIN OF THE CAVE CRUSTACEAN FAUNA

The researches of Dr. Pearse in Yucatan cast considerable light on the origin of the fauna of the caves. In view of the rather complete list of species it seems plausible now to assume that the fauna has arisen from three independent sources. *Porcellio pearsei* and the apparently new *Porcellionides* sp. unquestionably were derived from land forms. These isopods belong to genera which are of widespread and general distribution. Of the various cave crustaceans these isopods very likely were the last to become differentiated into cave forms. In fact *Porcellionides* sp.

seems to be merely an incipient cave species. There can be but little doubt that the three species, *Cirolana anops, Palaemon morleyi* and *Antromysis cenotensis,* are related to marine crustaceans. *Typhlatya pearsei* and the species of *Caecidotea* are probably derived from fresh-water forms. The status of *Typhlatya* is not known with certainty. The family Atyidae, of which it is a member, is known only from fresh waters but has its closest relationships with a marine family. The particular species of the caves of Yucatan differs greatly from the forms now living in fresh waters of the Americas but may be related to them. In connection with the origin of the cave crustacean fauna it will be interesting to compare the results and conclusions of Dr. Carl Leavitt Hubbs on the fish fauna (see paper XXI of this series).

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XIV

DIPLOPODA FROM YUCATAN

RALPH V. CHAMBERLIN
Zoology Department, University of Utah

The millipedes secured in caves of Yucatan represent seventeen species, nine genera and seven families. All of the species and two of the genera were previously unknown and are here first described and illustrated.

Evidence of modifications resulting from restriction to a cave habitat, such as are so marked in the case of some spiders from the same caves as indicated in the paper dealing with those arachnids, is missing or very dubious in the case of these millipedes with the possible exception of a more or less pronounced reduction in the pigmentation of the type specimens of some of the polydesmoid species. The diplopods are nearly all lucifugous, rarely moving about above cover except at night but remaining concealed in humus, under leaves and logs, or elsewhere. Nine of the species from the Yucatan caves are blind but this is not of special significance in this connection since all other members of the families to which they belong, including the four of the Polydesmida (Leptodesmidae, Rhacodesmidae, Stiodesmidae, and Sphaeriodesmidae) and the one of the Colobognatha (Siphonophoridae) are eyeless. In the case of the large juliform species, the five belonging to the Spirostreptidae have eyes normally developed although the eyes in the *Gymnostreptus* are small. The eyes are likewise normal in one of the two species of Rhinocricidae, *Rhinocricus motulensis* alone showing in the weaker development of eyes, with ocelli relatively few and neither convex nor sharply defined, a condition suggestive of a trend toward degeneration. Certainly most of the species will be found to occur outside as well as inside the caves.

It will not be surprising, however, to find that some of the smaller forms, such as those of the new genus *Yucodesmus*, are restricted to these caves, for most millipedes are localized in definite and sometimes very limited areas. Diplopods are nearly all slow-moving, relatively inactive creatures living upon decaying vegetable matter exclusively, with the exception of certain fungi, although more rarely they live similarly on decaying animal matter or upon animal excrement. They pass their lives buried in humus, decaying leaves and logs or in other similar organic material that constitutes their food. Thus, once established in a favorable location, they rarely need to travel far for food, a more frequent urge to move being the drying out of the vegetable cover in which they are buried, for they are very sensitive to drought and to extremes of heat and light. In general it may be said that a given individual in the course of its life rarely travels far from the place of its birth barring extraordinary events. Such events may be overpopulation in a certain locality following long continued, highly favorable weather permitting the maturing of a high percentage of the young, or, on the other hand, dryness due to unfavorable weather or occasionally flooding of the area. Under such conditions there may be considerable mass migrations, although these have never been demonstrated to extend more than two or three miles.

The environmental restrictions of the millipedes and their limitation in locomotion render them highly significant in a study of isolation and geographical distribution. These factors, in connection with the abundance of food materials and of the situations supplying their other vital requirements, in part account for the large number of species relatively to individuals represented in every collection taken in tropical regions, in contrast, e.g., with the active, free-moving, carnivorous chilopods, none of which is represented in the collection made in the Yucatan caves by Dr. Pearse.

Order Colobognatha

SIPHONOPHORIDAE

Siphonophora sabachana n. sp.

(Figs. 1-5)

Color.—General color yellow anteriorly, becoming paler posteriorly, with a series of white spots on each side. Antennae and rostrum paler, white or nearly so. Legs also nearly white.

Structure.—Head rather narrow, widest at base. Rostrum nearly straight, only slightly longer than the head. Antennae heavy, conspicuously thicker at middle than distally. Antennae exceeding the beak which reaches to or a little beyond the middle of the sixth article (Fig. 3).

Collum with anterior margin concave at middle, not angular.

Pleurites of anterior and posterior region as shown in Figures 1 and 2.

Gonopods as represented in Figures 4 and 5.

Number of segments, 85.

Length, 19.5 mm.; width, 1.1 mm.

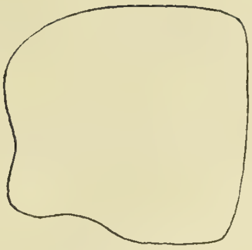
Locality.—Tekax: Sabacha Cave, July 30, 1936. One male.

Order Julida

Julides Saussure et Humbert 1872
Julidae Latzel 1884; Pocock 1887; Brolemann 1893
Diplochaeta+*Anocheta* Cook 1895
Juloidea Silvestri 1896; Attems 1898
Opistospermophora Verhoeff 1900, 1910, 1913, etc.
Juliformia Attems 1926, etc.

SPIROSTREPTIDAE

Although only one of the five species of this family in the collection is represented by a male it seems desirable, because of the high importance of the collection and the definiteness of location and habitat, to describe and name the species, all of which appear to be new. The species, with the exception of the first, are



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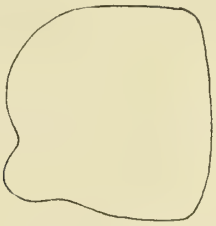

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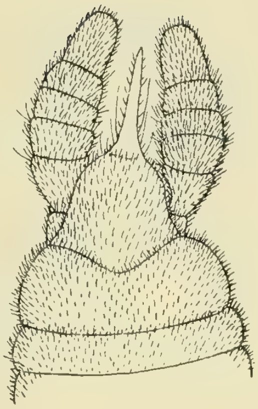

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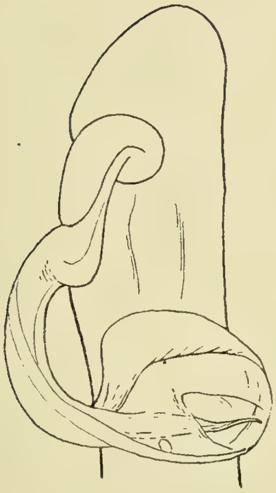

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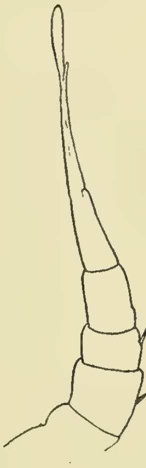

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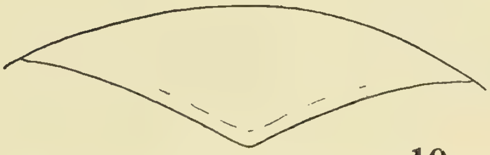

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FIGS. 1-5—*SIPHONOPHORA SABACHANA* n. sp.

1: Pleurite of posterior region.
2: Pleurite of anterior region.
3: Anterior end of body, dorsal view.
4: Anterior gonopod of male.
5: Posterior gonopod of male.

FIGS. 6-10—*GYMNOSTREPTUS ZIZICOLENS* n. sp.

6: Collum and second tergite, lateral view.
7: Lower end of cardo of mandible.
8: Right gonopods of male, anterior view.
9: Distal portion of same, lateral view.
10: Anal scale.

tentatively placed in the genus *Orthoporus,* sens. lat. The following key will aid in separating the species.

- a. Eyes small, more than twice their diameter apart; ocelli in four series and only about 20 in number.. *G. zizicolens* n. sp.
- aa. Eyes large, less than twice their diameter apart; ocelli in six or more series and more numerous.
  - b. Eyes once and a half their diameter apart................. *O. hoctunicolens* n. sp.
  - bb. Eyes less than once and a half their length apart.
    - c. Anal tergite with a sharply impressed transverse sulcus (width of body 7 mm.).. *O. solicolens* n. sp.
    - cc. Anal tergite at most transversely depressed in a shallow furrow but this not sulciform.
      - d. Caudal margin of anal scale nearly straight at middle; width of body 9 mm....................................... *O. tizamensis* n. sp.
      - dd. Caudal margin of anal scale widely convex, subangular at middle; width of body 6 mm............................ *O. luchilicolens* n. sp.

Gymnostreptus zizicolens n. sp.

(Figs. 6-10)

Venter, lower part of sides and anterior portion of prozonites light in color, fulvous gray, the remaining portion of prozonites and the metazonites dark brown. Antennae and legs yellowish or dilute ferruginous.

Median sulcus of head distinct only across vertex. Eyes small, transversely narrowly subelliptic, more than twice their diameter apart; ocelli in four series, e.g., 6, 5, 5, 3. Antennae long, when laid along side of partly coiled animal reaching seventh or eighth segment. Cardo of mandibles with lower margin concave (Fig. 7).

Collum narrowed conspicuously down the sides as usual, the anterior margin above lower end concave, the anteroventral corner being thus extended forward. The series of striae above each lower end as shown in Plate I, Figure 6.

Suture of segments sharply impressed throughout, the furrow not excurved opposite the small and remote pore. Encircling striations of prozonites as usual. The longitudinal striae of metazonites fine, distinct, not extending to level of pores.

Anal tergite but scarcely produced above, caudally rounded and much exceeded by the valves. Anal valves mesally compressed and elevated.

Anal scale of form shown in Figure 10.

Gonopods of male shown in Figures 8 and 9.

Number of segments, 50-57.

Width of male holotype, 4 mm.; of female allotype, 4.3 mm.

Locality.—Oxkutzcab: Ziz Cave, inner portion. Male and female taken July 24, 1936.

Orthoporus tizamensis n. sp.

(Figs. 11-13)

Color.—Each ordinary segment encircled with a broad dark chocolate-colored band, behind and in front of which the segment is abruptly lighter, being very light brown to grayish and sometimes showing a slightly olive tinge. Legs brown or slightly ferruginous, collum, head with antennae and anal tergite dark chocolate brown.

Structure.—Median sulcus of head short and rather weak, showing across caudal part of vertex only. Eyes once and a fourth their transverse length apart. Eye patch comparatively large, elongate transversely, the outer end broad and obtusely rounded; ocelli numerous, well defined, arranged in seven transverse series, e.g., 11, 12, 12, 11, 9, 8, 3, a total of 66. Antennae broken off of type except the basal portion of one. Lower margin of cardo as shown in Figure 12.

Collum with lower end not inflexed, the inferior margin convex and both corners rounded. Margining sulcus extending along lower border and up anterior border, not reaching level of eye; above this outermost sulcus first a sulcus not extending upward and then two which extend up to level of eye and then two short ones (Fig. 11).

Covered portion of prozonites transversely strongly striolate. Segmental sulcus deeply impressed throughout, not noticeably curved at level of pore which is remote but not fully half the distance from sulcus to posterior margin. Longitudinal striae of metazonite conspicuous, extending up on side to level of pores.

Last tergite very obtusely angled behind; caudal portion puncto-rugose, with the rugae chiefly longitudinal. Tergite much exceeded by the valves, the margins of which are compressed and elevated as usual. Last annulus striolate over portion covered by and adjacent to the preceding ring.

Anal scale as shown in Figure 13.

Number of segments, near 67.

Diameter, 9 mm.

Locality.—Tizamin: Muruztun Cave, near mouth. One female taken August 2, 1936.

Orthoporus luchilicolens n. sp.

(Figs. 14, 15)

Color.—Body blackish excepting a narrow band of light brown over caudal border of metazonites, this band narrower on more caudal segments, wider on the more anterior on which the anterior portion of prozonites also is lighter. Collum and head dark brown or dusky, the borders of the former lighter. Antennae and legs light brown.

Structure.—Sulcus across vertex of head to the fine interocular line as usual. Eyes of usual general shape but outer side relatively wider. Ocelli well developed, in seven or eight series, e.g., 11, 9, 9, 7, 6, 4, 4, 1, a total of 51. Eyes slightly more than once and a third their transverse length apart. Cardo of mandible as drawn (Fig. 14). Collum as figured (Fig. 15).

Repugnatorial pore more than one-third distance from sulcus to caudal margin. Striae extending to level of pore in anterior segments, not so high farther caudad where more of the upper striae are abbreviated.

Last tergite with caudal portion set off by a transverse depression, but this shallow and wide, not sulciform. Caudal portion with rugae obscure, punctae over entire surface as usual, these weaker cephalad as usual. Anal valves of usual form.

Anal scale sharply set off, with caudal margin widely convex and weakly obtusely angled at middle.

Number of segments, 65.

Width, 6 mm.

Locality.—Tixcacal: Luchil Cave. One female and one immature specimen taken July 6, 1936.

Orthoporus solicolens n. sp.

(Figs. 16, 17)

Color.—Body conspicuously annulate, the metazonites for the most part light brown and the prozonites dark chocolate brown or nearly black, the dark band on sides extending a little caudad of the suture. Collum dark excepting about the borders. Head also dark chocolate or blackish. Last tergite and anal valves dark like the head. Antennae also dark, the legs light brown.

Structure.—Sulcus across vertex fine as usual. Eyes shaped much as in *O. tizamensis;* ocelli conspicuously developed, black, arranged in six or seven transverse series, e.g., 9, 9, 9, 8, 6, 4, 1, giving a total of 46 ocelli. Eyes about once and a third their length apart. Antennae of moderate length, the joints proportioned as shown in Figure 16. Cardo of mandible of form shown in Figure 16.

Form of lower end of collum and its typical striae as shown in Figure 17.

Segmental sulcus deep throughout, crossed by short striae. Throughout its length widely, but not strongly, excurved opposite the pore which is located one-third the distance from the sulcus to the caudal margin. Striae across metazonite conspicuous below, up the sides, on most not extending quite to level of pore.

The last tergite more strongly produced than in *O. tizamensis,* the caudal angle less obtuse. Caudal portion set off by a deep transverse sulcus, puncto-rugose, such rugae as are present being mostly transverse. Anal valves compressed as usual.

Anal scale conspicuously produced caudad at middle, as shown in the figure, thus conspicuously differing in form from *O. tizamensis.*

Number of segments, 66.

Diameter, 7 mm.

Locality.—Hoctun: Hoctun Cave, under organic debris. One female taken July 7, 1936.

Orthoporus hoctunicolens n. sp.

(Fig. 18)

Color.—General coloration nearly as in *O. solicolens* but the dark ring extending more caudad of sulcus. Antennae as well as legs pale brown.

Structure.—The usual median longitudinal sulcus running across vertex to a fine impressed line that runs transversely between inner angles of eyes. Eyes


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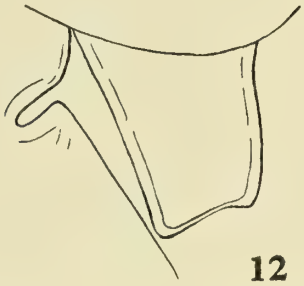
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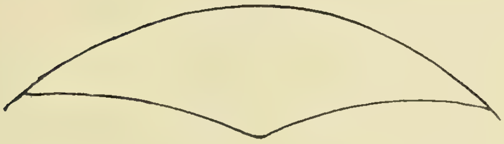
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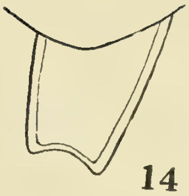
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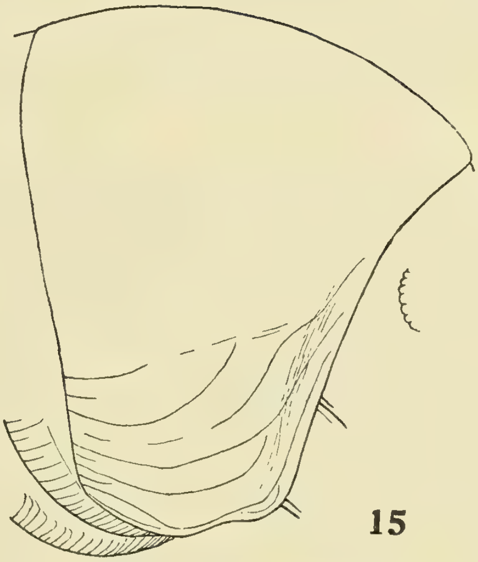
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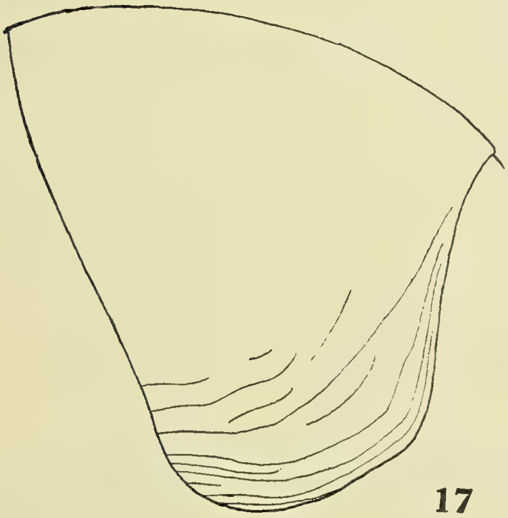
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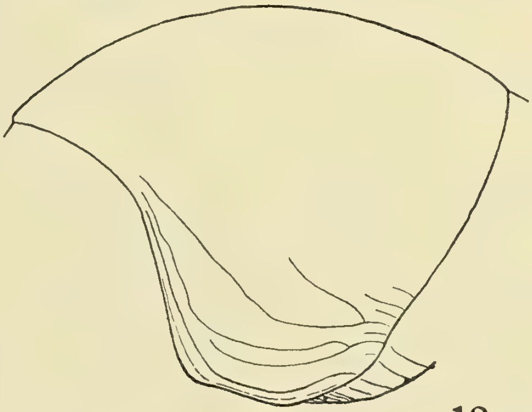
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Figs. 11-13—*ORTHOPORUS TIZAMENSIS* n. sp.
11: Collum, lateral view. 13: Anal scale.
12: Cardo of mandible.

Figs. 14, 15—*ORTHOPORUS LUCHILICOLENS* n. sp.
14: Cardo of mandible. 15: Collum from right side.

Figs. 16, 17—*ORTHOPORUS SOLICOLENS* n. sp.
16: Cardo of mandible.
17: Collum from right side.

Fig. 18—*ORTHOPORUS HOCTUNICOLENS* n. sp.
Collum from left side.

narrowly subtriangular with outer base convex and inner angle or apex acute. Ocelli strongly marked, arranged in series as follows: 12, 11, 10, 8, 8, 3, a total of 52. Eyes once and a half their transverse length apart. Antennae of moderate length. Cardo of mandible as in *O. solicolens.*

End portion of collum with its striae as represented in Figure 18.

Pore about one-third the distance from segmental sulcus to caudal margin. Sulcus widely curved opposite pore. Metazonites striate nearly to level of pore and with usually one abbreviated stria just below pore and several above it.

Anal tergite without transverse sulcus; with a low, rounded median ridge just in front of the obtuse caudal angle; caudal portion puncto-rugose. Anal valves as usual.

The anal scale sharply set off from the anal ring, the caudal margin obtusely angular, with the angle rounded.

Number of segments, 68.

Width, 7.2 mm.

LOCALITY.—Hoctun: Hoctun Cave, near mouth. One female taken July 8, 1936.

Orthoporus sp.

In addition to the species described above, immature specimens of several additional but uncertain species were secured from the following localities.

LOCALITIES.—Tixcacal: Luchil Cave, 5 specimens taken July 6.

Merida: San Bulha Cave, 1 specimen, July 13; San Isidro Cave, 1 specimen, July 5.

Calcehtok: Spukil Cave, 3 specimens, August 5.

Hoctun: Hoctun Cave, 3 specimens, July 8.

Motul: San Bulha Cenote, 1 specimen taken July 9.

Oxkutzcab: Gongora Cave, 1 specimen, July 16; Ziz Cave, inner part, 1 specimen taken July 24.

RHINOCRICIDAE

Rhinocricus motulensis n. sp.

(Figs. 19-24)

COLOR—General color black, with a narrow light band about caudal portion of metazonite. Antennae and legs brown.

STRUCTURE.—Head with median sulcus continuous to labrum excepting for an interruption just above level of antennae.

Eyes subsemicircular in outline, the upper margin being only slightly convex, the lower strongly so. Ocelli flattened, even with general surface, arranged in five series thus: 6, 6, 5, 4, 3, a total of 24. Eyes about 2.73 times their transverse diameter apart. Antennae short and relatively thick, compressed so that the cross section is elliptic. Sensory cones numerous (Fig. 20).

Collum of the general form usual in *Rhinocricus.* No margining sulcus (Fig. 19).

Second tergite produced well below lower end of collum, concavely depressed or pitted above its lower end. Sulcus very fine, obscure or absent above, that of third tergite similar or but slightly more distinct.

On succeeding tergites the sulcus becomes more strongly impressed and complete across dorsum. Sulcus contiguous with pore about the caudo-dorsal side of which it curves. Striae on metazonite developed only beneath, the uppermost of series abbreviated.

Scobina consisting of lunate impression followed by a pointed series of five striae, the impression in middle segments separated by a little less than the transverse width of the depression, extending to about the fourth from last segment (Fig. 23).

Last tergite triangularly pointed behind, the tip free but much exceeded by the anal valves. Free margin of valves strongly convex, the border compressed and elevated.

Anal scale triangular, the sides a little concave (Fig. 24).

Gonopods as shown in Figures 21, 22.

Number of segments, 44.

Width, 9.8 mm.

LOCALITY.—Motul: San Bulha Cenote. One male taken July 9, 1936.

Yucatobolus n. g.

Characterized especially in having on the lower end of the second tergite, ventrad of the lower end of the collum, a prominent rounded process undercut on dorsal and caudal side of base by a deep furrow; anterior border of this tergite below collum turned up in a prominent rim separated from the process by a conspicuous depression or furrow. Collum widely rounded below, not margined. Antennae small, bearing only four sensory cones. Anal valves with margin smooth. Scobina present, these small in the genotype.

GENOTYPE.—*Y. spukilensis* n. sp.

In modification of second tergite resembling *Oxypygides* but readily distinguishable from that genus in lacking a caudal spine on the anal valves and the deep pit on the second tergite.

Yucatobolus spukilensis n. sp.

(Figs. 25-28)

COLOR.—Dorsum of body black, the sides and venter light brown or yellow, this color also distinctly bordering metazonites across dorsum. Collum and head also light brown or yellowish, the antennae and legs of similar color.

STRUCTURE.—Median sulcus of head interrupted in frontal region. Clypeal foveolae 2+2. Eyes black, subcircular in outline, the upper margin being less convex. Ocelli in five series, e.g., 7, 7, 7, 7, 4, a total of 32. Antennae and articles short (Fig. 25).

Collum smooth, not striate or margined, its lower end and second tergite with its process as shown in Figure 28.

Segmental sulcus complete across dorsum, distinct throughout, incurved at level of pore and embracing latter on its caudal side. Metazonite coarsely punctate throughout, with a sharply impressed longitudinal stria at level of pore, otherwise without striae excepting below just ectad of legs.

Scobina small, widely separated, consisting of a depressed, finely striate area commonly more depressed at anterior end (see Fig. 26).

Anal tergite subtriangular in outline as viewed from above, the apex rounded and its side convex, its surface weakly rugose across middle but not sulcate, otherwise smooth. A little surpassing the valves, the free border of which is elevated and rounded, not strongly convex, in side view. Anal scale broadly subtriangular with apex truncate (see Fig. 27).

Number of segments, 45.

Width, 6.5 mm.

Locality.—Calcehtok: Spukil Cave. Two females taken August 5, 1936.

Order Polydesmida

Polydesmidae C. Koch 1847; Latzel 1884
Polydesmoidea Pocock 1887; Attems 1898, 1914, 1926
Merocheta Cook 1895; Silvestri 1903
Proterospermaphora Verhoeff 1913

LEPTODESMIDAE

Chondrodesmus sabachanus n. sp.

(Figs. 29-32)

Color.—The general color of the dorsum is black with the caudo-lateral portion of each keel yellow and also a deltoid area in front of caudal margin of metazonite yellow. Collum colored like ordinary metazonites, similarly presenting light areas on keels and in middle in front of caudal border. Head black excepting the lateral border which is yellowish. Antennae and legs light brown.

Structure.—Collum with anterior and lateral margins together forming an even convex curve, this margin sharply and narrowly elevated. Caudal margin subarcuate but the outer lateral portions straight.

Second tergite with anterior corner widely rounded, the caudal corner narrowly rounded but subrectangular in general outline. On anterior corner of keels two to four inclusive a minute, obsolete denticle.

All keels well developed. Margins turned up, more conspicuously about antero-lateral border and back to pore, thickening on the pore-bearing keels (see

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Figs. 19-24—*RHINOCRICUS MOTULENSIS* n. sp.

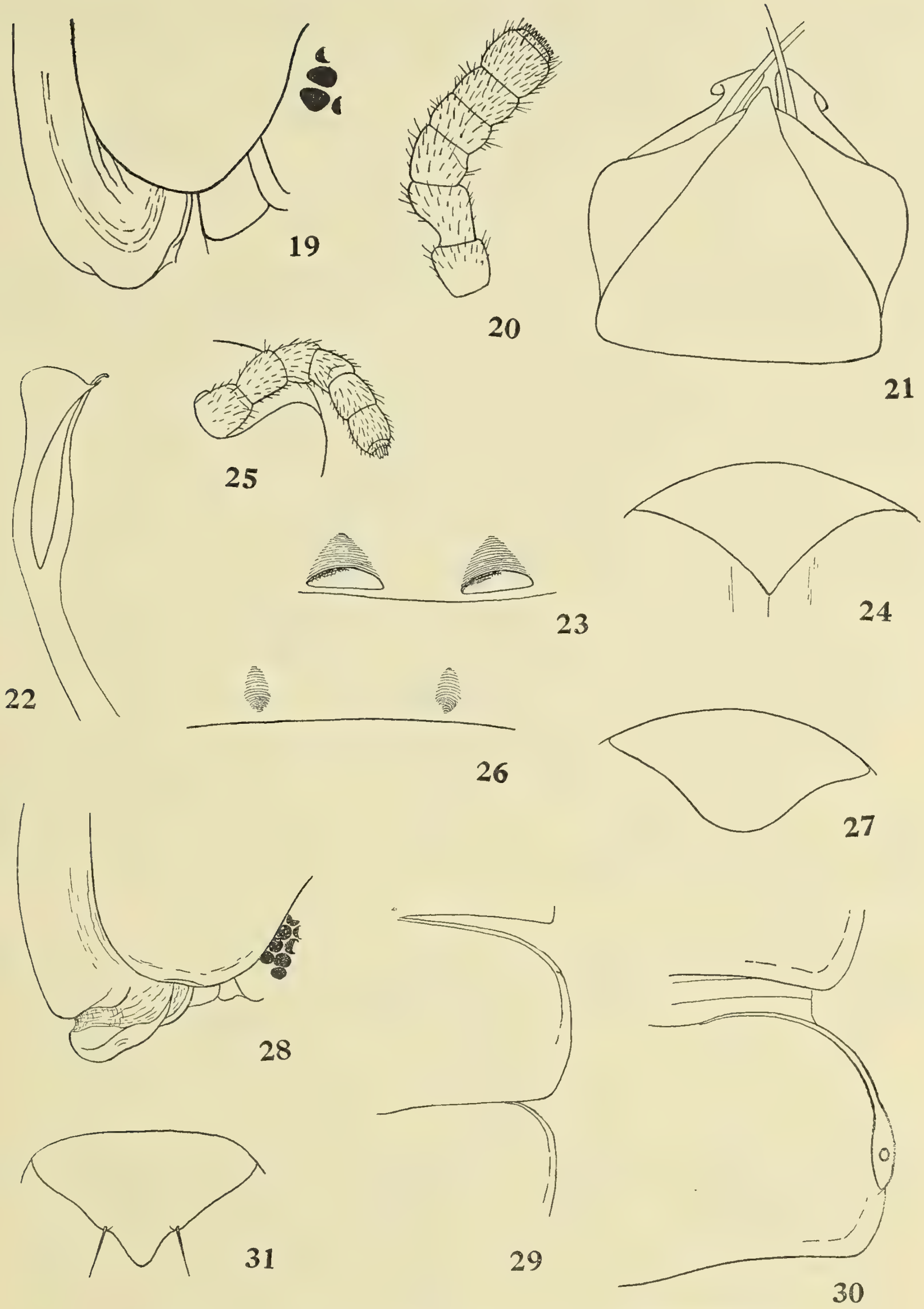
19: Collum and lower portion of second tergite, etc.
20: Antenna.
21: Anterior view of gonopods with distal portion of posterior pair omitted.
22: Posterior gonopod, distal portion.
23: Scobina.
24: Anal scale.

Figs. 25-28—*YUCATOBOLUS SPUKILENSIS* n. sp.

25: Antenna.
26: Scobina on fifteenth tergite from last.
27: Anal scale.
28: Lower portion of collum and second tergite.

Figs. 29-31—*CHONDRODESMUS SABACHANUS* n. sp.

29: Keel of third segment.
30: Keel of ninth segment.
31: Anal scale.



Figs. 19-31—*RHINOCRICUS, YUCATOBOLUS,* AND *CHONDRODESMUS*

(For description see opposite page.)

Figs. 30 and 31). Posterior angles of 16th to 19th keels distinctly produced, those of 15th and 14th but slightly extended. Processes of keels of 19th segment reduced.

Anal scale as shown in Figure 32.

Length, 38 mm.; width, 6 mm.

Locality.—Tekax: Sabacha Cave. One female taken July 30, 1936.

RHACODESMIDAE

Aceratophyllus oxkutzcabus n. sp.

(Figs. 33-39)

Color.—Dorsum bright orange, the head concolorous with it excepting the clypeal border which is yellow, venter pale, yellowish. Antennae and legs proximally yellow, distally becoming orange.

Structure.—Median sulcus of head sharply impressed across vertex and down to level of antennae. Several pairs of setae on vertex and more numerous, somewhat longer ones in frontal region on each side of lower end of sulcus. Articles of antennae proportioned as usual (Fig. 35).

Collum much wider than head, the anterior and lateral margins together forming an even semicircular line while the posterior margin is slightly arcuate with posterior corners a little produced (Fig. 36).

The succeeding tergites of the usual general form, the antero-lateral corners being rounded and presenting a single slight denticle and the posterior corners becoming more and more produced in going from segment to segment caudad.

Last tergite with cauda produced well beyond the anal valves, slightly decurved and distally narrowly subtruncate (Figs. 33, 34).

Anal scale subtriangular, the apex acute and the sides slightly convex (Fig. 34).

Gonopods apically biramous as usual; the inner branch slender throughout, apically rounded and with a slight indentation on apex. Telopodite with a large depression on inner side at base, this depression contracting to a narrow channel distad of main depression. Outer branch broader, narrowing from base to an acute point (Figs. 37, 38).

Width, 3-3.5 mm.

Localities.—Oxkutzcab: Gongora Cave (type locality), several males and females, taken July 16; Puz Cave, several taken under log July 20.

Tekax: Xmahit Cave, males and females taken July 31, 1936, "20 ft. deep."

Aceratophyllus hoctunanus n. sp.

(Fig. 40)

Color.—The integument of the types is essentially devoid of pigment over most of the body, the metazonites of anterior region especially, together with the

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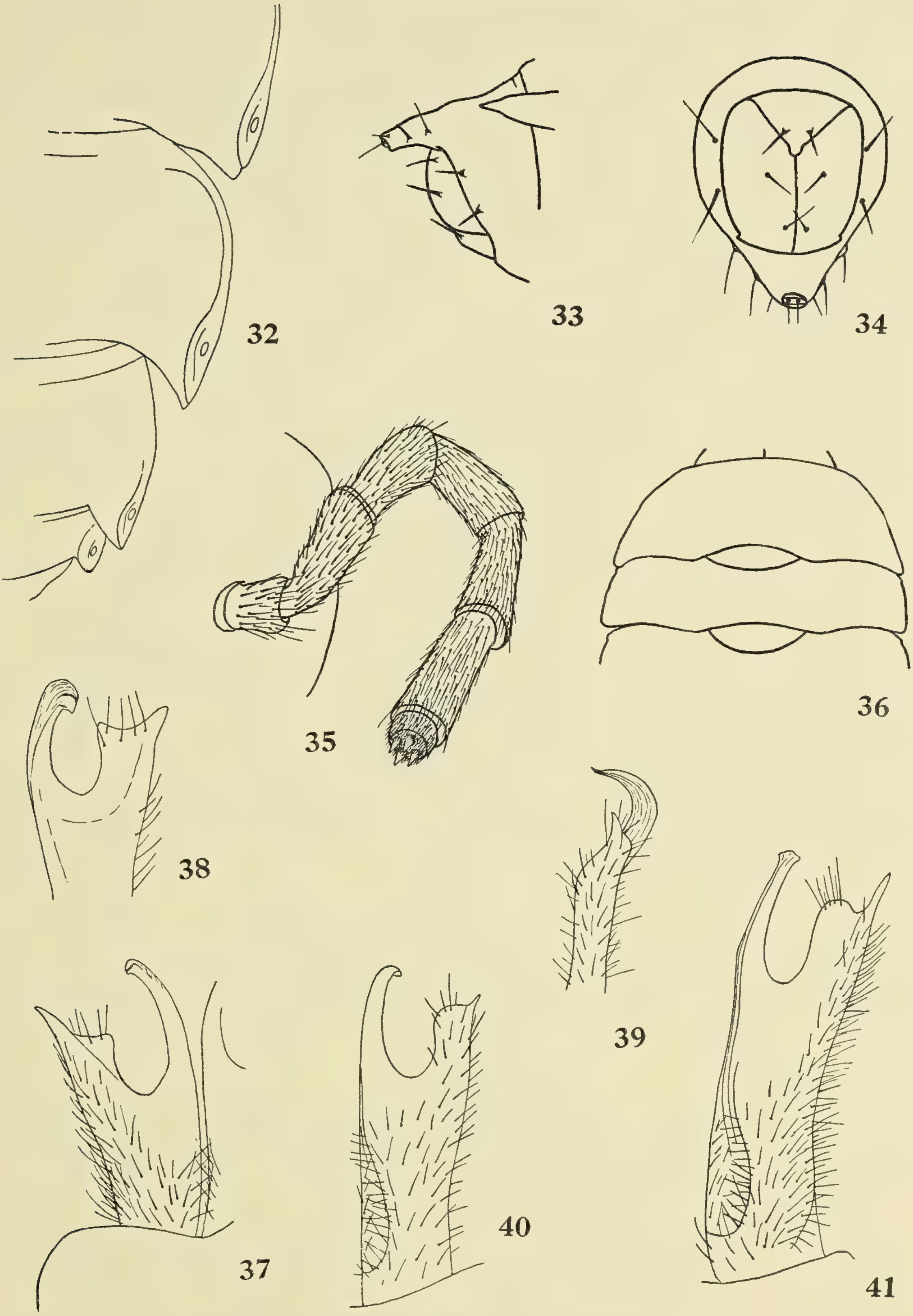
Fig. 32—*CHONDRODESMUS SABACHANUS* n. sp.
Keels of segments XVI to XIX.

Figs. 33-39—*ACERATOPHYLLUS OXKUTZCABUS* n. sp.
33: Last segment, lateral view.
34: Same, ventral view.
35: Antenna.
36: First two tergites, dorsal view.
37: Left gonopod of male.
38: Apex of telopodite of gonopod, anterior view.
39: Same, ectal view.

Fig. 40—*ACERATOPHYLLUS HOCTUNANUS* n. sp.
Left gonopod of male, caudal view.

Fig. 41—*ACERATOPHYLLUS CALCEHTOKANUS* n. sp.
Left gonopod of male, caudal aspect.



Figs. 32-41—*CHONDRODESMUS* AND *ACERATOPHYLLUS*

(*For description see opposite page.*)

head and antennae showing only dilute yellowish pigmentation. The dorsal aorta, etc., showing through the translucent integument.

STRUCTURE.—The collum, keels, anal tergite and scale of usual general form, not presenting any easily defined differences, though other keels appear somewhat narrower than usual.

The species is distinguished on the basis of differences in the gonopods, especially of the outer branch of the telopodite, which in form resembles that of *A. calcehtokanus* but has the apical process much shorter as shown in Figure 40.

Width, 3 mm.

LOCALITY.—Hoctun, Hoctun Cave, July 7 and 8, 1936. Male holotype, female allotype, female paratype, and two not fully matured paratypes.

Aceratophyllus calcehtokanus n. sp.

(Fig. 41)

COLOR.—Of the usual pale orange color, the pigment more pronounced toward anterior end. Antennae also orange, the legs more yellowish but of distinct orange tinge.

STRUCTURE.—The keels not up-curved quite as much as in *A. oxkutzcabus*.

In general structure of the gonopods close to *A. oxkutzcabus* but differing in the more pronounced inner lobe of the outer prong of the telopodite (Fig. 41).

Width, 4 mm.

LOCALITY.—Calcehtok: Xkyc Cave, August 7, 1936, one male (holotype); Spukil Cave, August 5, two females and two immature specimens; Sazich Cave, August 6, one female more fully pigmented.

Aceratophyllus sp. a.

LOCALITY.—Tekax: Sabacha Cave, July 30, 1936. Two females of a conspicuous bright orange color. Possibly an unnamed species but in the absence of males best left undescribed.

Aceratophyllus sp. b.

LOCALITY.—Merida: San Isidro Cave, July 3, 1936. Three well-pigmented females which cannot be placed with certainty as to species in the absence of males.

STIODESMIDAE

Yucodesmus n. g.

Agreeing in general structure, pore-formula, etc., with *Cynedesmus* from which, however, readily distinguished in having the anterior border of the collum divided into twelve areas or lobes instead of ten.

Gonopods of male with telopodite freely exposed, typically geniculate and with a process on dorsal (or caudal) side toward apical third; setose toward base and also typically bearing several setae near the process as shown in Figures 44, 45, 47-51.

GENOTYPE.—*Y. viabilis* n. sp.

Eight species, from as many caves, represent this genus. All agree rather closely in general characters, *Y. alienus* being the most aberrant in sculpturing, and *Y. isidricus* in character of gonopods. These forms are all pale in color, either wholly lacking pigment, or showing but little.

Yucodesmus viabilis n. sp.

(Figs. 42-45)

Color.—General color of dorsum pale orange yellow, the keels and the lobed rim of the collum and the ventral surface and legs a lighter, lemon yellow.

Structure.—Head densely granulo-tubercular over region of vertex and frons to a sharply defined transverse line between bases of antennae below which the surface is smooth; head also smooth in an area above sockets of antennae, in which area basal joints of antennae normally lie. Antennae with fifth article of antennae greatly enlarged, being much thicker than the others and approximately as long as the fourth and sixth joints combined.

Antero-lateral rim of collum horizontal, smooth, its surface divided into twelve areas, with corresponding crenations on margin of which the one at each end is smaller than the intervening ones. Convex area entirely densely granulo-tubercular and with two transverse series of larger tubercles, one across middle composed of seven tubercles and one near caudal border composed of four (Fig. 42).

On subsequent tergites the surface is also granulo-tubercular and bears four longitudinal series of larger tubercles, of which there are three in each series on each segment. Keels wide, but little depressed below horizontal plane and sharply set off from the strongly convex mid-dorsal portion of the tergites. Lateral margin of non-poriferous keels with three lobes or crenations excepting keels 17-19, which are four-lobed. Poriferous tubercle on segment 5 projecting over the second lobe, the others farther back, projecting between lobes 2 and 3. Anal tergite with caudal margin notched at middle and with two projecting lateral lobes on each side (Figs. 42, 43).

Gonopods as drawn (Figs. 44, 45).

Length, 5.2 mm. to 7 mm.; width, 1.1 mm. to 1.4 mm.

Locality.—Tixcacal: Luchil Cave, July 6, 1936, several males and females, in addition to male holotype and female allotype.

Calcehtok: Spukil Cave, 1 male taken August 5; and Sazich Cave, 1 male and 3 females taken August 6.

Oxkutzcab: Gongora Cave, 1 male taken July 6.

Merida: San Isidro Cave, 1 male taken July 4.

Yucodesmus isidricus n. sp.

(Fig. 51)

Color.—Pale, entire body without pigment or very nearly so.

Structure.—Head granulo-tubercular over vertex and frons to level of antennae, the granules tending to be arranged in longitudinal rows in which the most ventral are reduced in size.

Collum with the usual twelve marginal lobes. Tubercles of two rows typical, the granules between and in front of them moderately small, nearly uniform, not crowded, not encroaching upon border lobes.

The tubercles of succeeding tergites in the ordinary four series. Granules on upper surface of keels few, the end part free from them. Keels of second, third, fourth and fifth segments with three lateral lobes or crenations, all others with four lobes. Lateral lobes of keels of nineteenth segment only weakly indicated.

Anal tergite with caudal median emargination sharply defined.

Gonopods as drawn (Fig. 51).

Length of male holotype, 6 mm.; width, 1.35 mm.

LOCALITY.—Merida: San Isidro Cave, July 4, 1936. Male holotype, female allotype, one additional adult male paratype and several other, not fully grown, specimens in various stages of development.

In the character of the gonopods the most aberrant of the species.

Yucodesmus alienus n. sp.

(Figs. 46-48)

COLOR.—Pale yellow.

STRUCTURE.—Collum of the usual general shape but with tubercles more strongly developed, there being in addition to the usual two rows two additional series on anterior portion, these series irregular and composed of more numerous tubercles (Fig. 46).

The keels slanting more gradually from the mid-dorsal region. Differing from the preceding form in having the lateral margins of keels 17-19 trilobed instead of four-lobed, though the posterior lobe of segment 17 may be weakly subdivided. Poriferous tubercles more erect and a little more remote from margin than in the other forms.

Gonopods as drawn (Figs. 47, 48).

Length of female allotype 5.25 mm.; width, 1 mm. Width of male holotype, .8 mm.

LOCALITY.—Male holotype and female allotype from a cave the number of which was missing from the vial, but probably Hoctun Cave, from which a female paratype was also taken July 8, 1936.

FIGS. 42-45—*YUCODESMUS VIABILIS* n. sp.

42: Anterior end, dorsal view.
43: Caudal end, dorsal view.
44: Left gonopod of male, sub-ectal view.
45: Right gonopod, disto-ectal aspect.

FIGS. 46-48—*YUCODESMUS ALIENUS* n. sp.

46: Anterior end, dorsal view.
47: Telopodite of gonopod of male, ventro-mesal aspect.
48: Gonopod of male, sub-ectal view.

FIGS. 49, 50—*YUCODESMUS MURUZTUNICUS* n. sp.

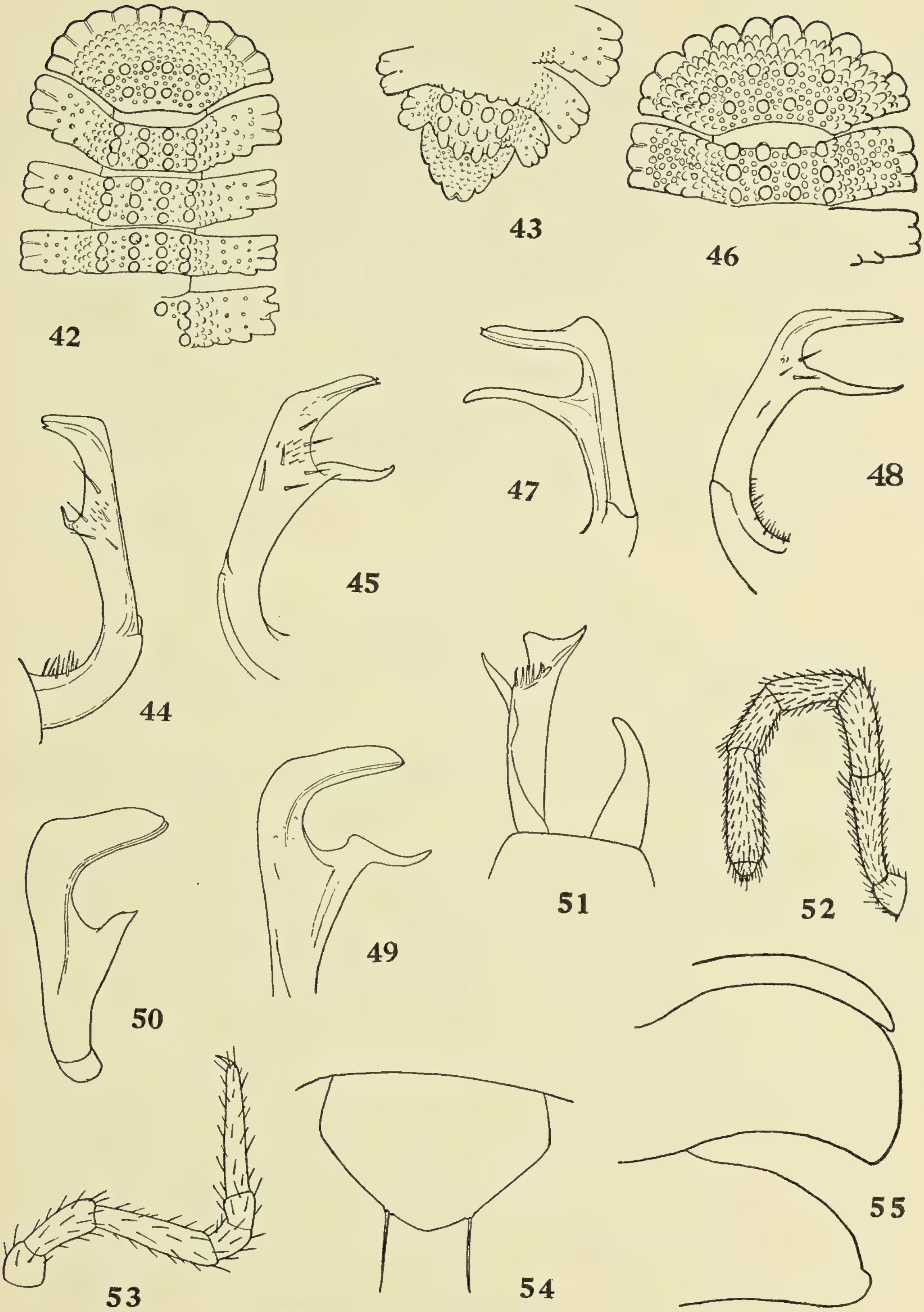
49: Telopodite of right gonopod of male, dorso-ectal aspect.
50: Telopodite of left gonopod, a little mesad of ventral aspect.

FIG. 51—*YUCODESMUS ISIDRICUS* n. sp.

Gonopod of male, ectal aspect.

FIGS. 52-55—*CYLIONUS KAUANUS* n. sp.

52: Antenna.
53: Leg.
54: Anal scale.
55: Keels of segments III to V.



Figs. 42-55—*YUCODESMUS* AND *CYLIONUS*

(*For description see opposite page.*)

Yucodesmus muruztunicus n. sp.

(Figs. 49-50)

COLOR.—Lemon yellow throughout.

STRUCTURE.—The end crenations or marginal lobes of the collum relatively larger than in *Y. viabilis.* A somewhat more slender form. The three major lobes of posterior margin and the lateral marginal crenations or lobes of keels more sharply defined, the incisions being deeper.

Best characterized by form of gonopods as shown in Figures 49, 50.

Length, 6.1 mm.; width, 1.2 mm.

LOCALITY.—Tizamin: Muruztun Cave, August 12, 1936, male holotype, female allotype.

Yucodesmus sp. a.

LOCALITY.—Kaua: Oxolodt Cave, one female taken in bat feces, June 18.

The specimen, in the absence of a male, cannot be placed with certainty. It resembles the form herein described as *Y. muruztunicus.*

SPHAERIODESMIDAE

Cylionus kauanus n. sp.

(Figs. 52-55)

COLOR.—General color pale yellow, with a vertical black spot or band on each keel, the two bands on posterior segments tending to unite in a continuous stripe across dorsum. Vertex of head with a network of dark lines, similar lines more condensed in a darker area between antennae.

STRUCTURE.—Antennae subfiliform, less crassate distally than in *C. gracilis* or *C. constrictus;* second, third and sixth articles longer than the fourth and fifth (Fig. 52).

The collum with postero-lateral margin forming an evenly curving semicircle, the anterior margin straight. Keels of second segment decidedly shorter than those of the third which extend as low as those of the fourth and are distally curved caudad. Keels of fourth segment also distally curved, much larger than the third and also exceeding the fifth which in turn are a little larger than the sixth. Succeeding tergites of typical shape and conformation (Fig. 55).

Anal scale subpentagonal, the setigerous tubercles widely separated, with margin between them gently convex (see Fig. 54).

Legs slender, the second article about half the length of the third (Fig. 53).

Length, 10 mm.; width, 2.8 mm.

LOCALITY.—Kaua, Kaua Cave. One female, June 16.

Apparently nearest to *C. constrictus* Pocock known from Guatemala (Volcan de Agua), but seems clearly distinct in color pattern, and in the form of antennae. The relative lengths of joints of legs also seem somewhat different, to judge from Pocock's description. Unfortunately no male was secured. This is only the third species referred to *Cylionus.*

XV

COLLEMBOLA FROM YUCATAN CAVES

Harlow B. Mills
Agricultural Experiment Station, Bozeman, Montana

Only one of the species which were taken from the caves in Yucatan can be identified with previously described species, and two of them represent new genera.

The Collembola herein described or discussed are:

Xenylla yucatana n. sp.
Proisotoma centralis Denis
Trogolaphysa maya n. g., n. sp.
Cyphoderus innominatus n. sp.
Lepidocyrtus pearsei n. sp.
Sulcuncus falciferus n. g., n. sp.

Types of the new species are in the collections of the author and in the Mexican National Museum.

Family PODURIDAE

Genus *Xenylla* Tullberg

Xenylla yucatana n. sp.

(Figs. 1-6)

Pale, spotted with light blue, the venter, segmental sutures, furcula, and legs lighter. The antennae shorter than the head diagonal; organ of the third segment composed of 2 slightly swollen, cylindrical clubs behind a large fold, and 2 blunt hairs (Fig. 3). Fourth segment with 3 externo-lateral subapical olfactory clubs and 1 dorsally and back from the apex (Fig. 1). First and second segments with 1 row of bristles each. Third and fourth segments ankylosed and bearing many bristles, the sense organs mentioned above, and an apical, retractile sense club. Eyes 4 on either side (Fig. 2). Small erect or proclinate hairs on the head. Minute reclinate hairs on the body, somewhat longer and straighter on the last 2 abdominal segments. More abundant laterally on the body and genae. Legs with longer and straighter hairs which become more abundant distally. Tenent hairs 2+2+2. Unguis rather straight, with a small inner tooth in the apical third (Fig. 6). Unguiculus absent. Dens with 2 dorsal setae. Mucro separated from the dens (Fig. 5), less than half its length, with a basal swelling, upturned apex, and large lobate external lamella which ends well before the apex. Anal horns 2, small. Rami of tenaculum (Fig. 4) three-toothed. Integumentary tubercles large, coarse, secondarily granulate. Length 0.75 mm.

Locality.—San Bulha Cenote, Motul, in bat feces, July 9: 11 specimens.

In the number of eyes this species approaches *X. octoculata* Carpenter from Samoa. In its other structures, however, it is close to the holarctic *X. mucronata* Axelson.

Family ENTOMOBRYIDAE

Genus *Proisotoma* Börner

Proisotoma centralis Denis 1931

(Figs. 7-12)

One specimen, which I identify with some doubt as the above species, was taken in a tow net in Yunchen Cave, Libre Union, on July 11. The eyes in *P. centralis* are 6 on either side. In the specimen at hand, which measures 0.7 mm. in length, 5 eyes were seen. It may have been abnormal or imperfectly seen in this respect. Further, it approaches the genus *Folsomides* in some of its characters. The prothorax is long, the apex of the abdomen is simply annulate, and the sense clubs of the third antennal segment are sunk somewhat in pits (Fig. 7). The furcula, on the other hand, is distinctly proisotomoid as is the general habitus, and it is covered with diffuse blue-gray pigment even to the apices of the appendages.

Genus *Isotomurus* Börner

One specimen, with the furcula lacking, was taken in a tow net in the Yunchen Cave, Libre Union, July 11.

Genus *Trogolaphysa* n.

Paronelloid, with eyes and pigment absent. Unguis usually with large pointed paramedian teeth. Fourth antennal segment with numerous curved sensory hairs. Type *T. maya* n. sp.

This genus bears much the same relationship to *Paronella* that *Pseudosinella* does to *Lepidocyrtus,* or *Sinella* to *Entomobrya.* It is represented in the Yucatan material by at least 3 species. Two of these are represented by 1 specimen each, in too poor condition to warrant description. The paramedian ungual teeth in one of these are poorly developed, approaching the condition of true *Paronellae.*

Trogolaphysa maya n. sp.

(Figs. 13-16)

White, eyeless. The food in the alimentary tract often showing through as a longitudinal dark streak. Antennae 4.5 times the length of the head diagonal, the fourth segment annulate. Proportions of the segments about as 14:19:18:40. Fourth segment with 3 kinds of hairs: suberect bare setae, shorter curved hairs, and heavier curved olfactory (?) hairs which become longer and more slender toward the base of the segment where they merge with the second type. Larger, more slender hairs on the third segment, which bears a few scales basally. Second

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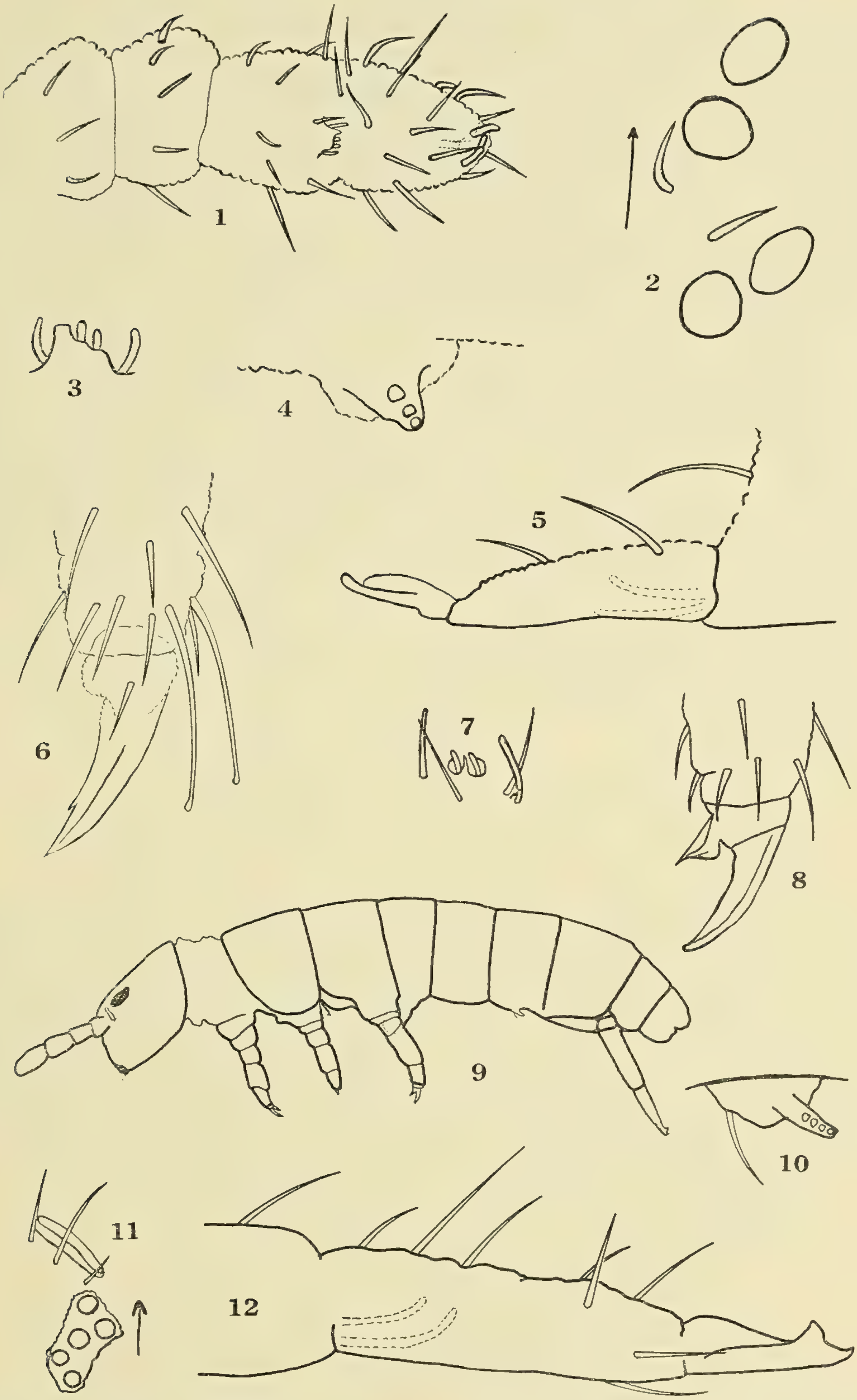
FIGS. 1-6—*XENYLLA YUCATANA* n. sp.

1: Right antenna.
2: Right eyes.
3: Sense organ, third antennal segment, right side.
4: Tenaculum.
5: Right dens and mucro.
6: Left hind foot.

FIGS. 7-12—*PROISOTOMA CENTRALIS* DENIS

7: Sense organ, third antennal segment, right side.
8: Left hind foot.
9: Lateral view.
10: Tenaculum.
11: Post-antennal organ and eyes, left side.
12: Left dens and mucro.



Figs. 1-6—*XENYLLA YUCATANA* n. sp. Figs. 7-12—*PROISOTOMA CENTRALIS* DENIS

(*For description see opposite page.*)

segment similar but hairs and basal scales more abundant. Basal segment with many hairs and scales. Head and body covered with scales which are elliptical, obovate, or weakly lanceolate and which are weakly and irregularly striate and occasionally fringed at the apex. Head densely scaled, with a few minute dorsal setae and many large ones laterally, ventrally, and about the mouthparts. Thorax and abdomen scaled, devoid of hairs dorsally as far back as the fourth abdominal segment, where minute bare setae appear; these setae grow larger posteriorly, the fifth and sixth segments with a number of large blunt, fringed hairs. Large fringed clavate dorsal bristles absent in the specimens examined which, however, were rubbed. Legs hairy to the apex, the setae on the inner face of the tibiotarsus heavier than the rest. Manubrium with hairs and scales dorsally and only scales ventrally. Dentes with numerous elongate subacute petiolate scales ventrally; hairs and 2 rows of heavy spines dorsally, each row with 35-40 spines. Manubrium to dentes about as 20:23. Third abdominal segment to fourth about as 1:7. Mucrones typically paronelloid (Figs. 14, 15), quadridentate. Unguis with very large paramedian teeth, the posterior one slender and acicular, 2 large median teeth, lateral teeth close to the base, and a large, pointed sub-basal external one (Fig. 16). Unguiculus lanceolate, the external border fringed. Tenent hair slender, unknobbed apically. Length 1.7 mm.

LOCALITIES.—Balaam Canche, Chichen Itza, under stones near the mouth, June 8: 1 specimen. Xkyc Cave, Calcehtok, at bottom of cave, 15 m. deep, August 7: 1 specimen.

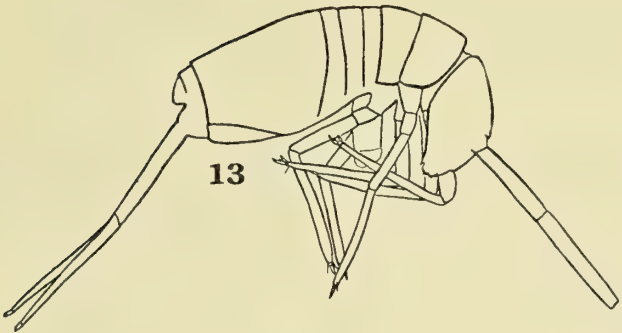
Genus *Cyphoderus* Nicolet

Cyphoderus innominatus n. sp.

(Figs. 17-19)

White, eyeless. Dentes with 6 scales in the outer series and 5 in the inner. Between these rows of scales is a row of 5 proclinate hairs, the basal one with a smaller curved one on either side of its base. Dentes scaled ventrally. Numerous large scales ventrally on the manubrium; many dorsal fringed hairs which grow smaller toward the base of the segment. Interspersed among these hairs is a dorsolateral series on either side composed of bare, more erect setae. Mucro with an apical tooth behind which is a subapical notch which in turn is sometimes limited proximally by a weak tooth-like elevation. Outer lamella with a weak tooth approximately ¼ from the apex (Fig. 18). Outer apical scale of the dens from ⅚ of to subequal to the mucro. Inner apical scale almost twice the mucronal length (Fig. 19). Body measurements of two specimens:

HEAD	ANTENNA				TOTAL	ABDOMEN		FURCULA		OUTER SCALE	INNER SCALE
	I	II	III	IV		III	IV	Dens	Mucro		
54	8	21	12	37	78	22	76	120	32		
42	7	20	11	30	68	21	75	125	24	44	20



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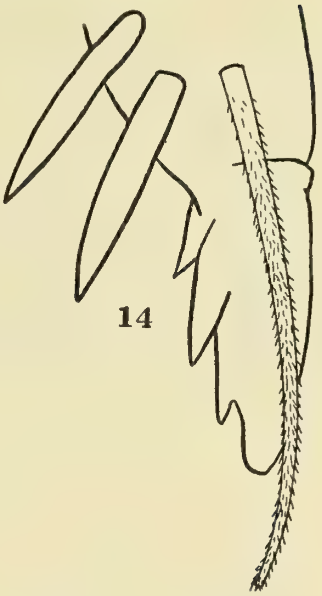

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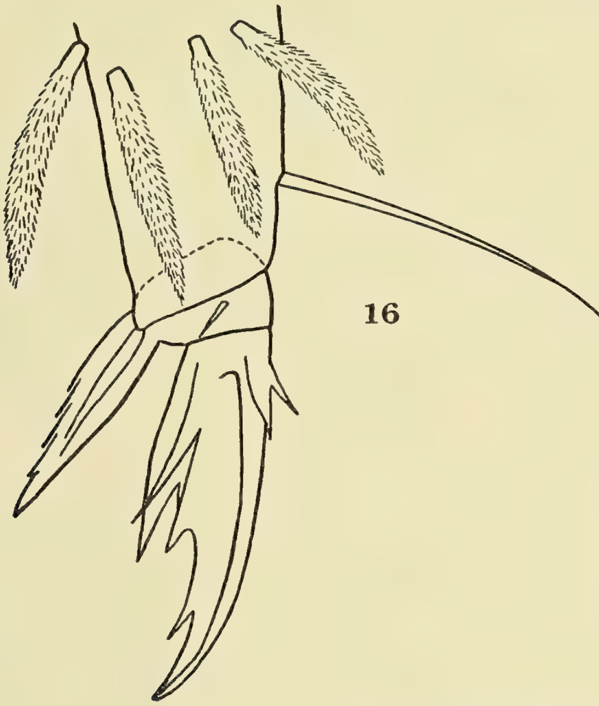

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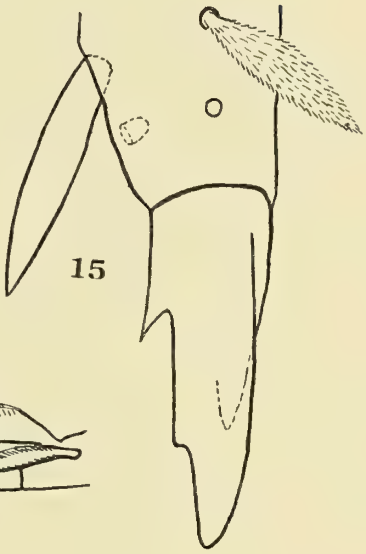

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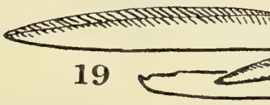

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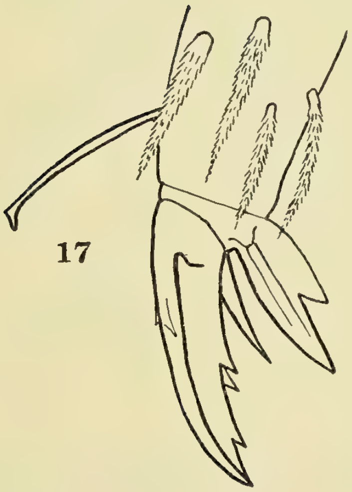

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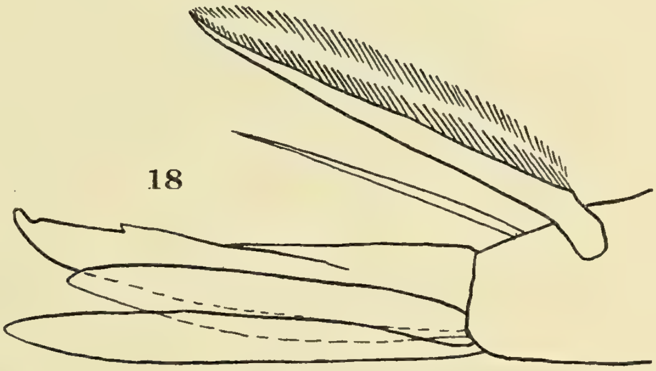

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Figs. 13-16—*TROGOLAPHYSA MAYA* n. g., n. sp.

13: Lateral view.
14: Left mucro.
15: Right mucro.
16: Right front foot.

Figs. 17-19—*CYPHODERUS INNOMINATUS* n. sp.

17: Right fore foot.
18: Apex of right dens.
19: Apex of right dens.

Unguis with a large pointed tooth on the posterior lamella, 2 smaller ones at about the middle, and a single one toward the apex. Unguiculus with a large external lamella which ends in a large tooth. Tenent hair weak, with a small apical swelling (Fig. 17). Length 1 mm.

Localities.—San Bulha Cenote, Motul, in bat feces, July 9: 4 specimens. Gongora Cave, Oxkutzcab, in bat feces, July 17: 1 specimen. Second cave on San Roque Road, Oxkutzcab, July 23: 3 specimens. Muruztun Cave, Tizamin, 40 m. from the mouth, August 12: 2 specimens.

This species is apparently most closely related to the African *C. limboxiphius* Börner, a termitophilous species.

Genus *Lepidocyrtus* Bourlet

Lepidocyrtus pearsei n. sp.

(Figs. 20-24)

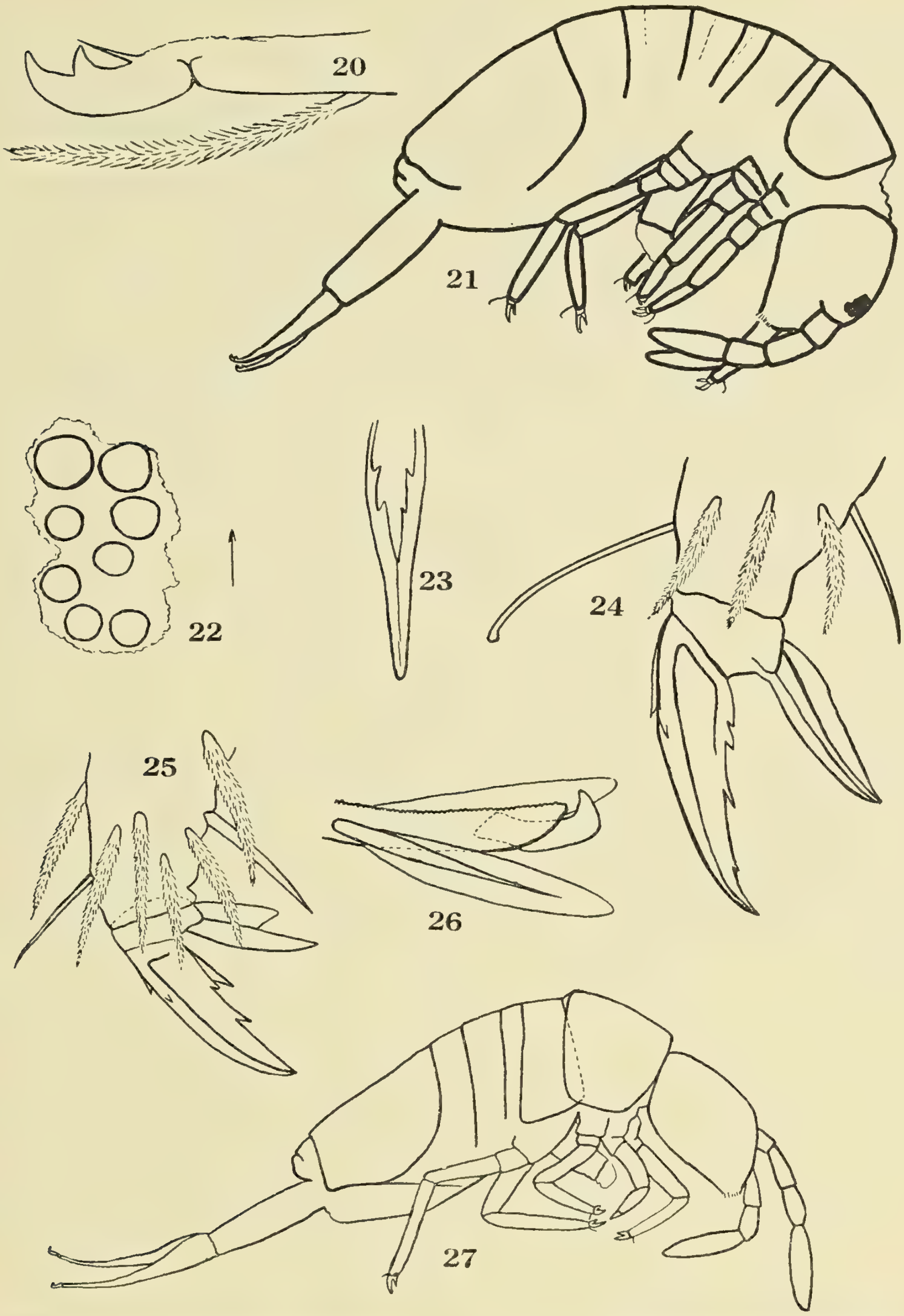
White but for black eye spots and antennae which are diffuse blue, more so apically. An irregular blue-black inverted V is present on the front, extending from the eye spots to the dark median ocellar spot. Other minute blue-black points often occur on the head, especially on the genae. Eyes 8 on either side (Fig. 22). Antennae a little longer than the head, about as 55:43, the segments about as 9:13:8:24. Third abdominal segment to the fourth about as 5:13. Dens and manubrium subequal. Mucro typical (Fig. 20). Bare area at apex of dens slightly less than twice the mucronal length. Unguis with 2 blunt teeth on each basal lamella, a single one near the middle, and a minute one near the apex (Figs. 23-24). Unguiculus lanceolate, usually weakly fringed externally. Tenent hair slender, slightly knobbed at apex. Many curved fringed hairs on the fourth antennal segment among which are short bare setae. Longer curved fringed hairs on the other segments. Head with rather long fringed hairs on the frons, genae, and gular region. Dorsum of head and body devoid of hairs (in my specimens) but for a small fringe on anterior and lateral margins of mesonotum and on the fifth and sixth abdominal segments. They are present laterally, however, on the thorax and abdomen. Legs hairy; tibiotarsus with heavy fringed pointed hairs inwardly and larger more slender ones on the outer face. Length 1.1 mm.

Localities.—San Bulha Cenote, Motul, in bat feces, July 9: 2 specimens. Gongora Cave, Oxkutzcab, in bat feces, July 17: 17 specimens. Second cave on San Roque Road, Oxkutzcab, July 23: 1 specimen.

I am pleased to name this interesting species for its discoverer, Dr. A. S. Pearse, who transmitted this collection to me for study.

Genus *Sulcuncus* n.

Essentially pseudosinelloid, with the mucro falcate and subapical instead of apical and with its base covered by the narrowly lobate apex of the dens. Dens with an inner series of imbricate scales which extend above its dorsal margin, and subapical lanceolate ribbed scales. White, eyes absent. Type *S. falciferus* n. sp.



Figs. 20-24—*LEPIDOCYRTUS PEARSEI* n. sp.

20: Right mucro.
21: Lateral view.
22: Left eyes.
23: Inner face of left hind unguis.
24: Right hind foot.

Figs. 25-27—*SULCUNCUS FALCIFERUS* n. g., n. sp.

25: Right hind foot.
26: Left mucro.
27: Lateral view.

Sulcuncus falciferus n. sp.

(Figs. 25-27)

White, eyeless. Head and body covered with oval or elliptical scales which are irregularly covered with minute striations. Antennae longer than the head, about as 29:22, the segments about as 9:12:13:24. Fourth abdominal segment about 4 times the third. Manubrium to the dentes about as 5:7. Antennae quite hairy, with many small reclinate hairs and other curving suberect ones. Fourth antennal segment with an abundance of hairs which become shorter and more curved apically, resembling olfactory hairs. A field of short erect smooth setae subapically. Head and body scaled, the head quite hairy laterally. Thorax and abdomen bare dorsally but for an anterior mesonotal fringe of heavy weakly clavate bristles, a few minute recurving setae on the disc of the mesonotum, and larger weakly fringed bristles on the fifth and sixth abdominal segments. Furcula with many minutely fringed dorsal hairs on the manubrium and similar but longer hairs on the swollen bases of the dentes. Dentes enlarged basally (Fig. 27), tapering rapidly to the attenuate apical region; strongly corrugated beyond the basal swelling to a point about 4 times the length of the mucro from the apex of the dens, and weakly granulate on to the apex. Each dens bears an inner row of scales which are imbricate and which extend above the dorsal margin, presenting a saw-toothed appearance. Subapical scales are lanceolate and ribbed (Fig. 26). Mucrones irregularly falcate, inserted subapically on the ventral face of the dentes (Fig. 26). Unguis rather straight, with 2 paramedian teeth, the anterior one small, and 1 well-developed median tooth. Lateral teeth are present about ⅓ the ungual length from its base, and a small external one proximad of these lateral ones (Fig. 25). Unguiculus lanceolate, with a large-toothed external lamella. Tenent hair weak, unknobbed, slightly curved at the apex. Length 1 mm.

Locality.—Sazich Cave, Calcehtok, at bottom of cave, 15 m. deep, August 6: 2 specimens.

XVI

NEW CAVE-CRICKETS FROM YUCATAN, WITH A REVIEW OF THE PENTACENTRINAE, AND STUDIES ON THE GENUS AMPHIACUSTA (ORTHOPTERA, GRYLLIDAE)

Theodore H. Hubbell

Department of Biology, University of Florida
Museum of Zoology, University of Michigan

The crickets collected in twenty-four Yucatan caves are of unusual interest, both because the Orthopteran fauna of the peninsula is so little known, and because the two species represented in the series both show adaptations to hypogeic existence. One is a small, yellowish-brown cricket, brachypterous and nearly blind, which constitutes a new genus and species of Pentacentrinae, a group in which cavernicoles have hitherto been unknown. The other—a larger, long-legged brownish-maculate insect, flightless though not blind—is an undescribed species of the cave-loving group Phalangopsinae.

Subfamily Pentacentrinae

Tohila n. g.

Small Pentacentrinae, related to *Trigonidomimus;* eyes reduced, degenerate, ocelli obsolete, rostrum very narrow and but slightly prominent; tegmina abbreviate, corneous, polished, with much-reduced venation which is similar in the two sexes; wings represented by minute rudiments ("apterous"); legs slender, elongate for the group, cephalic tibiae without auditory foramina, caudal tibiae slender, cylindrical, dorsal margins not denticulate, distad normally armed on each margin with 2 spurs (varying from 0 to 3), distal calcars 6, the two ventral ones small, externomedian as long as last outer dorsal spur, longer than externodorsal calcar, the two upper calcars of inner face elongate, the dorsal slightly the longer; all tarsi slender, very elongate, metatarsi very long, cylindrical, unarmed above; cerci very slender and extremely elongate, exceeding body-length; ovipositor nearly straight, four-fifths as long as caudal femur, apex slender, briefly lanceolate, of Phalangopsine aspect. The genus includes only *Tohila atelomma* n. sp., described below; its relationships are discussed following the description of the genotype.

Tohila atelomma[1] n. sp.

(Figs. 1-10, 77)

Holotype.—Male, Chac Mol Cave, Tohil, Yucatan, June 27, 1936 (A. S. Pearse—under stones at top); allotype a female, Xtoloc Cenote Cave, Chichen Itza, Yucatan, June 24, 1936 (A. S. Pearse—on ground); both in Museum of Zoology, University of Michigan.

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[1] From ’*ατελής* = imperfect, and ’*όμμα* = eye.

DESCRIPTION OF HOLOTYPIC MALE [2]

About the size of small *Nemobius carolinus,* but more slender and delicately built (Figs. 1, 2); body-length 5.3 (6.6) mm. Pale yellowish-brown, with venter and abdominal dorsum lighter and tegmina darker than head, pronotum and legs. Surface more or less polished, that of head, pronotum and tegmina especially so, these areas with few, minute pale setae, head and pronotum with groups of larger blackish bristles distributed as noted below; legs thickly setose.

Head (Figs. 1-3).—Nearly as broad as caudal breadth of pronotum, ventro-cephalic angles of pronotum flaring to receive it; occipital region narrow, strongly rounding into the steeply declivent, large and distinctly flattened vertex; antennal fossae situated low on head, as in other Pentacentrinae; front very short, transverse; interantennal prominence (rostrum) strongly narrowed, at apex only one-fourth as broad as proximal antennal segment, in side view but slightly protuberant and rounded obtuse-angulate at apex; rostrum with a pair of closely approximated blackish bristles just above narrowest point, and a single such bristle on vertex between upper margin of eye and antennal fossa; ocelli absent, position of laterals barely indicated by slightly paler areas at ends of arms of pale epicranial suture just above antennal fossae; eyes greatly reduced, represented by narrow, subvertical pigmented areas about twice as tall as broad and about half as large as antennal fossae, narrowly subpyriform with outer margin subangulate at upper third, margins weakly demarcate and surface scarcely raised above general contour of epicranium, pigmentation not reaching edge of ocular area at all points, about 25 imperfect ommatidia indistinctly indicated by small, irregularly distributed pale spots in central portion of eye, the integument faintly impressed over each; [3] clypeus strongly transverse, slightly tumid mesad; labrum suboval, half again as broad as

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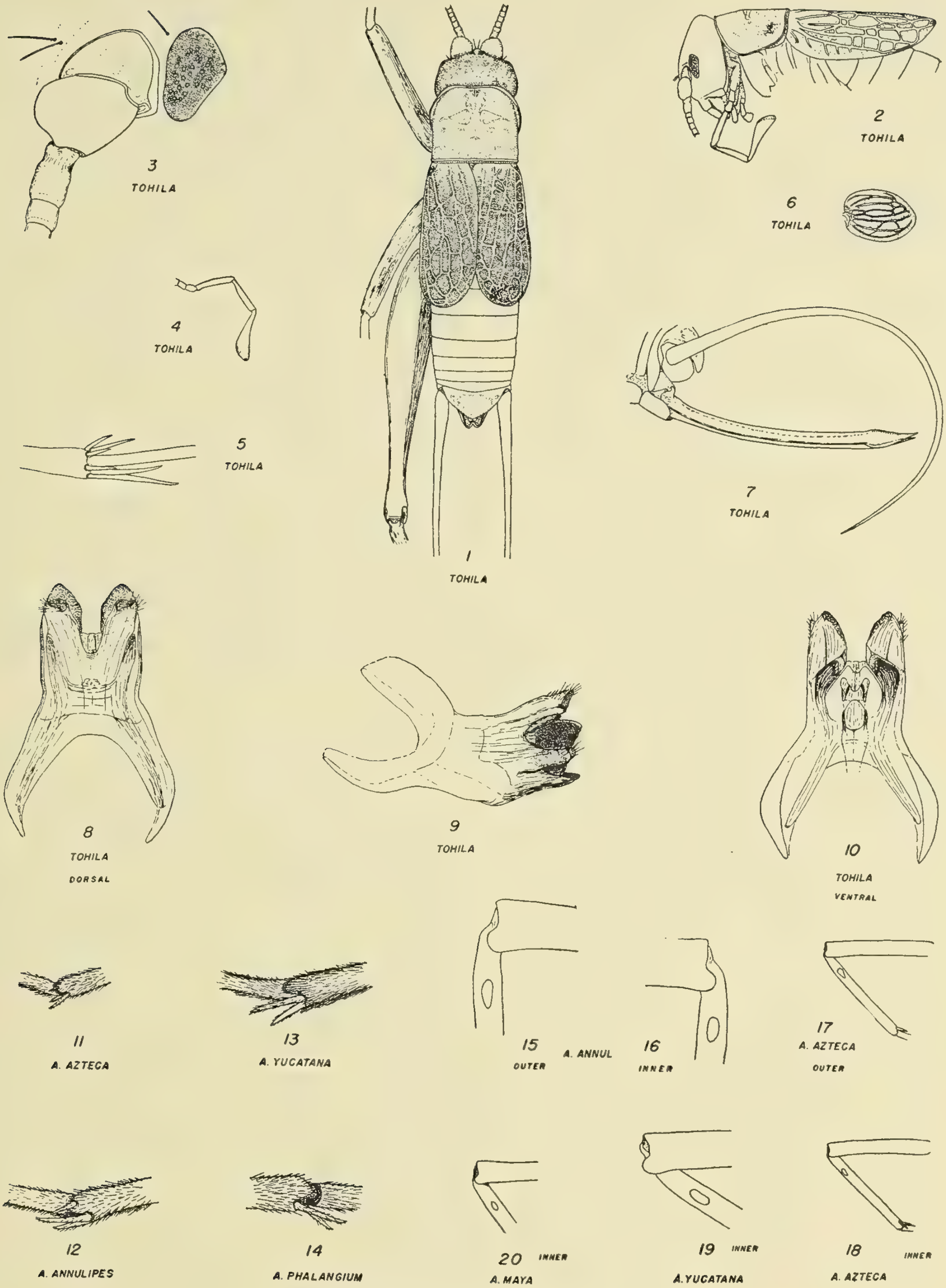
[2] Figures in parentheses refer to the adult male paratype from Balaam Canche Cave.

[3] In most of the nymphs the eyes are even less pigmented, often merely brownish-tinged, and in one first instar entirely white; imperfect ommatidia can be detected only in certain of the nymphal eyes, and in those of the other adults are fewer than in the holotype.

Figs. 1-20—*TOHILA* AND *AMPHIACUSTA*

1: *Tohila atelomma* n. g., n. sp., holotypic ♂, dorsal view, × 10.
2: Same, side view, × 10.
3. Same, detail showing eye and base of antenna, × 40.
4: Same, maxillary palpus, × 10.
5: Same, apex of caudal tibia showing calcars, ventral view, × 20.
6: *Tohila atelomma* n. g., n. sp., allotypic ♀, left tegmen, × 10.
7: Same, ovipositor and cercus, × 10.
8: *Tohila atelomma* n. g., n. sp., paratypic ♂, Balaam Canche Cave, concealed genitalia, dorsal view, × 40.
9: Same, oblique lateral view.
10: Same, ventral view.
11: *Amphiacusta azteca* Sauss., ♀, Jalapa, Vera Cruz, Mexico, inner face of apex of left middle tibia, showing 3 spurs, × 8.
12: *Amphiacusta annulipes* (Serv.), ♂, Clarencetown, Hamilton, Long I., Bahamas, same structures as Fig. 11, × 8.
13: *Amphiacusta yucatana* n. sp., holotypic ♂, inner face of apex of left middle tibia, showing 2 spurs, × 8.
14: *Amphiacusta phalangium* Sauss., ♀, Madden Dam, Canal Zone, Panama, inner face of right middle tibia, showing 2 spurs, × 8.
15: *Amphiacusta annulipes* (Serv.), ♂, same specimen as Fig. 12, outer face of base of left cephalic tibia, showing auditory foramen, × 8.
16: Same, inner face of base of left cephalic tibia.
17: *Amphiacusta azteca* Sauss., ♀, same specimen as Fig. 11, outer face of base of left cephalic tibia, showing auditory foramen, × 4.
18: Same, inner face of base of right cephalic tibia.
19: *Amphiacusta yucatana* n. sp., holotypic ♂, inner face of base of right cephalic tibia, showing auditory foramen, × 8; outer face without foramen.
20: *Amphiacusta maya* n. sp., holotypic ♂, inner face of base of right cephalic tibia, showing auditory foramen, × 4; outer face without foramen.



Figs. 1-20—*TOHILA* AND *AMPHIACUSTA*

(*For description see opposite page.*)

long; proximal antennal segment broad, depressed, those of the two sides almost touching, remainder of antenna moderately stout, gently tapering, probably about three times as long as body, but broken in all specimens; maxillary palpi (Fig. 4) moderately elongate, largely pale,[4] third and fourth segments subequal, three-fourths as long as fifth (terminal) segment, the latter moderately expanding distad, its greatest breadth about one-fourth its dorsal length, dorsal margin gently concave, apex obliquely truncate, truncation about one-half length of straight ventral margin, distal half slightly infumate.

Pronotum (Figs. 1, 2).—Disk subquadrate, slightly narrowed cephalad, caudal breadth 1.17 (1.14) times dorsal length, cephalic margin gently arcuate-emarginate mesad, caudal margin straight, surface of disk moderately depressed, with fine pale median hair-line along which are shallow impressions, a minute T-shaped one just within cephalic margination, a larger transverse impression at cephalic fourth, a broad, shallow impression just behind middle (this with shallow, linear anterior and oval posterior pits at its lateral edges), and a last diamond-shaped impression just within caudal margin; surface somewhat tumid between two middle impressions;[5] lateral lobes shallow, in caudal half compressed, subvertical, in cephalic portion flaring outward and rounding more broadly into disk, ventral margin subhorizontal, just perceptibly rising caudad, ventrocephalic angle somewhat more prominent than ventrocaudal, both strongly rounded; marginate cephalic border with numerous small pale setae, and with fewer large, blackish bristles imperfectly aligned in two or three rows, those of caudal row largest; caudolateral borders with a few medium-sized setae.

Tegmina and wings.—Tegmina (Figs. 1, 2) corneous, polished, with few, scattered pale setae; abbreviate, covering about half of abdomen, 1.8 (1.6) times pronotal length, when flattened out about two-thirds as broad as long; lateral margins broadly arcuate, apices strongly rounded, inner margins gently convex, slightly overlapping; dorsal field only moderately depressed, transversely convex, and rounding with but gentle angulation into lateral field; latter with two distinct longitudinal veins (mediastine and humeral), and a short, arcuate axillary spur at base, the mediastine and humeral veins joined by four cross-veins and with indications of additional obsolete ones proximad, the mediastine with short oblique spurs which disappear before reaching thin tegminal margin; dorsal field with longitudinal venation, anal (stridulatory) vein not deviated toward anal margin, and mirror indistinguishable among the ovate or elongate cells of the tegminal apex; venation moderately distinct, veins broadened, slightly raised and paler than rest of surface, venation of the two tegmina unlike in detail (individually variable in series). Wings micropterous, apparently absent, represented by extremely minute, arcuate rudiments applied to caudal margin of metanotum, easily detached.

Legs (Figs. 1, 5).—Slender, relatively elongate, closely setose. Cephalic femur stouter than middle femur, gently tapering distad, 1.75 (1.67) times pronotal length, middle femur similar, 1.83 (1.81) times pronotal length, each with about

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[4] Coloration variable; see below.

[5] These foveolar impressions are variably conspicuous in the series.

15 strong bristles; cephalic and middle tibiae slender, cylindrical, unarmed except for pair of distoventral spurs of which the inner is somewhat longer than the outer, especially on cephalic tibia; cephalic and middle tarsi very elongate, metatarsi slender, cylindrical, unarmed except for distal spurs, covered with short, stiff setae, about as long as the two distal segments united. Caudal femur slightly swollen proximad, tapering evenly to apex, about four-fifths as long as body, 3.67 (3.7) times pronotal length, 2.1 (2.22) times length of cephalic femur, 4.0 (4.2) times as long as broad; unarmed, with scattered blackish bristles, some of which form a dorsal row. Caudal tibia slender, cylindrical, .9 (.9) times femoral length, upper face without denticles, but with two subopposite pairs of slender, setose spurs in distal third, these approximately equidistant from each other and from tibial apex, inner spurs shorter than outer and proximal pair than distal, outer distal spur subequal to externomedian calcar;[6] calcars as described in generic diagnosis, externomedian .19 (.2), internodorsal .4 (.4), internomedian .3 (.3) times length of metatarsus; ventral calcars short, internal slightly the larger; caudal tarsus two-thirds as long as tibia, metatarsus cylindrical, covered with short, stiff setae but dorsally unarmed, very slender and elongate, 2.5 times as long as the two distal segments united, inner apical spur slightly longer than outer.

Abdominal structures.—Dorsum of abdomen unspecialized, surface sparsely setose beyond tegminal apices. Supra-anal plate (Fig. 1) large, submembranous, triangular, with straight margins and rounded apex, its surface shallowly impressed within the more heavily sclerotized margins, free edges declivent, setose. Cerci slender, gently tapering, extraordinarily elongate, 1.25 (1.2, estimated) times length of body, 1.5 times length of caudal femur, terminating in excessively fine, slenderly aciculate points. Subgenital plate (Fig. 1) compressed, narrowly scoop-shaped, its sides subvertical, ventral surface subplanate, apex narrowly truncate with an impressed groove indenting margin mesad, giving margin a doubly **U**-shaped outline and causing a median fold to project as a short ridge into genital chamber; surface of plate setose, with two isolated bristles on each side just below the straight dorsolateral margins. Concealed genital sclerites as shown in Figures 8 to 10.

DESCRIPTION OF ALLOTYPIC FEMALE[7]

Similar to the male in all respects except as noted below. Slightly larger, body length 7.0 (7.9) mm. Pronotum slightly broader, 1.21 (1.27) times as broad as long; tegmina (Fig. 6) very greatly reduced, being mere lateral pads .8 (.6) times pronotal length, with their inner margins separated by a distance of about one-half millimeter, their texture corneous, surface polished, and venation similar to that of male, but even more strongly reduced; cephalic femur 1.78 (1.67), caudal femur 3.57 (3.53) times as long as pronotum, breadth of caudal femur equal to pronotal length (in both specimens); caudal tibia .94 (.92) times length of femur; caudal tarsus .6 (.63) times as long as caudal tibia; cerci (Fig. 7) 1.25 times length of body, 1.76 times as long as caudal femur; subgenital plate scoop-shaped, as broad proximad as long,

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[6] Number and size of spurs variable in series; see below.

[7] Figures in parentheses refer to the adult paratypic female from Xtolóc Cenote Cave.

its sides weakly convergent to broadly rounded distolateral angles, distal margin shallowly V-emarginate; ovipositor (Fig. 7) moderately stout, nearly straight with just appreciable upward curvature, 2.9 (2.8) times pronotal length, .82 (.79) times as long as caudal femur, apex compressed, short, narrowly lanceolate.

TABLE 1

Measurements of Adult Specimens of Tohila atelomma
(in millimeters)

Specimens	Length				Breadth	Length		
	Pronotum	Tegmen	Cephalic Femur	Caudal Femur	Caudal Femur	Caudal Tibia	Cercus	Ovipositor
Males:								
Holotype*.....	1.2	2.2	2.1	4.4	1.1	3.95	6.6	....
Paratype......	1.35	2.2	2.25	5.0	1.2	4.5	6.8	....
Females:								
Allotype*.....	1.4	1.1	2.5	5.0	1.4	4.7	8.8	4.1
Paratype......	1.5	0.9	2.5	5.3	1.5	4.9	....	4.2

*Additional measurements of the holotype and allotype are as follows, those of the male being given first: breadth of head 1.3, 1.5; length fifth segment of maxillary palpus 0.8, 0.9; interocular distance 0.8, 0.9; caudal breadth of pronotum 1.4, 1.7; breadth of tegmen, approximately 1.3, 0.7; length of middle femur 2.2, 2.7; length of caudal tarsus 2.6, 2.8; length of caudal metatarsus 1.8, 2.1.

COLORATION

Three of the four adults (holotype, allotype and male paratype) are of rather uniformly pale coloration, with head and pronotum a clear yellow tinged with orange or brown and showing a very faint darker pattern, tegmina darker and distinctly brownish, the veins alone pale, legs and abdominal dorsum yellowish, and venter creamy white. The remaining female has the head, pronotum and tegmina only slightly darker than in the other specimens, but the abdomen is reddish brown, the palpal segments are in part infuscate, and the legs are somewhat darker. In greater detail the coloration of these specimens is as follows: [8]

Pale phase.—Head and pronotum dilute yellow ocher, dilute ochraceous tawny, or dilute buckthorn brown, except labrum, distal half of clypeus, small areas on ventrocephalic lobes of pronotum, epicranial suture and median hair-line of pronotum, pale; head with very weak, inconspicuous brownish shadings as follows: triangular patch on mesal part of front above clypeus, narrow bands along sides of antennal fossae on front, surface of fastigium, pair of short admesal bars on vertex, and pair of bars running from upper edge of each eye to caudal margin of head, dilute brown; eyes reddish- or purplish-brown; proximal antennal segments of general head color, segments 2 to 12 of head color, or faintly infumate, remainder of antenna uniformly pale; labial and maxillary palpi of general head color, or labial palpi with entire second segment and sides of third segment, maxillary palpi with entire second and third segments and distal halves of fourth and fifth segments, more or less infumate with dark brown; pronotum with faint brownish admesal shadings which include a pair of larger transverse markings anterior to middle and

[8] Specific color names used are those of Ridgway, 1912.

a pair of small oval foveolar spots just caudad of middle, the latter separated by about the breadth of the proximal antennal segment; tegmina somewhat darker than pronotum, clear buckthorn or antique brown, immediate base and veins yellowish; legs honey yellow to chamois; abdominal dorsum and cerci light buff or cream color; venter, coxae and membranous areas creamy white.

Dark phase.—As last, except abdomen approximately cinnamon brown both above and below, palpal segments conspicuously darkened on portions indicated above, legs antimony yellow to mustard yellow, cerci cream buff. The dark female and the male paratype are preserved in alcohol; the other two specimens have been mounted after treatment with xylol, and are hence slightly paler than in life.

LIFE HISTORY

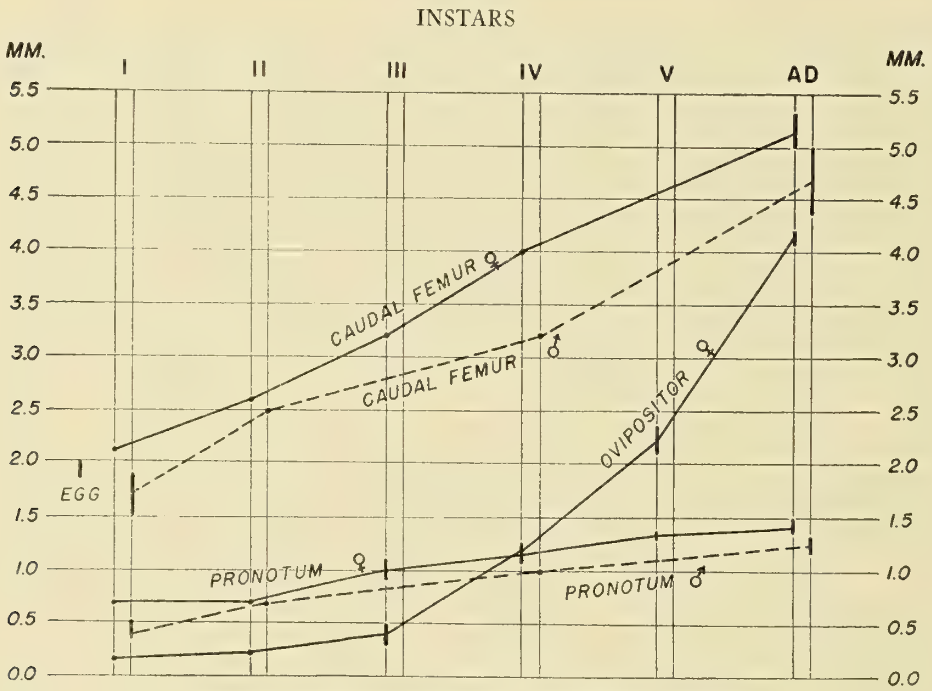
The seventeen nymphs included in the type series fortunately represent all pre-adult instars, as demonstrated by Graph I, which gives growth curves of pronotum, caudal femur and ovipositor, and as shown by study of the developmental stages of the genitalia and of the tegmina and wings (see Fig. 77). The only stadium which might be supposed absent from the series is that which immediately follows emergence from the egg membranes; what is here called Instar I is believed to represent this stadium, since its measurements correspond with the size of the egg, and since a total of six instars, the number here found, is apparently normal in related Gryllids. Thus the rather unusual opportunity is afforded of describing all stages in the life history at the time of characterization of the genus and species.

The average growth increment from one instar to the next is approximately constant for pronotal length, length of cephalic femur, and length of caudal femur. Even the earliest instars are quite like the adult in general appearance, except for the relatively larger head, rudimentary genitalia, absence of tegmina and wings, and paler coloration. While there is considerable variation in the number and size of the caudal tibial spurs (some of the first instar nymphs having the full adult complement), there is, in general, an increase in spur length (and average spur number?) with successive moults. From a nearly glabrous, colorless initial condition the nymphs gradually acquire the setose vestiture and coloration of the adult, but the rate of development of coloration is variable, some of the nymphs remaining pale until late stadia. Initial tegmen and wing rudiments, in the form of differentiated meso- and metanotal side margins, are detectable in the second instar (Fig. 77 B and D); in the third instar these rudiments, while still deflexed, show distinct apical projections (Fig. 77 E); in the fourth instar (Fig. 77 C and F) they are reflexed, but small and relatively narrow; in the fifth instar the tegmen increases greatly in length and breadth, an increase shared to only a minor degree by the alar rudiment; in the sixth (adult) instar the tegmen becomes fully developed, while the wing remains as in the preceding stage. Observations made on two female nymphs, both third instars by measurements and ovipositor characters, indicate that there is some variation in rate of alar development. In one of these nymphs the tegmen and wing rudiments are like those of normal second instar nymphs

(Fig. 77 D); in the other they are much larger, though still deflexed, and the apices are distinct (Fig. 77 E). The degree of brachyptery shown by the adult is probably determined by such variations in rate of development of the alar organs.

The egg.—Nearly mature eggs were observed within the body of the female allotype while it was in a translucent state through treatment with xylol. They are, as far as could be determined, elongate cylindrical, slightly curved, with hemispherical ends, the inner end apparently minutely roughened. The largest were about 2 mm. long by .45 mm. broad.

Instar I.—Represented by 5 males, 1 female. Dimensions in millimeters: body length, ♂♂ 2.5, 2.4, 2.7, 2.9, 3.0, ♀ 3.5; length of pronotum, ♂♂ .35, .38, .5, .4, .38, ♀ .7; length of cephalic femur, ♂♂ .7, .94, .93, .8, .78, ♀ 1.2; length of caudal femur, ♂♂ 1.4, 1.8, 1.8, 1.7, 1.6, ♀ 2.1; for second specimen in above series of ♂♂, length of cercus 2.23, vertical diameter of head, including mouthparts .95, length of distal segment of maxillary palpus .35, apical breadth of same .15. All specimens colorless, except that the abdomen may appear dark, due to the abdominal contents showing through its translucent wall. One of males with colorless eyes, the other specimens with central area of eye dilute reddish-brown, no trace of ommatidia visible. Rostrum relatively broad, nearly as broad as proximal segment of antenna, and with large, faintly indicated oval area in position of median ocellus. Maxillary palpi (Fig. 77 A) rather short, fourth segment slightly shorter than third, fifth longer than third, but much shorter, broader and more triangular than in adult (turned so as to show narrow edge in figure). Alar rudiments not differentiated; ovipositor rudiments as shown in Figure 77 G.



Graph I—*TOHILA ATELOMMA*, GROWTH CURVES

Instar II.—Represented by 2 males, 2 females. Dimensions in millimeters: length of body, ♂♂ 3.5, ——, ♀♀ 3.7, 3.8; length of pronotum, ♂♂ .7, .65, ♀♀ .7, .72; length of cephalic femur, ♂♂ 1.2, 1.15, ♀♀ 1.22, 1.3; length of caudal femur, ♂♂ 2.5, 2.3, ♀♀ 2.6, 2.62. Similar to last, except head relatively smaller and rostrum narrower. Eyes with faint brownish pigmentation. Tegmen and wing rudiments (Fig. 77 B and D) just perceptible as membranous borders of mesonotum and metanotum. Ovipositor rudiments shown in Figure 77 H.

Instar III.—Represented by 2 females. Dimensions in millimeters: length of body, ♀♀ 4.1, 5.0; length of pronotum, ♀♀ .95, 1.1; length of cephalic femur, ♀♀ 1.6, 1.7; length of caudal femur, ♀♀ 3.2, 3.4; for the first of the two specimens, vertical diameter of head, including mouthparts 1.49, length of distal segment of maxillary palpus .57. One of specimens pale, with antennal segments 2-12, the 2 distal segments of labial palpi, and segments 2 and 3 of maxillary palpi infumate, the abdomen and cerci brownish; the other specimen entirely pale except for faint traces of the adult head markings. Eyes faintly brownish in both. Alar rudiments in one individual like those of Instar II, in the other larger, with distinct free apices (Fig. 77 E); ovipositor as shown in Figure 77 J and K.

Instar IV.—Represented by 2 males, 1 female. Dimensions in millimeters: length of body, ♂♂ 4.8, 4.1, ♀ 5.5; length of pronotum, ♂♂ 1.0, 1.0, ♀ 1.17; length of cephalic femur, ♂♂ 1.75, 1.7, ♀ 2.0; length of caudal femur ♂♂ 3.2, ——, ♀ 4.0; for the ♀ nymph, vertical diameter of head, including mouthparts, 1.75, length of distal segment of maxillary palpus .73. All 3 specimens pale, but head, pronotum and palpi showing traces of adult coloration. Eyes faint reddish-brown to darker brown, those of the males with 4 to 7 weakly indicated paler ommatidia. Alar rudiments (Fig. 77 C and F) reflexed, small and relatively narrow; ovipositor as shown in Figure 77 L, 1.1 mm. long.

Instar V.—Represented by 2 females. Dimensions in millimeters: length of body, ♀♀ 5.4, 5.6; length of pronotum, ♀♀ 1.3, 1.4; length of cephalic femur, ♀♀ ——, 2.4; length of ovipositor, ♀♀ 2.1, 2.35; caudal femora lacking in both specimens. Coloration slightly paler than that of adult, but otherwise similar. Eyes reddish-brown. Tegminal rudiments considerably larger than in Instar IV, alar rudiments but little different.

Instar VI (adult).—Represented by 2 males, 2 females, described above.

Variation.—This has for the most part been treated in the foregoing descriptions. Degree of eye reduction is quite constant in all instars. The pigmentation of the eye apparently increases with age, but varies somewhat in each instar. A small but variable number of pale ommatidial spots can be distinguished in some late stage nymphs and adults, but none are observable in most specimens. The number of dorsal spurs present on the caudal tibiae varies as shown in the following table, in which each leg is separately counted, and number of spurs present on outer margin precedes the number present on inner margin.

General remarks.—The strongly degenerate eyes of *Tohila atelomma* indicate that the species, if not exclusively a cave-dweller, is at least entirely hypogeic in its habits. The species was taken in Balaam Canche Cave as far as 260 m. from the mouth, in complete darkness, and most of the specimens were found well within the caves, generally under stones on the ground. It is highly probable that *Tohila* (evidently an offshoot from the tropical American genus *Trigonidomimus*) is restricted to the limestone-cave region of Yucatan, and largely or completely confined to the cave environment. It belongs to what is probably an ancient subfamily which shows a quite discontinuous world-wide distribution in the tropics. *Tohila* is the first described member of the Pentacentrinae which shows adaptations to hypogeic existence.

Specimens examined.—21:2♂, 2♀ and 17 nymphs, all included in the type series. Holotype, allotype and part of paratypes in Museum of Zoology, University of Michigan; remainder of paratypes in Mexican National Museum. Holotype and allotype pinned, remaining specimens in alcohol. All collected in Yucatan during the summer of 1936 by Dr. A. S. Pearse, in caves, as follows:

TABLE 2

Number of Spurs Present on Outer and Inner Carinae of Individual Caudal Tibiae

Instar	0–0	2–0	2–1	2–2	3–1	3–2
I..........	1	2	4	3	....	....
II..........	....	....	4	2	....	....
III..........	....	....	....	2	....	....
IV..........	....	....	....	2	....	1
V..........	....	....	....	2	....	....
VI (Ad)....	....	....	....	3	2	....

Balaam Canche Cave, Chichen Itza: June 8, 2 ♂♂ I, 1 ♂ IV, 1 adult ♂ (Cat. No. 2—"under stones, 18 m. down and 61 m. within cave"); 1 ♀ I, 1 ♀ III (Cat. No. 7 "under stones, 21 m. down and 100 m. within cave"); June 12, 1 ♂ I, 1 ♀ III, 1 ♀ IV (Cat. No. 15—"temple pool, 260 m. from mouth"); June 13, 1 ♂ I, 1 ♂ IV (Cat. No. 17—"under stones, 6 m. down and 7.6 m. from mouth").

Xtoloc Cenote Cave, Chichen Itza: June 24, 1 ♂ II, 1 ♀ V, 2 adult ♀♀, one the allotype (Cat. No. 52—"on ground, along walls of a cave 92 m. long, mostly under stones; some of crickets found at inner end").

Chac Mol Cave, Tohil: June 27, 1 ♂ II, 1 adult ♂, the holotype, 1 ♀ II (Cat. No. 61—"under stones at top, within entrance").

Oxolodt Cave, Kaua: June 18, 1 ♂ I (Cat. No. 34—"in the deep cave").

Luchil Cave, Tixcacal: July 6, 1 ♀ II (Cat. No. 80/81—"on floor; below mouth of cave").

San Isidro Cave, Merida: July 3, 1 ♀ V (Cat. No. 69—"walls and roof").

A REVIEW OF THE SUBFAMILY PENTACENTRINAE

The subfamily Pentacentrinae, as delimited by Hebard (1928*a*) and Chopard (1933*a*), includes small crickets in various degrees transitional between the Phalangopsinae, Nemobiinae and Eneopterinae. Almost the only character which its members possess in common is the deep head, with antennae inserted below the middle, instead of above the middle as in most Gryllids. The subfamily, as now understood, comprises 11 genera and 30 species.[9] Its members are distributed throughout the tropical and subtropical regions of the world, with the apparent

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[9] These figures include an undescribed genus and species known from Costa Rica, mentioned by Hebard (1928*a*, p. 244).

exception of the Australian and Pacific realms. The genera have been somewhat briefly discussed by Hebard (1928*a*, pp. 244-245) and by Chopard (1933*a*, pp. 247-249), and the latter author gives a key for their separation. More recently Hebard has synonymized his 1928*a* genus *Quarequa* with *Trigonidomimus* Caudell; and Chopard has erected the new genus *Apentacentrus* (1934, p. 57) to include the species which he earlier placed in *Pentacentrodes* Bolivar, which proved synonymous with *Pentacentrus*. Chopard has also found (1933*b*, p. 170) that the Australian genus *Salmania* F. Walker 1869 is not a Pentacentrine, as it was placed by Kirby in 1906, but instead a member of the Eneopterinae.

Four of the ten described genera and three-fifths of the known species have been described since 1925, one-third of the species since 1930. Even though many additional species and genera of these obscure insects will probably be discovered in the next few years, it appears desirable to bring together a summary of our present knowledge of the group. The following tabulation of certain characters of the Pentacentrine genera is drawn largely from the scattered literature, and is hence incomplete, and doubtless includes some errors. Nevertheless it will direct attention to gaps in available information, and will show the position of the new genus *Tohila* in relation to those previously established.

Tohila is essentially only a degenerate *Trigonidomimus*, differing from that genus in the imperfectly developed eyes, absence of ocelli and tibial foramina, corneous tegmina with reduced venation which in the male shows no tympanal modification, vestigial wings, and smaller number of caudal tibial spurs. In all other respects the agreement between the two is close; but because of the tegminal reduction the general appearance of *Tohila* is more like that of the Indo-Malayan *Lissotrachelus*, to which it is apparently more distantly related. *Tohila* differs from *Lissotrachelus* in the extremely narrow rostrum, relatively elongate maxillary palpi, truncate caudal margin of pronotum (which is also less narrowed cephalad), slender and relatively elongate legs, presence of 6 instead of 5 apical calcars on caudal tibiae, and moderately elongate instead of short ovipositor. Furthermore, the male tegmina in *Lissotrachelus*[10] show definite tympanal modification, the stridulatory vein being deflected to the inner margin of the tegmen, and an imperfectly formed mirror being recognizable. While the resemblance between *Tohila* and *Lissotrachelus* is striking, I attribute it to convergence between two related genera, for morphologic and zoögeographic evidence clearly points to an immediate common origin with *Trigonidomimus*. These three genera form within the subfamily a group which may be called the Lissotracheli.

Since three-fourths of the known Pentacentrinae have been described since the appearance of Kirby's Catalogue in 1906, it appears worth while to present a list of the genera and species of this subfamily, grouping the genera according to their characters as shown in Table 3.

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[10] The male of only one of the 3 species of *Lissotrachelus* is known, that of *L. ater* Brunner. Through inadvertence this was described under the name "*L. niger* Br." by Chopard (1925, pp. 303-304, fig. 25).

TABLE 3

Distribution of Certain Characters Among the Pentacentrine Genera

Genera	I	II	III	IV	V	VI	VII	VIII	IX	X
	Form of Body	Form of Head	Form of Pronotum	Vestiture	Caudal Metatarsus	Calcars Caudal Tibia	Form of Tegmina	Tegminal Venation	Wings	Eyes
Homalogryllus	E–d	D–b	D–a	S	D–m	5	N	S	M	L
Parapentacentrus	E–d	D–b	D–s	S	D–m	6	N	S	C	L
Apentacentrus	E–c	R–b, n	C–a, s	P	D–e	6	N	S	C	L
Pentacentrus	E–c (d)	R–b, n	C(D)–s,a	S–(P)	D–e	5	N	D	C–S	L
Orthoxiphus	E–c	R–b	C–s	P	U–e	?	N	D	C–S	L
Trigonidomimus	B	F–vn	D–t	S	U–e	6	B	C	C–A	L
Tohila	B	F–vn	D–t	S	U–e	6	C	S	A	S
Lissotrachelus	B	F–vn	D–s	S	U–e	5	C	D	C–A	L
Aphemogryllus	B	F–b	D–s	S	D–e	6	B	D	C	L
Nemobiopsis	B	?	D–s	S	D–d	5	B	S	C	L
Costa Rican genus	B?	?	D–s?	S?	D–e	5	B?	?	?	L?

Genera	XI	XII	XIII	XIV	XV		XVI	XVII	XVIII	XIX
	Ocelli	Maxillary Palpi	Foramina of Cephalic Tibiae	Denticles of Caudal Tibia	Spurs of Caudal Tibiae		Length of Caudal Tibia	Length of Cephalic Femur	Length of Cerci	Ovipositor Apex
					Outer	Inner				
Homalogryllus	P–b	S	1a	B	2–3	2–3	S	S	S	...
Parapentacentrus	P–a	S	2	B	3+	3+	SM	S?	M?	A
Apentacentrus	P–a	S–M	2	A (–C?)	4–5	3–4	M	S	M–L?	...
Pentacentrus	P–a, b	S	1a–2	B–C	3–5	3–5	M	S	M–L	A–D
Orthoxiphus	P?	S	2	C?	3	3	M?	S?	L?	A
Trigonidomimus	O	L	1a	B–C	2–3	3	M	L	L–VL	A
Tohila	O	L	0	C	2 (0–3)	2 (0–2)	M	L	VL	A
Lissotrachelus	O	S	0	C	3	3	M	S?	L	A?
Aphemogryllus	P–a	S	1p–2	C?	4–5	4–5	M	S?	L	N
Nemobiopsis	P–a	S	2	A	3	2	M	S?	S?	A
Costa Rican genus	?	?	?	?	?	?	M?	S?	?	A

Explanation of Table

I. *Form of body:* E—elongate, (d) slightly depressed, (c) very elongate, subcylindrical, very slender; B—broader, pronotum and dorsal field of tegmina more or less flattened, general facies Trigonidiine or Nemobiine.

II. *Form of head:* D—head depressed, vertex flattened; R—head rounded, vertex more or less convex; F—head short, vertex very high and anteriorly more or less flattened; (b) rostrum as broad as or broader than proximal antennal segment, (n) rostrum slightly narrower than proximal antennal segment, (vn) rostrum very narrow, at apex not more than one-third as broad as proximal antennal segment.

III. *Form of pronotum:* D—disk more or less distinctly flattened; C—disk more or less distinctly convex; (a) caudal margin broadly angulate, (s) caudal margin distinctly bisinuate, mesally convex, (t) caudal margin straight-truncate.

IV. *Vestiture of head, pronotum and tegmina:* S—subglabrous to more or less setose; P—finely pubescent.

V. *Caudal metatarsus:* D—compressed, one or both dorsal margins denticulate; U—cylindrical, dorsal margins unarmed; (m) moderately elongate, (e) elongate to very elongate, (d) shorter, strongly compressed and dilated in male.

VI. *Calcars of caudal tibiae:* Number present.

VII. *Form of tegmina:* N—long and narrow, convex, thin and of normal texture, veins distinct; B—shorter and broader, dorsal fields more or less depressed, thin and of normal texture, veins distinct; C—short, relatively thick and corneous, veins broadened and forming elevated ridges.

VIII. *Tegminal venation:* S—similar in male and female, veins of dorsal field longitudinal, anal (stridulatory) vein undeviated and mirror not developed in male; D—venation of male slightly differentiated from that of female, stridulatory vein slightly to moderately deviated toward anal margin, mirror not or scarcely discernible; C—venation relatively complete, that of male forming a well-developed tympanum with arcuate, strongly deviated functional stridulatory vein, and complete mirror with 0 to 2 cross-veins.

IX. *Wings:* C—fully developed, caudate; M—well-developed, but only slightly surpassing tegmina; S—abbreviate; A—"apterous" (micropterous), represented by minute rudiments.

X. *Eyes:* L—normally developed, moderately to distinctly large, slightly to distinctly prominent; S—small, with reduced pigmentation and subobsolete ommatidia.

XI. *Ocelli:* P—present, (a) very large to moderate, median sometimes smaller than laterals, (b) small, median scarcely visible; O—obsolete, position sometimes indicated by pale spots.

XII. *Maxillary palpi:* S—short, terminal segment short, broadly triangular; M—of moderate length, distal segment intermediate in form; L—elongate, distal segment moderately expanding distad, two or more times as long as broad, apex obliquely truncate.

XIII. *Auditory foramina of cephalic tibiae:* 1—single one present, (a) on anterior, (p) on posterior face; 2—present on both faces; 0—absent.

[*continued on opposite page*]

Group HOMALOGRYLLI

(showing Eneopterine tendencies)

HOMALOGRYLLUS Chopard 1925*b*, pp. 523-525 (genotype *H. depressus*); Chopard 1933*a*, p. 248; Chopard 1936, pp. 63-64.
depressus Chopard 1925*b*, pp. 523-525, figs. 19-21 (Ceylon); Chopard 1936, p. 64.
PARAPENTACENTRUS Shiraki 1930, pp. 222-224 (genotype *P. formosanus*); Chopard 1933*a*, p. 248.
formosanus Shiraki 1930, pp. 224-225, fig. 15 (Formosa).

Group PENTACENTRI

APENTACENTRUS Chopard 1934, p. 57 (genotype *Pentacentrodes fulvus*).
(=Pentacentrodes Chopard 1926, p. 11; 1933*a*, p. 248; not of Bolivar 1910.)
aurantiacus Chopard 1935, pp. 27-28 (Mozambique).
fulvus (Chopard) 1926, p. 9, figs. 3-4 (*Pentacentrodes;* Belgian Congo); Chopard 1934, p. 58.
PENTACENTRUS Saussure 1878, pp. 536, 539-541 (genotype *P. pulchellus*); Kirby 1906, p. 62; Chopard 1926, p. 11; Hebard 1928*a*, pp. 244, 245; Chopard 1930, p. 20 (key to species of *punctulatus* group); Chopard 1933*a*, p. 249 (characters in key); Chopard 1934, p. 57 (*Pentacentrodes* a synonym); Chopard 1936, pp. 63, 64.
(=Pentacentrodes Bolivar 1910, p. 534; genotype *Pentacentrus tenellus.*)
acuminatus Chopard 1930, p. 19, pl. 3, figs. 25-27 (♂, ♀—Sarawak).
annulicornis Chopard 1929, p. 104, figs. (Mentawi I., West Sumatra); 1931*b*, p. 135 (Perak).
biroi Chopard 1927, pp. 161-162, fig. 19 (♂, ♀—New Guinea).
brunneus Chopard 1930, p. 21, pl. 4, fig. 34 (♂—Sarawak); 1931*b*, pp. 126, 134 (Rim, Malacca).
cupulifera Chopard 1930, pp. 18-19, pl. 3, figs. 23-24 (♂—Sarawak).
minutus Chopard 1927, pp. 160-161, fig. 18 (♂—New Guinea).
mjöbergi Chopard 1930, p. 18, pl. 3, figs. 19-20 (♂, ♀—Sarawak).
nigrifrons Bolivar 1912, p. 282 (Seychelles).
philippinensis Chopard 1925*a*, pp. 309-310, fig. 33 (♂—Philippine Is.).
pulchellus Saussure 1878, pp. 541-543, pl. 17 (L), figs. 1-5 (♀—Ceylon); Kirby 1906, p. 62; Chopard 1925*b*, p. 523, fig. 18; 1936, p. 64.
punctulatus Chopard 1925*a*, pp. 307-308, fig. 32 (♂—Sumatra); 1930, pp. 18-20, pl. 3, figs. 21, 22, 30 (characters in key); 1931*b*, pp. 126, 134 (Pahang, Malay Peninsula).
tenellus Karsch 1893, p. 157 (♀—Camerun and Togo, West Africa); Kirby 1906, p. 62; Bolivar 1910, p. 534 (genotype of *Pentacentrodes;* ♂—Spanish Guinea); Chopard 1926, p. 10 (*Pentacentrodes*); Chopard 1934, p. 57, fig. 20 (*Pentacentrus;* Belgian Congo).
unicolor Chopard 1925*c*, p. 150, figs. (Java); Chopard 1930, p. 21.
unifenestratus Caudell 1927, pp. 39-40 (♂—Java); Chopard 1931*b*, p. 134 (Selangor and Pahang, Malay Peninsula).
vicinus Chopard 1930, p. 20, pl. 3, figs. 28, 29, 31, 32 (♂, ♀—Sarawak).
ORTHOXIPHUS Saussure 1899, p. 613 (genotype *O. atriceps*); Kirby 1906, p. 83; Chopard 1933*a*, p. 249 (characters in key).
atriceps Saussure 1899, p. 613, pl. 37, fig. 9 (Nossi Bé, Madagascar).

XIV. *Denticulation of dorsal margins of caudal tibiae:* A—Denticles present on one or both margins both proximad of and between dorsal spurs; B—denticles present on one or both margins but only proximad of spurs; C—without denticles.

XV. *Number of spurs* present on outer and inner dorsal margins of caudal tibiae.

XVI. *Relative length of caudal tibia,* compared with caudal femur: S—Very short, only three-fifths as long as femur; M—of moderate length, generally more than four-fifths as long as femur.

XVII. *Length of cephalic femur,* compared with that of pronotum: S—short, rarely as much as 1.5 times length of pronotum; L—relatively long, more than 1.5 times length of pronotum.

XVIII. *Length of cerci:* S—shorter than caudal femur; M—subequal to length of caudal femur; L—distinctly longer than caudal femur; VL—excessively elongate, considerably longer than rest of body.

XIX. *Apical specialization of ovipositor:* A—apex of Phalangopsine aspect, acute-lanceolate, valves simple, not toothed or notched; D—apical valves toothed or notched; N—apex acuminate, but "of Nemobiine rather than Phalangopsine aspect."

Group LISSOTRACHELI

(Facies of Nemobiinae or Trigonidiinae)

Trigonidomimus Caudell 1912, p. 187 (genotype *T. belfragei*); Hebard 1928, p. 244 (referred to Pentacentrinae); Hebard 1932, p. 356 (*Quarequa* a synonym); Chopard 1933*a*, p. 249 (characters in key).

(=*Querequa* Hebard 1928*a*, pp. 244-245, genotype *Q. annuliger*); Chopard 1933*a*, p. 247-249 (characters in key.)

annuliger (Hebard) 1928*a*, pp. 245-247, pl. 25, figs. 1, 2 (*Quarequa;* ♂, ♀—Panama, Nicaragua); Hebard 1932, p. 356 (*Trigonidomimus*); Chopard 1933*a*, p. 247 (*Quarequa*).

belfragei Caudell 1912, p. 188 (♀—[Bosque Co.], Texas); Hebard 1928*a*, p. 244 (referred to Pentacentrinae); Hebard 1932, p. 356 (Vera Cruz, Mexico). See also Hebard's forthcoming paper on the Tettigoniidae and Gryllidae of Texas.

zernyi (Chopard) 1933*a*, pp. 246-247, figs. 1, 9 (*Quarequa;* ♂—Amazonas, Brazil).

Tohila, new genus (genotype *T. atelomma*).

atelomma, new species (caves of Yucatan).

Lissotrachelus Brunner 1893, pp. 204-205; (genotype, selected by Kirby 1906, p. 61, *L. ferrugineo-notatus*); Chopard 1933*a*, pp. 247-249 (referred to Pentacentrinae; characters in key).

ater Brunner 1893, p. 206 (♀—Borneo); Kirby 1906, p. 61; Chopard 1925*a*, pp. 303-304, fig. 25 (♂—Tonkin; as "*L. niger* Br.", nomen nudum); Chopard 1931*a*, p. 10 (♀—Sumatra, Indo-China, Philippines); Chopard 1931*b*, pp. 127, 135 (Perak; peninsular Siam).

castaneus Brunner 1893, p. 205 (♀—Rangoon, Burma); Kirby 1906, p. 61.

ferrugineo-notatus Brunner 1893, p. 205, pl. 6, fig. 74 (♀—Burma); Kirby 1906, p. 61 (as "*ferrugineovittatus* Br.", nomen nudum).

Group APHEMOGRYLLI

Aphemogryllus Rehn 1918, pp. 209-210 (genotype *A. gracilis*); Hebard 1928*a*, p. 244 (referred to Pentacentrinae); Chopard 1933*a*, p. 249 (characters in key).

gracilis Rehn 1918, pp. 210-213, pl. 2, figs. 48-53 (♂, ♀—Para, Brazil; Rio Pacaya, Peru); Hebard 1928*a*, p. 244.

Group NEMOBIOPSES

Nemobiopsis Bolivar 1891, pp. 329-330 (genotype *N. gundlachi*); Kirby 1906, p. 63; Hebard 1928*a*, p. 249 (characters in key).

gundlachi Bolivar 1891, pp. 330-331, pl. 1, fig. 10 (♂, ♀—Cuba); Gundlach 1891, pp. 370-371; Kirby 1906, p. 63; Rehn 1909, p. 221; Bruner 1916, p. 385; Hebard 1928*a*, p. 244.

Position uncertain

Undescribed genus and species from Costa Rica—Hebard 1928*a*, p. 244.

REMARKS ON THE AMERICAN PHALANGOPSINAE

This subfamily, formerly treated as the section Phalangopsites of the subfamily Oecanthinae, has been raised to independent rank by recent workers. The American genera apparently fall into three groups, one of which, the Luzarae, has recently been revised by Hebard (1928*c*). Although the other two are equally in need of revision, we may, on the basis of available information, assign the described American genera as follows:

Group LUZARAE

Includes the following genera, the sequence being that of Hebard's revision: *Lernecella* Hebard 1928*c*, *Miogryllodes* Hebard 1928*c*, *Lerneca* Walker 1869

(=*Diplacusta* Saussure 1874), *Prosthacusta* Saussure 1874, *Cophella* Hebard 1928*c*, *Paracophella* Hebard 1928*c*, *Gryllosoma* Hebard 1928*c*, *Tairona* Hebard 1928*c*, *Niquirana* Hebard 1928*c*, *Amusina* Hebard 1928*c*, *Rehniella* Hebard 1928*c*, *Prosthama* Hebard 1928*c*, *Palpigera* Hebard 1928*c*, *Luzarida* Hebard 1928*c*, *Luzara* Walker 1869 (=*Amusus* Saussure 1878), *Amusodes* Hebard 1928*c*, *Megalamusus* Hebard 1928*c*, and *Anacusta* Hebard 1928*c*. Additional undescribed Central American genera are represented in the collections of the Museum of Zoology of the University of Michigan.

The members of this group, according to Hebard, are distinguished principally by the following characters: Body somewhat compressed; fastigium broad or moderately broad, declivent, curving into the face so that the projection thus formed is short and obtuse (except in some species of the aberrant *Amusodes* and *Megalamusus*, which show divergence toward the Heterogrylli); ocelli with distance between the laterals equal to or slightly greater than that between one of the laterals and the median (except in the two aberrant genera mentioned above); pronotum with ventrocephalic angle broadly rounded, ventral margin thence gradually ascending caudad to the more broadly rounded ventrocaudal angle; legs not very elongate and slender; caudal tibial calcars six, the three external very short with the median the longest, the dorso-internal very elongate but only surpassing the medio-internal by a short distance; caudal metatarsus armed on dorsal surface with two rows of teeth.

In addition to the above it may be noted that the membranous apex of the distal segment of the maxillary palpus is distinctly to strongly oblique in all these genera, forming in dried specimens an obliquely truncate apex. In this respect the members of the Luzarae resemble the Amphiacustae and differ from the Heterogrylli. Most of the species are small to moderate in size, and of relatively compact form. The less specialized have large tegmina with flattened dorsal fields showing well-developed venation, but in many the tegmina are reduced and often more or less corneous, polished, and with little or no external indication of veins. In an undescribed Panamanian genus they are thickened, slightly overlapping, rounded-triangular pads of nymphal aspect, suggesting those of *Phalangopsis*.

Group HETEROGRYLLI

Includes the genera *Acla* Hebard 1928*b*, *Eugryllina* Hebard 1928*b*, *Aclodes* Hebard 1928*b*, *Ectecous* Saussure 1878, and *Paragryllus* Guerin 1844. The sequence is that suggested by Mr. Hebard in a recent letter. These genera are almost certainly to be associated with *Heterogryllus* Saussure 1874, which gives the name to the group, and *Laranda* Walker 1869 may well be a member of the same assemblage. *Benoistia* Chopard 1920, somewhat doubtfully associated by its author with *Paragryllus*, seems rather aberrant for inclusion in the Heterogrylli because of its broad rostrum. Material representing an undescribed genus from Panama is in the collection of the Museum of Zoology of the University of Michigan.

Revision is required before the Heterogrylli can be satisfactorily defined, but the following characters appear to be significant. The membranous tip of the distal segment of the maxillary palpus is apical, and in dried material forms a square-cut or only slightly oblique truncation in nearly all instances. In some species of *Acla* and *Aclodes* it has a short ventral prolongation proximad, but even in these the truncation is short and almost wholly apical, not distinctly oblique as in most Luzarae and Amphiacustae. The body is slightly depressed to moderately compressed, the legs rather short to moderately elongate for the subfamily, not very slender and elongate as in many Amphiacustae. Head generally tall and subvertical, fastigium narrow to very narrow (except in *Benoistia*), projecting as a distinct rostrum; the lateral ocelli closer together than the distance from one of them to the median ocellus (except in *Benoistia*), sometimes very strongly approximated; auditory foramina (generally) present on both faces of cephalic tibiae, or absent from either inner or outer face, or from both faces; caudal tibial calcars generally six, sometimes reduced to five by loss of the internoventral; internodorsal calcar longer than or subequal to the internomedian; caudal metatarsus armed above with two rows of denticles, or the inner row represented only by the apical denticle, and the outer row shifted to a more or less median position. Male tegmina complete (*Paragryllus, Benoistia*), or more or less strongly reduced, but venation distinct and surface not smooth and polished; females often apterous; wings present only in *Paragryllus* and *Benoistia*.

Group AMPHIACUSTAE

The American genera apparently referable to this group are: *Amphiacusta* Saussure 1874, the American species assigned to "*Arachnomimus*" Saussure 1897, *Endecous* Saussure 1878, *Uvaroviella* Chopard 1923, *Hemicophus* Saussure 1878 and *Cophus* Saussure 1874, the last being distinctly aberrant for the group. *Phalangopsis* Serville 1831, though very highly specialized, may represent an offshoot of this stock. The position of *Dyscophogryllus* Rehn 1901 (=*Dyscophus* Saussure 1874, not of Grandidier 1872) has not been determined. The sequence given above is that suggested by Mr. Hebard in a recent letter, except that "*Arachnomimus*" is placed following *Amphiacusta* in accordance with evidence given below.

As in the instance of the Heterogrylli, revision is necessary before the Amphiacustae can be adequately defined. The group includes insects of moderate to large size, most of which have long to very long legs. In general build they are closer to the Heterogrylli than to the Luzarae, but the membranous apex of the distal segment of the maxillary palpus is obliquely to extremely obliquely set. The pronotum is deeper cephalad than caudad and the ventral margins of the lateral lobes rise caudad from the ventrocephalic angle, as in the Heterogrylli, except in *Cophus,* where the reverse is true. Other characters shown by members of the Amphiacustae are: Body slightly depressed to (usually) somewhat compressed. Vertex forming a distinct and usually narrow rostrum (except in *Dyscophogryllus,* if this genus be a member of the group); the lateral ocelli (minute or absent in

Cophus) forming with the median ocellus a triangle the base of which is subequal to or distinctly shorter than the sides, but the lateral ocelli not very closely approximated as in many Heterogrylli; median ocellus situated at or near apex of rostrum, generally visible from above. Auditory foramina present on both faces of cephalic tibiae (most species of *Amphiacusta, Dyscophogryllus,* and by variation *Hemicophus*), on the inner face only (some species of *Amphiacusta* normally and others by variation, *Endecous, Uvaroviella*), or absent from both faces of the tibia (occasionally by variation in *Amphiacusta,* normally in *"Arachnomimus", Cophus, Phalangopsis*); only in *Hemicophus* present on outer face and absent or greatly reduced on inner face. Externomedian calcar longer than externodorsal except in *Cophus* and some species of *Phalangopsis,*[11] internomedian calcar longer than internodorsal in *Amphiacusta, "Arachnomimus",* and *Hemicophus,* the two subequal or the dorsal sometimes longer and sometimes shorter in *Uvaroviella, Phalangopsis* [11] and *Dyscophogryllus,* the dorsal calcar longer than the median in *Endecous* and *Cophus.* Dorsal surface of caudal metatarsus with a variable number of denticles in two rows in all genera except *Endecous, Hemicophus* and some species of *Phalangopsis,* in which only the outer row (except for the distointernal denticle) is said to be present (but this probably variable).

The male tegmina are fully developed in *Hemicophus,* but show various degrees of reduction in the other genera. In *Amphiacusta* they vary from 1.5 to 4 times as long as the pronotum; in *Endecous, Uvaroviella* and *Dyscophogryllus* they are strongly abbreviate; in *Phalangopsis* they are reduced to triangular pads shorter than the pronotum, and almost without venation; in an undescribed genus from Panama represented by series in the Museum of Zoology of the University of Michigan they are mere lobiform pads scarcely projecting beyond the margin of the pronotum; and in the species assigned to *"Arachnomimus"* they are completely atrophied. The females show greater tegminal reduction; those of *Hemicophus* probably have fully developed tegmina and wings, but in *Uvaroviella* the tegmina are lobiform, and females of *Amphiacusta, "Arachnomimus", Cophus, Phalangopsis* and probably *Endecous* are apterous.

Studies made during the preparation of this paper clearly show the need for redefinition of the Amphiacustine genera. Saussure, in his several treatments of the group (1874, 1878, 1897) over-emphasized the importance of the disposition of the foramina of the cephalic tibiae. Loss of the foramen from one or the other or from both faces of the tibiae is evidently of frequent occurrence, both among closely related forms, and in distantly related stocks. This gives rise to parallelisms and to differences which are misleading unless other characters are taken into account. In *Amphiacusta phalangium* the foramina may be present (though small) on both faces of the tibiae, on the inner faces only, or entirely absent, as Saussure himself noted (1897, p. 249). Furthermore, the tegminal venation, upon the characteristics of which Saussure placed great reliance, often varies considerably, as inspection of Figures 30-42 of this paper will show. Inadequate series of many

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[11] In paratypes of *Phalangopsis maculata* Bruner the median is longer than the dorsal calcar on both external and internal faces of the tibia.

of the described species of Amphiacustae prevent determination of the extent of their variability, but knowledge of the variation in the number of oblique veins, number and disposition of the dividing veins of the mirror, curvature of the cordes and their connections with the diagonal vein and mirror, in such species as *A. maya* and *A. yucatana,* should prove a deterrant to undue reliance upon such features. Venational characters of this sort should not be used for the separation of species without indication of the amount of variation which they exhibit, even though, properly treated, they may be of value for identification and for determining relationships within the group.

Both of the new species of *Amphiacusta* described below would, by Saussure's criteria, fall in the genus *Endacusta* Brunner, since they possess auditory foramina only upon the inner faces of the cephalic tibiae. But *Endacusta* has been shown by Hebard (1928*b,* p. 91) to be an exclusively Australian genus only distantly related to *Amphiacusta,* to which both of the new species clearly belong.

Another instance of unnatural grouping caused by reliance upon a few key characters is found in the assignment of certain American species to the genus *Arachnomimus.*[12] This genus was erected for the reception of two Oriental species: *nietneri* (Saussure) 1878, from Ceylon, and *picticeps* (Walker) 1869, from Hindostan, India. The first was designated genotype by Kirby in 1906. *Arachnomimus* was principally characterized by the very long, attenuate legs, complete aptery, loss of auditory foramina from both faces of the cephalic tibiae, and greater length of median than of dorsal calcars upon both faces of the caudal tibiae. Six additional Oriental species have since been assigned to the genus: *annulicornis* Chopard 1936 [Ceylon]; *annulipes* (Bolivar) 1889 [Philippines]; *bicolor* Chopard 1928 [Ceylon]; *jacobsoni* Chopard 1924 [Java]; *microphthalmus* Chopard 1929 [Selangor, Malay Peninsula]; and *dubius* (Bolivar) 1900 [southern India]. The last was removed to become genotype of *Phalangopsina* Chopard in 1933.

Three American species have been placed in *Arachnomimus.* These are: *Phalangopsis annulata* Bilimek (1867, p. 904) [Cacahuamilpa Cave, 45 leagues from Mexico City]; *Arachnomimus cavicola* Saussure (1897, p. 251) [Cave of Lanquin in Vera Paz, Guatemala]; and *Arachnomimus bahamaënsis* Bruner (1916, p. 394) [Blue Hills, Nassau, Bahama Islands]. Examination of the type series of the latter in the Carnegie Museum at Pittsburgh shows that Bruner's species is based on nymphs of an *Amphiacusta,* in all probability *annulipes* (Serville), and evidently not *bahamensis* Morse. The other two species are believed to be valid. Recently Dr. Alfons Dampf has sent me specimens of an undescribed species collected in a Mexican cave, some of which are adult. Like *annulata* and *cavicola* this species is completely apterous in both sexes, and lacks auditory foramina. A second undescribed species is represented in the University of Michigan collections by material from Chiriqui Province, Panama. This form, which may constitute a distinct genus, lacks auditory foramina and is apparently apterous, but close examination shows that the males possess minute, pad-like tegmina.

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[12] *Arachnomimus* Saussure (1897, p. 251) was proposed to replace *Arachnopsis* Saussure 1878, not of Stimpson 1870.

On geographic grounds alone it is highly unlikely that these American species are members of an otherwise strictly Oriental genus. The resemblances to *Arachnomimus* are doubtless mere parallelisms, resulting from loss of tegmina and auditory foramina among the members of two somewhat distantly related Phalangopsine stocks of slender build. The two undescribed species referred to above are evidently very closely related to *Amphiacusta.* The Mexican species greatly resembles *A. yucatana* both in general structure and in the details of the concealed male genitalia, the resemblance in the latter instance being closer than that which exists between the genitalia of *A. yucatana* and those of *A. maya* or *A. annulipes.* Since a gradation exists in tegminal development from the relatively large tegmina of *A. tolteca* through the much-reduced tegmina of *A. yucatana* and *A. phalangium* and the minute pad-like tegmina of the Panamanian form, to the completely apterous condition found in the species assigned to "*Arachnomimus*", and since a similar transition can be traced from the Amphiacustae with large, paired auditory foramina to species like *yucatana* and *maya,* which have lost the outer foramen, to *A. phalangium,* in which the foramina are minute and often absent, and thus to the Arachnomimoid species without foramina, it is evident that these features cannot be made the basis of generic segregation. If the species now assigned to *Amphiacusta* and "*Arachnomimus*" are to be separated into different genera it must be on the basis of additional characters, and the groupings thus arrived at may well cut across the lines of specialization of tegmina and auditory foramina. Detailed revisionary study is needed to clear up this and similar problems among the Amphiacustae.

AMPHIACUSTA Saussure

Amphiacusta Saussure 1874, p. 444; Rehn 1905, p. 182 (*annulipes* selected as genotype); Kirby 1906, p. 67; Bruner 1916, pp. 387, 391; Hebard 1928*a,* p. 249; Wolcott 1933, p. 541 (habits, control).

Amphiacustes (variant spelling) Saussure 1878, p. 429; Saussure 1897, p. 245.

Including the two here described, twelve species have been assigned to the genus *Amphiacusta.* In order to facilitate my own work, the following key was prepared, based upon the literature and upon examination of the four species *azteca, phalangium, yucatana* and *maya.* It brings into relief the characters which various authors have considered diagnostic, and adds somewhat to the published information regarding a number of the species, especially since a recent trip to Philadelphia enabled me to test it upon specimens of *tolteca, caraibea* and *bahamensis.* However, examination of the Philadelphia collections shows that they contain probably as many undescribed species from the West Indies as all those hitherto placed in the genus, so that undue reliance upon the key may lead to serious error. Furthermore, some of the characters upon which it is based are in all probability quite variable.

KEY TO THE DESCRIBED SPECIES OF AMPHIACUSTA

1. Middle tibia armed at apex with a dorsocaudal and two ventral spurs (Figs. 11, 12); auditory foramina (normally) present on both faces of cephalic tibia (Figs. 15-17) (these rarely subobsolete or obsolete) 2

1′. Middle tibia armed at apex with two ventral spurs only (Figs. 13, 14); auditory foramina present on both faces or only on inner face of cephalic tibia (Figs. 19, 20) (Dorsal margins of caudal tibiae normally armed with 4-4 spurs; auditory foramina rarely subobsolete or obsolete) 9

2 (1). Dorsal margins of caudal tibiae (normally) armed with 4-4 or with 4-3 spurs; rostrum (cf. Fig. 47) narrower than first antennal segment; dorsal projection of facial scutellum relatively narrow between antennal fossae; first corde of male tegmen (normally) emitting a branch to the anterior angle of the mirror (cf. Fig. 50) 3

2′. Dorsal margins of caudal tibiae (normally) armed with 5-5 or with 5-6 spurs; rostrum as broad as first antennal segment; dorsal projection of facial scutellum relatively broad, trapeziform; first corde of male tegmen (normally) straight with its base alone incurved, emitting a branch from near the base to the diagonal vein. (Vertex without foveolae back of the lateral ocelli; rostrum continuing the curve of the vertex, not depressed between the lateral ocelli (cf. Fig. 51); mirror transverse, asymmetrical) 8

3 (2). First corde of male tegmen (normally) quite straight, only incurved near the base and there emitting a branch to the diagonal vein, as in *azteca*. (Vertex depressed toward the base of the rostrum, the latter narrow, separated from the vertex by a sulcus). [West Indies: Guadeloupe (type locality), Porto Rico, Culebra I., Vieques I., Barbados, Dominica] .... *A. caraibea* Saussure 1897.

3′. First corde of male tegmen (normally) angulate in the middle, emitting from the angle a straight branch to the anterior angle of the mirror (cf. Fig. 50). (Lateral lobes of pronotum more angulate, the lower margin nearly straight and rather strongly oblique; cf. Fig. 49) 4

4(3′). Rostrum continuing the curve of the vertex, not impressed between the lateral ocelli (Fig. 47). (Size moderate, body-length, ♂ 12-14 mm., ♀ 16-20 mm., length of caudal femur, ♂ ♀ 18-21 mm.; femora and tibiae yellowish, annulate with brown; tegmina exposing about half of abdomen, about 2.5-3.0 times as long as pronotum, dark reddish-brown with pale veins (Fig. 50); ovipositor apex set off by small but distinct notch; concealed genital sclerites of Bahama male as shown in Figs. 56-63). [West Indies: Haiti (type locality), Bahama Islands, Cuba, Isle of Pines, Jamaica, Guadeloupe].[13] ...... *A. annulipes* (Serville) 1831.

4′. Vertex anteriorly depressed toward base of rostrum, surfaces of vertex and rostrum in lateral aspect forming a distinct re-entrant angle, and generally set off by a distinct sulcus running between the lateral ocelli; post-ocellar foveolae distinctly indicated 5

5 (4′). Size large; male unknown, body-length of ♀ 27 mm., length of caudal femur, ♀ 26 mm.; ventrocaudal margins of lateral lobes of pronotum somewhat excised; re-entrant between rostrum and vertex deep, subrectangulate. [West Indies: Cuba (type locality), ? Guadeloupe] .... *A. grandis* Saussure 1874.

5′. Size (normally) smaller, about that of *annulipes* (see 4 above); ventral margins of lateral lobes of pronotum nearly straight and strongly oblique, the ventrocephalic angles strongly rounded; re-entrant between rostrum and vertex subrectangulate to obtuse. (Tegmina of male ordinarily 7.5-8.5 mm. in length, 2.6-3.2 times as long as pronotum) 6

6 (5′). Mirror of male tegmen elliptical, transverse, its cephalic and caudal margins equally curved, its disk (normally?) divided by a single vein anterior to middle, this vein terminating at or near the junction of the diagonal vein;

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[13] Also recorded, certainly in error, from Peru.

oblique veins 5-6. (Yellowish; pronotum black, with yellowish transverse band and border). [West Indies: Haiti (type locality), Dominica]........ .... *A. aranea* Saussure 1878.

6′. Mirror of male tegmen trigonal, or forming a sector of a circle bounded by nearly straight radii, (normally?) with 2 dividing veins; oblique veins 3-4. (Reddish-brown above, pronotum less contrastingly colored)........................ 7

7 (6′). Anterior dividing vein (normally?) running forward to junction with diagonal vein slightly beyond point where the inner margin of the mirror is joined by the branch from the first corde. (Tegmina pale, translucent yellowish-brown, covering about one-half the abdomen). [Brazil].[14]...... *A. fuscicornis* (Serville) 1839.

7′. Anterior dividing vein (normally?) running obliquely cephalad and then curving laterad to join the external margin of the mirror near the external angle. (Tegmina reddish-brown, with pale veins). [Bahama Islands]..... *A. bahamensis* Morse 1905.

8 (2′). Rostrum wider than first antennal segment; male tegmen longer and broader than in alternative, approximately 4.2 times length of pronotum, brownish-black; mirror strongly asymmetrical, the outer margin much shorter than the inner; pronotum of male twice as broad as long, the lower margins of the lateral lobes arcuate throughout, not oblique and little ascendent caudad, their anterior angles moderately to broadly rounded; supra-anal plate of male with distolateral processes. (General coloration blackish-chestnut). [*Tierra templada* of southern Mexico: Guerrero, 8000 ft.; Cordoba in Vera Cruz].... .... *A. tolteca* Saussure 1897.

8′. Rostrum as broad as first antennal segment; male tegmen smaller, 2.7-3.0 times length of pronotum, reddish-brown; mirror only slightly asymmetrical, the anterior margins not very unequal; pronotum of male 1.5-1.7 times as broad as long, the lower margins of its lateral lobes straighter and more oblique, with narrower ventrocephalic angles (cf. Fig. 51); supra-anal plate of male without processes. (General coloration reddish-brown; ovipositor as shown in Fig. 43). [*Tierra templada* of southern Mexico: Jalapa, Cordoba and Orizaba in Vera Cruz; Distrito Federal; in "prairies"]........................ *A. azteca* Saussure 1859.

9 (1′). Surfaces of vertex and rostrum forming a continuous, gently sloping declivity in lateral aspect, not making a re-entrant angle at the level of the lateral ocelli (Fig. 22); oblique veins of male tegmen normally[15] 4 or 5; apices of dorsal valves of ovipositor set off from shafts by mere inconspicuous angulations of dorsal margins (Fig. 44); general coloration pale yellowish-brown, maculate with slightly darker brown; disk of pronotum amber brown, lower parts of lateral lobes pale, cephalic margin and narrow caudal bands which descend to the ventro-lateral margins just anterior to the ventrocaudal angles darker brown (Figs. 21, 22); tegmina unicolorous pale brown or brownish-yellow. (Auditory foramina present only on inner face of cephalic tibiae;[15] cephalic femur/pronotum ratio, ♂ 3.3-4.1, mean 3.7, ♀ 3.2-3.7, mean 3.4; caudal femur/pronotum ratio, ♂ 5.6-6.4, mean 6.0, ♀ 5.5-6.2, mean 5.7. Male tegmen very short, breadth of dorsal field averaging equal to length, the latter 1.2-1.8, mean 1.53 times length of pronotum; mirror transversely trigonal, its caudal marginal vein very weakly arcuate, dividing veins variable, commonly absent or incomplete; first corde generally sending a branch to the diagonal vein, but this variable (Figs. 21, 34-42). Concealed male genital sclerites as shown in Figs. 64-67, 72-74). [Cenotes and caves in the limestone region of Yucatan]..... *A. yucatana* n. sp.

9′. Vertex more strongly declivent to base of more depressed rostrum, forming with it a distinct though obtuse re-entrant angle in lateral aspect; oblique veins of male tegmen generally 3 (varying from 2 to 4, perhaps occasionally 5); apices

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[14] Also recorded, probably in error, from the West Indies.

[15] Oblique veins varying from 3 to 6, some of them often incomplete or branched (see Figs. 34-42). Auditory foramina in one specimen entirely absent from one leg; in another specimen one leg has the inner foramen present but minute.

of dorsal valves of ovipositor set off from shafts by slight to distinct, obliquely emarginate notches (Figs. 45, 46); general coloration dark reddish-brown, including pronotum and dorsal field of tegmen.............................. 10

10 (9′). Legs relatively short, cephalic femur in both sexes approximately two-thirds as long as body, cephalic femur/pronotum ratio, ♂ 4.6-4.1 (3.9), mean 4.2, ♀ 3.9-3.5 (3.3) mean 3.6; auditory foramina present only on inner faces of cephalic tibiae (Fig. 20); male tegmen (Figs. 26, 30-33) relatively large, 2.3-3.0, mean 2.6 times pronotal length, 1.18-1.33, mean 1.26 times as long as broad, reddish-brown, conspicuously marginate with a moderately broad costal and narrower apical edging of yellow; mirror trigonal or somewhat irregular, generally with a single dividing vein;[16] oblique veins normally 3 or 4; first corde normally sending a branch to the mirror, and occasionally an additional branch to the diagonal vein. Apex of ovipositor as shown in Fig. 46. [Progreso, Ulua Valley, Honduras; probably north to Teapa in Tabasco, southern Mexico]. .... *A. maya* n. sp.[16]

10′. Legs very elongate and attenuate; cephalic femur of ♂ slightly longer than body and about 4.7 times as long as pronotum, of ♀ four-fifths as long as body and about 4.1 times as long as pronotum; auditory foramina present on both faces of cephalic tibiae (occasionally subobsolete, or absent from one or both faces); male tegmen relatively short and narrow, 1.75-1.85 times as long as pronotum, 1.67 times as long as broad, without contrasted yellow margins; mirror ovoid, about as long as broad and (normally) with 2 dividing veins behind middle; oblique veins generally 2 or 3; first corde (normally) without a branch; apex of ovipositor as shown in Fig. 45. [Guatemala (type locality) to Panama]. .... *A. phalangium* Saussure 1874.

Phalangopsis spectrum Walker 1869, a Brazilian species assigned to *Amphiacusta* by Kirby in 1906, is omitted from the above key because of the brevity and inadequacy of the original description.

The accompanying bibliography of the species of *Amphiacusta* is believed to be nearly complete, since access to Mr. A. N. Caudell's manuscript index to the Orthoptera of North and Central America enabled me to add several references to those previously known to me. It must be noted that some of the records are certainly incorrect, and none should be accepted without critical consideration.

Amphiacusta tolteca Saussure 1897

Saussure 1897, pp. 247-248, Pl. 12, Figs. 14-17 (*Amphiacustes*) [♂, ♀—Omilteme in Guerrero, Cordova in Vera Cruz, Mexico]; Scudder 1901, p. 18 (*Amphiacustes*); Rehn 1903*a*, p. 34 [Mexico]; Kirby 1906, p. 67 [Mexico]; also: *Amphiacusta azteca*, var. ♀, Saussure 1874, p. 450 [Mexico], cited by Kirby 1906.

Amphiacusta azteca (Saussure) 1859

(Figs. 11, 17, 18, 43, 51)

Saussure 1859, p. 209 (reprint pag. 12) (*Phalangopsis*) [♀—Mexico]; Walker 1869, p. 116 (*Phalangopsis*) [Mexico]; Saussure 1874, pp. 449-450 [Mexico:

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[16] This species is quite possibly identical with *Endacustes aztecus* Saussure (1897, p. 250), described from Teapa, Mexico, and preocccupied in *Amphiacusta* by *A. azteca* Saussure 1874. In the Honduran series the mirror of the male tegmen occasionally has a second complete or incomplete dividing vein, and sometimes a third incomplete one. In the type of *Endacustes aztecus* the mirror is shown with one longitudinal dividing vein, from which arise two other transversely arcuate ones (see Saussure 1897, Pl. 12, Fig. 20).

prairies of temperate plateau]; Saussure 1874, Pl. 8, Figs. 39, 39a (*A. mexicana* nomen nudum); Saussure 1878, p. 431 (reprint pag. 571) (*Amphiacustes*) [characters in key]; Saussure 1897, pp. 246, 247, 248, Pl. 12, Fig. 18 (*Amphiacustes*) [Vera Cruz, Cordova and Orizaba, Mexico]; Scudder 1901, p. 18 (*Amphiacustes*), p. 255 (*Phalangopsis*); Rehn 1903*a*, p. 34 [Jalapa, Mexico]; Kirby 1906, p. 67 [Mexico]; Hebard 1932, p. 357 [Jalapa and Orizaba in Vera Cruz, and Distrito Federal, Mexico].

The specimen from which the figures in this paper were drawn is a female recorded by Rehn (1930*a*) from Jalapa, Mexico.

Amphiacusta caraibea Saussure 1897

Saussure 1897, pp. 246, 247, 248-49 (*Amphiacustes*) [♂—Guadeloupe I.]; Scudder 1901, p. 18 (*Amphiacustes*); Rehn 1903*b*, pp. 135, 136 [Culebra I., Porto Rico; note on form of pronotum]; Rehn 1905, p. 182 (*A. caribea*) [Barbados]; Kirby 1906, p. 68 [Guadeloupe]; Rehn 1906*a*, p. 52 [Barbados]; Anonymous 1907, p. 106 [Barbados; brief description, habits, control]; Rehn 1910, p. 77 [Vieques and Culebra Is., Porto Rico; in caves; measurements of ♀]; Ballou 1912, p. 145, Fig. 155 [West Indies]; Caudell 1914, p. 495 [Dominica]; Anonymous 1917, p. 47 [Barbados]; Cotton 1918, pp. 270-271, Fig. 25 [Porto Rico]; Van Zwaluwenburg 1918, p. 26 [Porto Rico; description of eggs]; Colcord 1921, p. 15; Luciano 1922, p. 32 (*A. caribbea*) [Porto Rico; habits, control]; Wilson 1923, p. 10 [West Indies]; Wolcott 1924*a*, p. 29 [Porto Rico; summary of habitat data]; Wolcott 1924*b*, p. 11 [eaten by lizards *Ameiva exsul* and *Anolis cristatelus*, in Porto Rico]; Colcord 1925, p. 18 (*A. caribbea*); Zacher 1925, p. 160 [Porto Rico]; Ciferri 1927, p. 80 [Moca, Dominican Republic]; Wolcott 1936, pp. 43-44 [Porto Rico; many records, beach to mountains]; also recorded as *Amphiacusta aranea*, var., Saussure 1878, p. 432 (reprint pag. 572) [Guadeloupe]. The Porto Rican records of "*Phalangopsis guerrina* Saussure" (apparently a nomen nudum) by Stahl 1882, p. 208, Wolcott 1924*a*, p. 29, and Wolcott 1936, p. 43, are probably based on immature specimens of this species.

Amphiacusta annulipes (Serville) 1831

(Figs. 12, 15, 16, 47-50, 52, 56-63)

Serville 1831, p. 167 (reprint pag. 70) (*Phalangopsis*) [♀—Port-au-Prince, Haiti]; Oken 1835, Isis, p. 174 (*Phalangopsis*) [Haiti]; Burmeister 1838, p. 723 (*Phalangopsis*) [Prinzen-hafen, Haiti]; Serville 1839, pp. 369-370 (*Phalangopsis*) [Haiti]; Blanchard 1840, p. 32 (*Phalangopsis*) [Haiti]; De Haan 1842, p. 226 (*Gryllus* (*Phalangopsis*)) [Port-au-Prince]; Guerin-Meneville 1857, p. 353, Pl. 12, Fig. 9 (*Phalangopsis*) [Cuba]; Girard 1879, p. 137 (*Phalangopsis*) [Haiti]; Saussure 1874, pp. 445-447, Pl. 8, Fig. 40 [Cuba; Guadeloupe; [not] Peru]; Saussure 1878, p. 431 (reprint pag. 571) (*Amphiacustes*) [characters in key]; Gundlach 1887, p. 149 (*Amphiacustes*) [Porto Rico]; Bolivar 1888, p. 157 (reprint pag. 42) (*Amphiacustes*) [Cuba; very common; ♂ supra-anal plate cornuate]; Gundlach

1891, p. 371 [Cuba; Porto Rico; habitats]; Scudder 1901, p. 18 (*Amphiacustes*), p. 133 (*Gryllus* (*Phalangopsis*)), p. 255 (*Phalangopsis*); Morse 1905, p. 23 [Nassau, Bahama Is.]; Rehn 1905, p. 182 [selected as genotype]; Kirby 1906, p. 68 [Haiti, Cuba, Guadeloupe, Jamaica; Peru?]; Rehn 1906*b*, p. 118 [Nassau, Mangrove Key, Andros, in Bahama Is.]; Rehn 1909, p. 221 [El Guama, in Pinar del Rio, Cuba; West Indies]; Bruner 1916, p. 391 [Isle of Pines]; Holland and Kahl 1916, p. 543 [Isle of Pines]; Smyth 1919, p. 110 [Porto Rico]; Caudell 1922, p. 42 [♂♂ with foramina on both faces of cephalic tibiae, ♀♀ in U. S. National Museum (determined by Rehn) lack foramina on both faces]; also recorded as *Acheta arachnoides,* Westwood 1840, p. 248, Pl. 6, Fig. 1 [Jamaica].

The specimen from which the figures in this paper were drawn is a male, collected in Cartwright's Cave, Clarencetown, Hamilton, Long Island, Bahamas (British West Indies), July 26–Aug. 20, 1935, by L. A. Hodsdon. It was received from Dr. J. F. W. Pearson of the University of Miami. Being in bad condition, it was mounted on points and slides, deposited in the Museum of Zoology of the University of Michigan.

Amphiacusta fuscicornis (Serville) 1839

Serville 1839, p. 370 (*Phalangopsis*) [♂—Brazil]; Saussure 1874, pp. 448-449 [Brazil; redescription of type]; Saussure 1878, p. 431 (reprint pag. 571) (*Amphiacustes*) [characters in key]; Kirby 1906, p. 68 [Brazil; ? West Indies].

Amphiacusta bahamensis Morse 1905

Morse 1905, pp. 23-24 [♂, ♀—Mangrove Key, Andros I.; Nassau, New Providence and Abacos Is., Bahamas]; Rehn 1906*b*, p. 118 [Andros I., Bahamas].

Amphiacusta spectrum (F. Walker) 1869

Walker 1869, p. 108 (*Phalangopsis*) [♂—Tejuca, Brazil]; Kirby 1906, p. 68 [Brazil].

Amphiacusta aranea Saussure 1878

Saussure 1878, pp. 431-432 (reprint pag. 571-572) (*Amphiacustes*) [♂—Santo Domingo; [not] Guadeloupe]; Scudder 1901, p. 18 (*Amphiacustes*); Kirby 1906, p. 68 [Haiti, Dominica].

Amphiacusta grandis Saussure 1874

Saussure 1874, pp. 447-448 [♀—Cuba; Guadeloupe]; Saussure 1878, p. 431 (reprint pag. 571) (*Amphiacustes*) [characters in key]; Bolivar 1888, pp. 157-158 (reprint pag. 42-43) (*Amphiacustes*) [Cuba]; Gundlach 1891, p. 372 (*Amphiacustes*) [Yateras, Cuba]; Scudder 1901, p. 18 (*Amphiacustes*); Kirby 1906, p. 68 [Cuba]; Rehn 1909, p. 222 [Cuba]. Cursory examination of the female in the Carnegie Museum from Muñez Freires, Espirito Santo, Brazil, recorded as *A. grandis* with a query by Bruner (1916, p. 391) indicates that it is probably not an *Amphiacusta*.

Amphiacusta phalangium Saussure 1874

(Figs. 14, 45, 55)

Saussure 1874, pp. 450-451 [♂—Central America]; Saussure 1878, p. 431 (reprint pag. 571) (*Amphiacustes*) [characters in key]; Saussure 1897, pp. 246, 247, 249, Pl. 12, Fig. 19 (*Amphiacustes*) [♂—Guatemala; cephalic tibiae often without foramina]; Scudder 1901, p. 18 (*Amphiacustes*); Kirby 1906, p. 68 [Guatemala]; Hebard 1928*a*, pp. 249-250 [Gatun and Barro Colorado, Canal Zone, Panama; structural notes; closer to the Mexican than to the West Indian species].

The specimen from which the figures in this paper were drawn is a female, collected at Madden Dam, Canal Zone, Panama, July 15, 1933, by A. Greenhall, in the Museum of Zoology, University of Michigan.

Amphiacusta maya n. sp.

(Figs. 20, 26-33, 46, 54, 68-71, 75, 76)

? *Endacustes aztecus* Saussure, 1897, p. 250, Pl. 12, Figs. 20-22 [♂, ♀—Teapa in Tabasco, Mexico] (preoccupied in *Amphiacusta* by *A. azteca* Saussure 1859); Kirby 1906, p. 69 (*Endacusta*) [Mexico]; Hebard 1928*b*, p. 91 [belongs to or near the genus *Amphiacusta*]; Hebard 1932, p. 357 [if an *Amphiacusta*, will require a new name].

Holotype: Male, Progreso, Ulua Valley, Honduras, March 30, 1923 (T. H. Hubbell); *allotype* a female with the same data; both in Museum of Zoology, University of Michigan.

The rather large and handsomely colored insect here described as *Amphiacusta maya* is very close to and quite possibly identical with Saussure's *Endacustes aztecus*, described from Teapa in Tabasco, Mexico. As was pointed out above, the latter is not a member of the Australian genus *Endacustes*, but is clearly an *Amphiacusta*, and as such must be renamed because it is a homonym of *Amphiacusta azteca* Saussure 1859. Since I have not had access to the type of Saussure's species, and since the material here treated is from a locality distant from Tabasco, introducing the possibility that even if the two are the same species a different geographic race may be represented, I have preferred to describe the Honduran insect as new. However, the moist, forested lowland which runs from Tabasco southward between the Guatemalan highland on the west, the arid Yucatan lowland to the northeast, and the low ranges of British Honduras on the east, may well form a continuous area of distribution carrying this species from southern Mexico to the northern coastal lowland of Honduras.

The specimens of the type series of *A. maya* agree in every essential respect with Saussure's rather full description and good figures of *Endacustes aztecus*, except for rather minor variations in body proportions and in the venation of the male tegmina (compare Saussure's Fig. 20, Pl. 12, with Figs. 26 and 30-33 of this paper). A detailed description of the new species seems therefore unnecessary. Unfortunately the important characters of the concealed male genitalia and of the ovipositor apex were not figured for *Endacustes aztecus* (those of *A. maya* are shown in Figs. 46, 68-71, 75-76). Comparison of these structures in Mexican and Honduran material will be necessary to establish the identity of *A. maya* with Saussure's species.

The series recorded below was taken near Progreso, in the Ulua Valley, Honduras, at the end of the dry season. Sixty-seven of the 84 specimens constituted the entire colony which inhabited a prostrate hollow log in a dense thicket of young trees, bushes and thorny vines, at the edge of a dry, gravelly watercourse near the foot of the Mico Quemado mountains. The males were heard singing, and were located in the log by the extremely long, waving antennae which protruded from its open end. The song consists of short notes, generally three together, followed by a pause; it has a ringing quality, and is quite loud and penetrating. The colony was captured by spraying the interior with carbon-disulphide, and splitting open the log. Six other nymphs were collected in dead leaves and forest debris in a patch of dry woods at the edge of a gravel-pit, and one was found with other crickets crawling near the ground on the walls of the oficina at Progreso, at night.

TABLE 4

Measurements of Adult Specimens of Amphiacusta maya

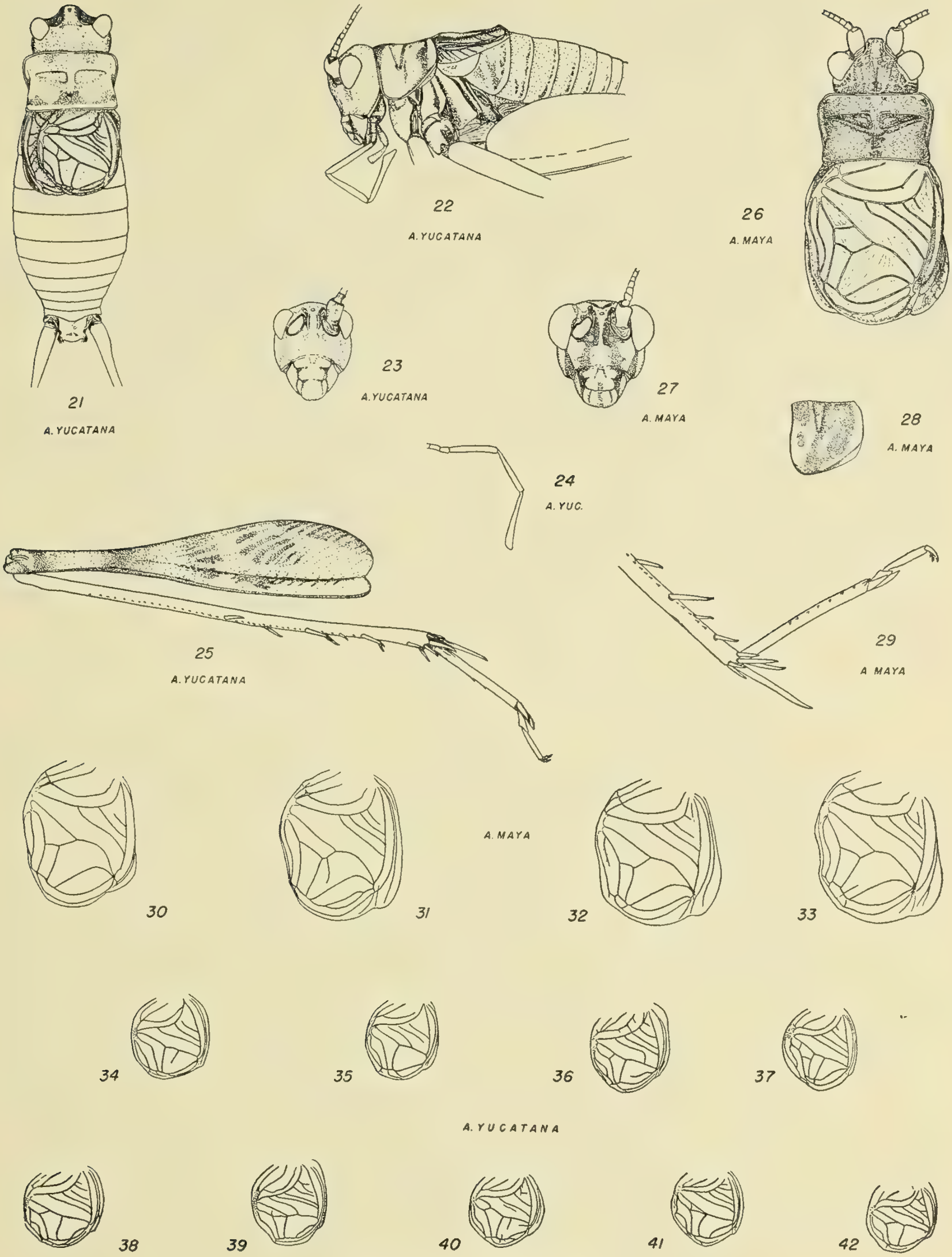
(in millimeters)

Specimens	Length			Breadth	Length		Breadth	Length			
	Body	Pro-notum	Tegmen	Tegmen	Cephalic Femur	Caudal Femur	Caudal Femur	Caudal Tibia	Ovi-positor	An-tenna	Cercus
Males:..........											
Holotype.....	16.9	2.7	6.9	5.7	11.2	18.5	3.6	21.3	....	80±	17.0
Paratype.....	17.0	2.9	7.3	5.6	12.0	19.0	3.7	20.8	....	98±	18.5
Paratype.....	16.0	2.5	7.3	5.7	10.8	17.7	3.5	19.2	....	....	16.1
Paratype.....	18.0	3.0	7.2	6.1	12.5	19.6	3.7	22.3	....	....	....
Paratype.....	16.0	2.5	7.4	5.7	11.4	17.6	3.3	20.3	....	85±	16.8
E. aztecus*....	14.0	3.0	7.0	5.7±	11.7±	18.0	....	....	....	....	14.3±
Females:											
Allotype......	19.0	3.1	....	....	12.0	21.0	4.1	23.0	18.5	....	18.5
Paratype.....	16.0	3.3	....	....	11.7	20.5	4.3	22.9	16.2	....	20.0
Paratype.....	19.4	3.4	....	....	12.0	....	....	....	17.7	72±	20.0
Paratype.....	14.8	3.3	....	....	11.6	20.3	4.0	22.5	17.0	80±	17.2
E. aztecus*....	14.0	3.0	....	....	....	17.5	....	....	13.0	....	....

*Measurements of the holotypic ♂ and allotypic ♀ of *Endacustes aztecus*, after Saussure, except that breadth of tegmen, length of cephalic femur and length of cercus were estimated from the figure of the male type (Saussure 1897, Pl. 12, Fig. 20). "Breadth tegmen" refers to the breadth of the dorsal field only.

Figs. 21-42—*AMPHIACUSTA*

21: *Amphiacusta yucatana* n. sp., holotypic ♂, dorsal view, × 3.75.
22: Same, lateral view, × 3.75.
23: Same, cephalic view of head, × 3.75.
24: Same, right maxillary palpus, × 3.75.
25: Same, right caudal leg, × 3.75.
26: *Amphiacusta maya* n. sp., holotypic ♂, dorsal view, × 3.75.
27: Same, cephalic view of head, × 3.75.
28: *Amphiacusta maya* n. sp., paratopotypic ♂, of lighter coloration than holotype, lateral view of pronotum, × 3.75.
29: Same as Fig. 26, end of caudal tibia and tarsus of left leg, × 3.75.
30-33: *Amphiacusta maya* n. sp., tegmina of paratopotypic males, showing variations in venation of dorsal field.
34-42: *Amphiacusta yucatana* n. sp., tegmina of paratypic males, showing variations in venation of dorsal field—
    34: Loltun Cave, Oxkutzcab.
    35: San Bulha Cave, Motul.
    36: Muruztun Cave, Tizamin.
    37: Kaua Cave, Kaua.
    38: Balaam Canche Cave, Chichen Itza.
    39: San Isidro Cave, Merida.
    40: San Bulha Cave, Motul.
    41: Kaua Cave, Kaua.
    42: Spukil Cave, Calcehtok.



Figs. 21-42—*AMPHIACUSTA*

(*For description see opposite page.*)

Specimens examined.—84: 5♂, 4♀ (holotype, allotype and paratypes), and 75 medium-sized to large nymphs, all collected by T. H. Hubbell at the type locality, as follows: March 20, 1923, 1 juv. ♂; March 22, 1923, 3 juv. ♂, 3 juv. ♀; March 30, 1923, 5 ♂, 32 juv. ♂, 4 ♀, 26 juv. ♀. Entire series in Museum of Zoology, University of Michigan.

Amphiacusta yucatana n. sp.

(Figs. 13, 19, 21-25, 34-42, 44, 53, 64-67, 72-74, 78)

The principal diagnostic features of this species have been given above in the key. The combination of pale coloration, absence of angulation between vertex and fastigium, very narrow eyes, absence of external auditory foramina, very small male tegmina, absence of a distinct notch setting off ovipositor apex, and moderate size suffices to distinguish *yucatana* from all other described species of *Amphiacusta.* Relationships within the genus cannot be determined without thorough revision. *A. yucatana* resembles *azteca* in ovipositor form, *maya* and *phalangium* in armature of the middle tibia, and is closer to the undescribed Mexican *"Arachnomimus"* in male genital structure than to *maya* or *annulipes,* the only other species of *Amphiacusta* of which the genitalia are known to me.

Holotype: Male, Balaam Canche Cave, Chichen Itza, Yucatan, June 13, 1936 (A. S. Pearse—taken just within cave mouth, on walls); *allotype* a female with the same data, except taken June 28, 1936; both in Museum of Zoology, University of Michigan.

DESCRIPTION OF HOLOTYPIC MALE[17]

Slightly smaller than *annulipes* or *maya,* larger than *azteca* and *tolteca,* length of body 16.0 (12.8-17.5, mean 15.25) mm.; legs rather long and slender, but of only moderate length for the genus, much less attenuate than those of *phalangium;* tegmina unusually small, dorsal fields nearly circular in outline. Surface of body dull, dorsum densely pilose with recumbent pale hairs, legs densely covered with minute pale hairs and larger brownish setae. General coloration pale yellowish-brown with inconspicuous darker brown markings, caudal margins of thoracic tergites strikingly pale-banded, legs slightly darker than body, rather faintly annulate, caudal femur obliquely barred with brownish.

Head (Figs. 21-23).—In dorsal aspect broad and short; in cephalic aspect tall, narrowing strongly and rather evenly ventrad, subpyriform, in outline closest to that of *phalangium,* but ventral parts of genae less prominent than in that species and distinctly less so than in *maya;* head considerably taller, narrower and less globose than in *azteca.* Eyes very prominent, very narrowly pyriform, much narrower than in other species of the genus, 1.67 (1.55-2.0, mean 1.76) times as long as broad, .78 (.69-1.07, mean .88) times as broad as first antennal segment; interocular distance 1.27 (1.14-1.47, mean 1.31) times length of eye. Vertex transversely

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[17] Figures in parentheses show the range of variation in the paratypic series. All measurements save those on the pinned holotype and allotype made on specimens preserved in alcohol.

weakly convex, on each side strongly convex in cephalocaudal direction, but mesad sloping continuously into vertex as a gently rounded, weakly declivent ridge; fastigium bounded caudad by a faintly retroarcuate, weakly impressed suture extending between the lateral ocelli; dorsum of fastigium weakly flattened, furnished with numerous erect dark bristles; median ocellus situated just above apex of rostrum, directed forward, of nearly same size as lateral ocelli; the latter situated at sides of fastigium and nearly touching edges of smooth channels bounding antennal fossae, separated from each other by a space .43 (.36-.47, mean .41) times interocular distance, distance from median ocellus to suture at base of fastigium 1.07 (.9-1.3, mean 1.04) times as long as distance between lateral ocelli; apical angulation of rostrum, where fastigium joins interantennal projection of facial scutellum, in lateral aspect abruptly rounded, slightly obtuse; apical breadth of rostrum .7 (.5-.9, mean .73) times breadth of proximal antennal segment; mesal portion of facial scutellum and its interantennal prolongation slightly elevated, flattened on summit; distance from lower angle of eye to anterior mandibular condyle .67 (.63-.97, mean .75) times length of eye; palpi (Figs. 22, 24) very long and slender, total length of maxillary palpus 2.8 (2.4-3.2, mean 2.88) times pronotal length, the two proximal segments small, the three distal segments elongate and slender, length of distal (5th) segment 1.32 (1.17-1.59, mean 1.39) times interocular distance, segments 5, 4, 3 having the ratio 100:72:76 (100:68-86, mean 76:70-90, mean 77); antennae very slender and long, broken in holotype, in paratypic males 104-145 mm. long, 7.1-9.6 times length of caudal femur.

Thorax.—Pronotum (Figs. 21, 22) short, transverse, caudal breadth less than cephalic, maximum breadth 1.72 (1.60-1.86, mean 1.71) times dorsal length; completely marginate, cephalic margin weakly concave, caudal margin straight, dorsum with impressions and contours as in *annulipes, maya* and *phalangium;* lateral lobes weakly flaring cephalad, constricted at caudal third, ventral margin nearly straight, strongly oblique, ventrocephalic angle narrowly rounded and more acute than in most other species of the genus, ventrocaudal angle abruptly rounded but strongly obtuse. Metanotum unspecialized, as shown in Figure 53 (cf. that of *annulipes,* shown in Fig. 52). Mesosternal lobes together forming a small, quadrate plate with caudal margin subtruncate and shallowly excised at middle; metasternal lobes forming a plate resembling those of *maya* and *phalangium* (cf. Figs. 54, 55), its sides straight and convergent to narrowly rounded angles bordering a shallow V-shaped mesal emargination.

Tegmina (Figs. 21, 22, 34-42).—Very short, dorsal fields subcircular, as broad as long (ratio length/breadth 1.0, in paratypic series .94-1.1, mean 1.05); lateral fields thin, narrowing rapidly distad, median, humeral and mediastine veins approximated near angle between dorsal and lateral fields, in side view nearly straight, mediastine vein emitting a few indistinct branches to margin; distal field reduced to a narrow, decurved, veinless margin; dorsal field with humeral border broadly and evenly convex; 2 complete and 3 proximal incomplete oblique veins present; mirror reduced to a somewhat transverse triangle with straight, only moderately unequal anterior margins, gently arcuate caudal margin, and with one dividing vein; first corde unevenly arcuate, sending two branches to the diagonal vein. Venation in series quite variable, as shown in Figures 34-42. Wings altogether absent.

LEGS.—Long and slender. Cephalic femur 3.76 (3.32-4.17, mean 3.68) times as long as pronotum; middle femur .93 (.89-.98, mean .94) times as long as cephalic femur; both straight and unarmed. Cephalic tibiae slender, straight, furnished on inner face only with small, oval auditory foramen (Fig. 19); cephalic and middle tibiae both subequal in length to their femora, and armed ventrodistad with 2 slender spurs (Fig. 13); cephalic tarsus four-fifths as long as tibia, very slender, metatarsus 2.9 times length of remaining 2 segments; middle tarsus .7 times as long as tibia, metatarsus 2.7 times as long as remaining segments. Caudal femur (Fig. 25) unarmed, nearly equal in length to body, 6.28 (5.61-6.37, mean 6.0) times as long as pronotum, 1.67 (1.45-1.75, mean 1.63) times as long as cephalic femur,

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FIGS. 43-63—*AMPHIACUSTA*
(See Figs. 64-76 for abbreviations on Figs. 56-63.)

43: *Amphiacusta azteca* Sauss., ♀, Jalapa, Vera Cruz, Mexico, apex of ovipositor, outer face of right valve (upper), inner face of left valve (lower), × 12.

44: *Amphiacusta yucatana* n. sp., paratypic ♀, Xkyc Cave, Calcehtok, apex of ovipositor, as in Fig. 43, × 12.

45: *Amphiacusta phalangium* Sauss., ♀, Madden Dam, Canal Zone, Panama, apex of ovipositor, as in Fig. 43, × 12.

46: *Amphiacusta maya* n. sp., allotypic ♀, apex of ovipositor, as in Fig. 43, × 12.

47: *Amphiacusta annulipes* (Serv.), ♂, Clarencetown, Hamilton, Long I., Bahamas, dorsal view of head, × 4.

48: Same, dorsal view of pronotum, × 4.

49: Same, lateral view of pronotum, × 4.

50: Same, tegmen, with lateral field flattened into same plane as dorsal field. Venation, according to nomenclature of Saussure (Ss), Brunner (Br), Hebard 1913, and Comstock-Needham (C), as follows:

1: Mediastine vein (Ss, Br) = subcosta (C).

2: Humeral vein (Ss) = anterior radial vein (Br) = radius (C).

3: Discoidal vein (Ss) = posterior radial vein (Br) = media (C).

4: False discoidal vein (Ss) = ramus of posterior radial vein (Br) = median vein (Hebard-Nemobius) = cubitus (C); 4A—outer anterior margin of mirror (Ss) = first accessory cubital vein (C); 4B—posterior margin of mirror (Ss) = distal accessory cubital vein (C); 4C—inner anterior margin of mirror (Ss) = continuation of 4A (C); 4D—dividing veins of mirror (Ss) = second and third accessory cubital veins (C).

5: Anal vein or archet (Ss) = posterior ulnar vein (Br) = cubitus$_2$ (C) = stridulating vein of many authors; 5A—first corde or first post-axillary vein (Ss) = distal part of cubitus$_2$ (C).

6, 7: Axillary veins (Ss, Br, Hebard) = first (6) and second (7) anal veins (C); 6A—second corde or second post-axillary vein (Ss) = distal part of first anal vein (C).

8: Diagonal vein (Ss, Hebard) = an unnamed intracubital cross vein (C).

9: Oblique veins (only two of the four shown are labelled) (Ss) = anterior ulnar vein (Br) (for the distal one) = ulnar vein (Hebard) (for the distal one) = unnamed intracubital cross veins (C).

10: Spur from first corde to angle of mirror (Ss) = an unnamed intracubital cross vein (C).

11: Enveloping vein (Ss) = ambient intramarginal vein (C).

AN: Anal or musical node (Ss), node or nodus of authors.

51: *Amphiacusta azteca* Sauss., ♀, same as Fig. 43, lateral view of head and pronotum, × 2.5.

52: *Amphiacusta annulipes* (Serv.), ♂, same as Fig. 47, dorsal view of metanotum, × 4.

53: *Amphiacusta yucatana* n. sp., paratypic ♂, Balaam Canche Cave, Chichen Itza, dorsal view of metanotum, × 4.

54: *Amphiacusta maya* n. sp., paratopotypic ♂, ventral view of metasternal lobes, × 5.

55: *Amphiacusta phalangium* Sauss., ♀, same as Fig. 45, ventral view of metasternal lobes, × 5.

56: *Amphiacusta annulipes* (Serv.), ♂, same as Fig. 47, ventral view of parameres and endoparameres, pseudosternite removed, × 20.

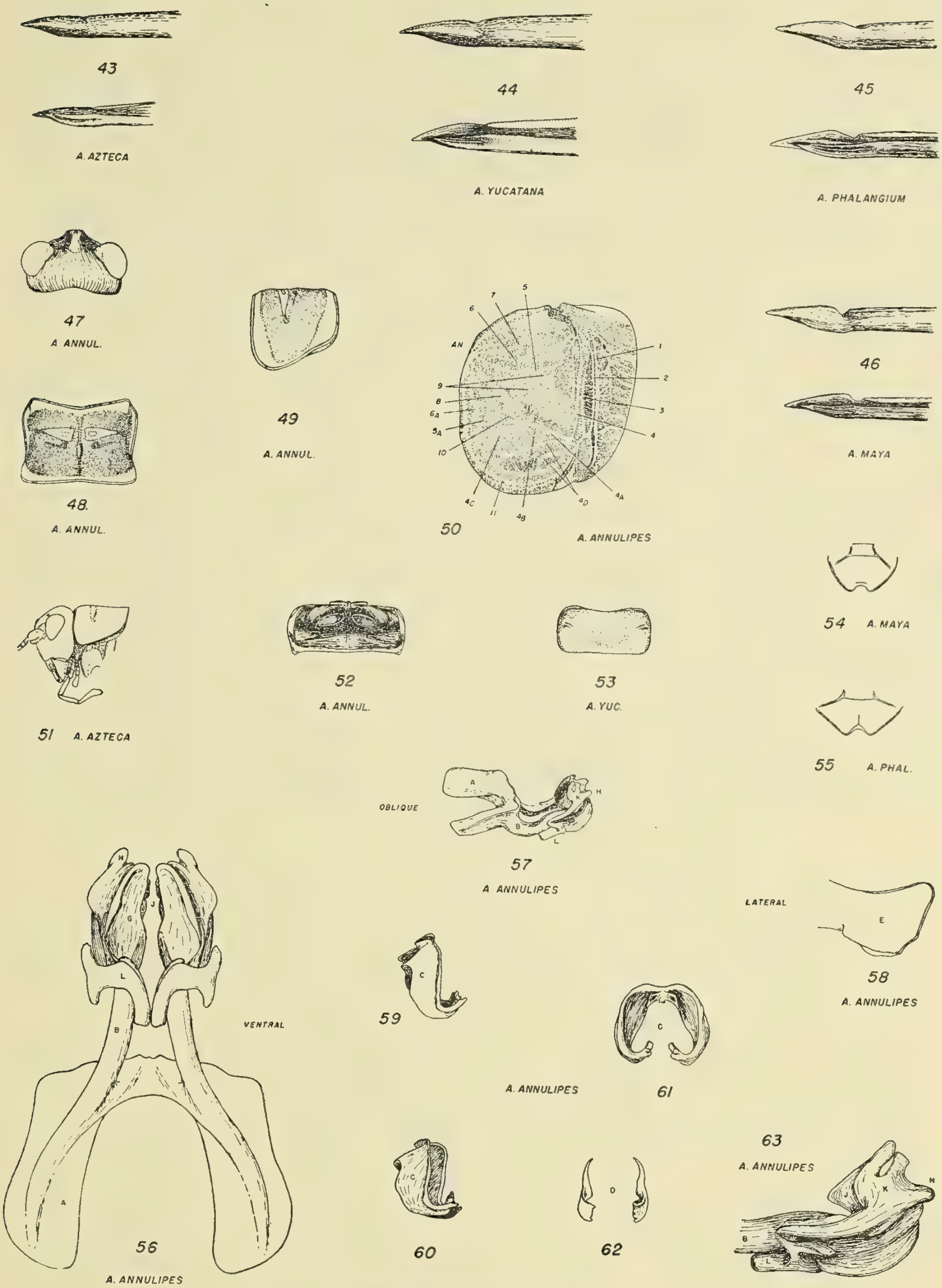
57: Same, oblique lateral view of parameres and endoparameres, pseudosternite removed, × 6.5.

58: Same, lateral view of distal lobes of spermatophore sac, × 20.

59-61: Same, lateral, lateral-oblique, and dorso-caudal views of pseudosternite, which in natural position fits around the parameres, as shown in Fig. 57, between points B and L, × 6.5.

62: Same, two views of one of the distal spinous lobes which articulate with the apices of the rami of the pseudosternite, which is shown in Figs. 59-61, × 20.

63: Same, enlarged detail of apex of one of parameres in side view, × 20.



FIGS. 43-63—*AMPHIACUSTA*

(*For description see opposite page.*)

4.76 (4.25-5.12, mean 4.7) times as long as greatest breadth, proximal half swollen, distal third slender and subequal. Caudal tibia (Fig. 25) straight, slender, 1.13 (1.10-1.18, mean 1.15) times as long as femur, armed above on outer carina with 33 (right) and 37 (left) sharp spinules, on inner carina with 28 (right) and 26 (left) similar ones, these extending nearly to base, (range in paratypic series, outer carina 21-45, mean 32, inner carina 14-37, mean 25); in addition to these spinules the distal half of the tibia bears, on the outer carina, 5 (right) and 4 (left) spurs, on the inner carina 4 spurs on each leg, these spurs subalternate, slender, setose, those of outer carina longer than those of inner, and increasing in length distad to penultimate spur, which is nearly twice as long as tibial depth, the distal spur of outer carina shorter, 1.4 (mean 1.3) times as long as tibial depth, separated from externodorsal calcar by its own length; distal spur of inner carina adjacent to internodorsal calcar; these spurs interrupting spine rows to give the following spine formulae: right outer 17/10/2/1/3/0, left outer 18/10/6/3/0, right inner 19/6/3/0, left inner 18/5/3/0; ventral calcars short, externoventral shorter than last outer dorsal spur, internoventral half again as long as externoventral; externodorsal calcar as long as last dorsal spur, about half as long as externomedian calcar; latter 2.6 (mean 2.3) times as long as tibial depth, .28 (mean .25) times length of metatarsus; internodorsal calcar 3.0 times as long as tibial depth, .33 (mean .32) times length of metatarsus; internomedian calcar very elongate, 5.4 (mean 5.25) times as long as tibial depth, .59 (mean .56) times length of metatarsus. Caudal tarsus (Fig. 25) elongate, .39 (.37-.44, mean .39) times length of caudal tibia; metatarsus slender, straight, .26 (.25-.33, mean .28) times length of caudal tibia, averaging 1.94 times pronotal length, armed on externodorsal margin with 3 (right) and 6 (left), on internodorsal margin with 2 (right) and 3 (left) small sharp denticulations, one pair being apical (in series externodorsal margin with 1-7, commonly 3-7, weakly

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FIGS. 64-76—*AMPHIACUSTA*

64: *Amphiacusta yucatana* n. sp., paratypic ♂, San Bulha Cave, Merida, concealed genital sclerites, dorsal view, before complete removal of tissues, showing normal position of sclerites, × 20.

65: Same, Oxolodt Cave, Kaua, concealed genital sclerites, dorsal view, after complete removal of tissues and mounting on slide under pressure, spreading the sclerites apart, × 20.

66: Same as Fig. 64, with enclosing tissues, caudal view, × 20.

67: Same as Fig. 64, oblique lateral view, × 20.

68: *Amphiacusta maya* n. sp., paratopotypic ♂, concealed genital sclerites, ventral view, after removal of tissues and sclerites associated with spermatophore sac, × 20.

69: Same, oblique lateral view, × 20.

70: Same, dorsal view, × 20.

71: Same, ventral view of pseudosternite and distal flaps, × 20.

72: *Amphiacusta yucatana* n. sp., same as Fig. 64, distal lobes of spermatophore sac, dorsal view, in normal, unflattened condition (cf. Fig. 65, E), × 20.

73: Same, lateral view, × 30.

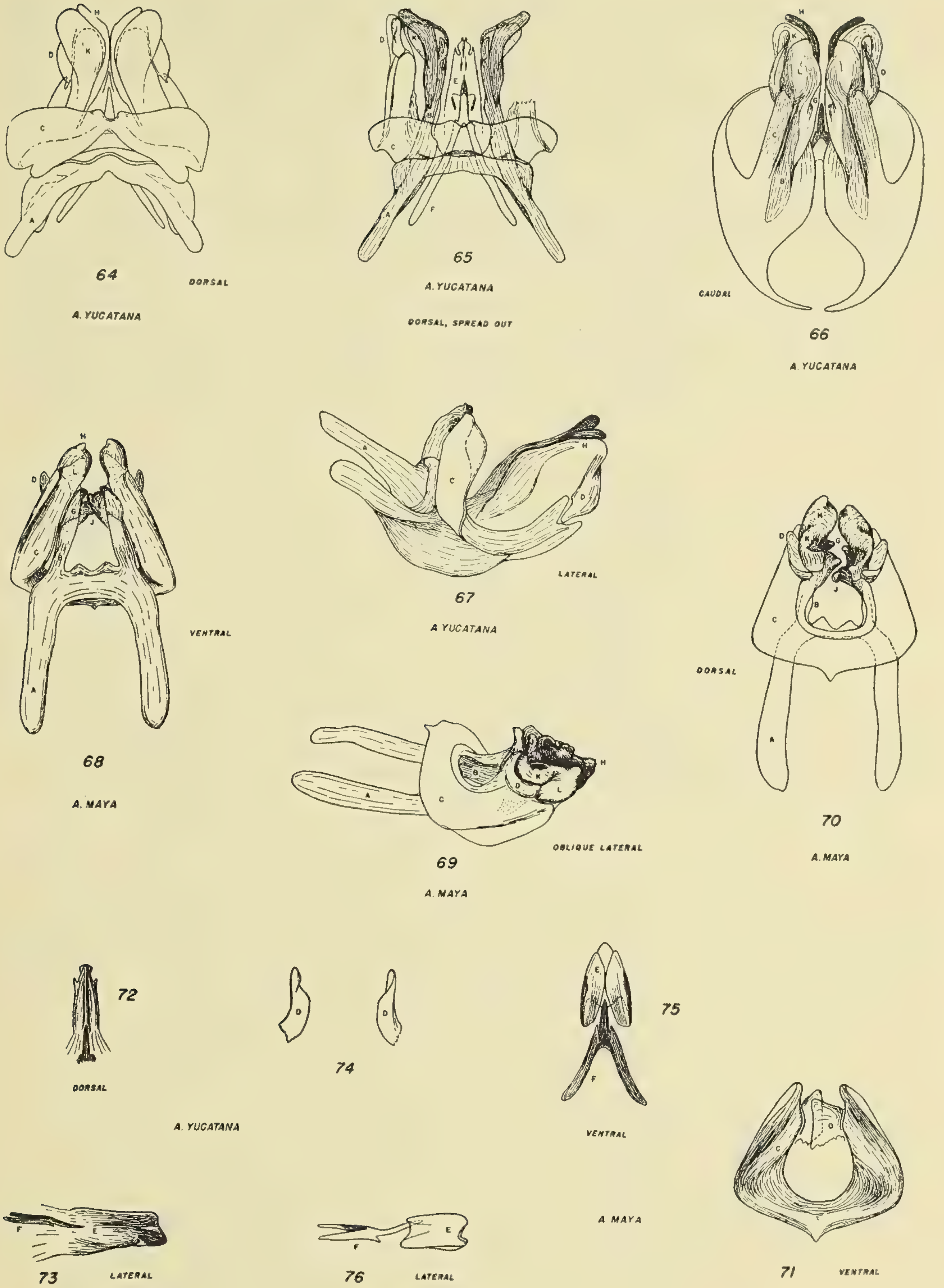
74: Same as Fig. 64, two views of one of the distal lobes which articulate with the apices of the rami of the pseudosternite, × 20.

75: *Amphiacusta maya* n. sp., same as Fig. 68, ventral view of distal lobes of spermatophore sac, × 30.

76: Same, lateral view, × 20.

In the figures of the concealed male genital sclerites, homologous parts and loci are correspondingly lettered. Their probable homologies, in terms of the nomenclature established by E. M. Walker (1922, cf. *Oecanthus*, Pl. V, Figs. 44-46), are as follows:

A—Endoparamere, or paramere base.
B—Base of distal portion of paramere.
C—Pseudosternite.
D—A distal lobe, flap, or spinous process, articulating with distal (caudal) ends of rami of pseudosternite, and sometimes adnate to K and L.
E—Distal lobes of spermatophore sac.
F—Proximal sclerite associated with spermatophore sac.
G—Ventral lobe of paramere.
H—Distolateral lobe of paramere.
J—Dorsal lobe of paramere.
K—Dorsal fold of distolateral lobe of paramere.
L—Ventral fold of distolateral lobe of paramere.



Figs. 64-76—*AMPHIACUSTA*

(*For description see opposite page.*)

indicated mode 6; internodorsal margin with 0-6, preponderatingly 1 or 2; average total number of denticulations 8+); length of tarsal segments 1:2:3 forming ratio 100:13:35 (in series 100:7-14, mean 11:23-38, mean 32); metatarsal spurs large, the outer three-fifths as long as the inner, the latter reaching proximal third of distal tarsal segment and subequal to that segment in length; all tarsal claws small, slender, strongly curved.

Terminal abdominal structures.—Ninth tergite forming a subquadrate supra-anal plate, with distolateral angles divaricately produced as short, rounded, setose lobes, distal margin between lobes gently convex (Fig. 21). Cerci very elongate, exceeding body-length, 1.21 (1.18-1.24) times as long as caudal femur, the base stout and rapidly tapering, the remainder slender and gradually tapering to excessively fine apex. Subgenital plate a simple, compressed, scoop-shaped structure, with broadly and shallowly excavate, subtruncate apical margin. Concealed genital sclerites as shown in Figures 64-67, 72-74.

DESCRIPTION OF ALLOTYPIC FEMALE

Agrees with male except as indicated below. Larger, body-length 18.8 (14.0-20.5, mean 17.5) mm. Apterous.

Head.—Eyes 1.8 times as long as broad, interocular distance 1.22 times length of eye, distance between lateral ocelli .55 (.49-.57) times interocular distance, distance from median ocellus to suture at base of fastigium .79 (.77-.89) times as long as distance between lateral ocelli, apical breadth of rostrum .78 (.6-.95) times breadth of proximal antennal segment, distance from lower angle of eye to anterior mandibular condyle .75 times length of eye; total length of maxillary palpus 2.74 times pronotal length, distal segment 1.41 times interocular distance; antennae of ♀ paratypes 106-162 mm. long, 6.0-7.9, mean 7.2 times as long as caudal femur.

Legs.—Cephalic femur 3.26 (3.18-3.68, mean 3.37) times length of pronotum; caudal femur 5.62 (5.47-6.19, mean 5.73) times length of pronotum, 1.72 (1.63-1.81, mean 1.71) times as long as cephalic femur, 4.78 (4.33-5.24, mean 4.70) times as long as greatest breadth; caudal tibia 1.15 (1.08-1.20, mean 1.13) times as long as caudal femur, armed on both dorsal margins with 4 spurs on each leg (variation as in male), spine formulae of outer dorsal margins (right) 19/10/5/1/0, (left) 20/10/7/2/0, of inner dorsal margins (right) 19/6/4/0, (left) 19/8/5/0 (average total number of spines on outer margin 36.5, on inner margin 28.5), internomedian calcar 4.6 times as long as tibial depth, .60 times length of caudal metatarsus; latter .25 times length of caudal tibia, 1.58 times as long as pronotum, armed on externodorsal margin with 4 (right) and 5 (left), on both internodorsal margins with 3 denticulations (variation as in male).

Terminal abdominal structures.—Cerci longer than body, 1.10 (1.0-1.16, mean 1.08 times as long as caudal femur. Subgenital plate compressed, narrowly truncate, when flattened out the apex shallowly rounded-emarginate. Ovipositor straight, linear, .74 (to .93, mean .83) times as long as caudal femur, 4.15 (4.12-5.47, mean 4.81) times as long as pronotum, apex acute-lanceolate in dorsal and lateral views (Fig. 44), set off from shaft by mere angulation of dorsal margin, not by a distinct notch as in *maya* and *phalangium*.

TABLE 5

MEASUREMENTS OF ADULT SPECIMENS OF AMPHIACUSTA YUCATANA

(in millimeters)

SPECIMENS	LENGTH			BREADTH	LENGTH		BREADTH	LENGTH			
	Body	Pronotum	Tegmen	Tegmen	Cephalic Femur	Caudal Femur	Caudal Femur	Caudal Tibia	Ovipositor	Antenna	Cercus
Males:											
Holotype*	16.0	2.5	3.4	3.4	9.4	15.7	3.3	17.8	.....	...	17.5
Paratype[a]	12.2	1.9	3.0	2.9	7.3	11.9	2.4	13.8	.....	...	....
Paratype[b]	12.8	2.4	3.2	3.4	9.7	14.1	3.1	15.5	.....	122	....
Paratype[c]	16.4	2.6	3.8	3.6	8.8	14.7	3.1	17.2	.....	141	18.0
Paratype[d]	15.7	2.8	3.5	3.7	9.7	15.7	3.3	17.8	.....	130	....
Paratype[e]	17.5	2.7	3.9	3.9	10.3	16.9	3.8	19.2	.....	130	20.0
Paratype[f]	15.6	2.8	4.1	4.0	10.2	16.9	3.7	19.1	.....	145	21.0
Paratype[g]	.....	3.0	4.4	4.0	10.9	17.9	4.0	20.8	.....	...	....
Mean	15.3	2.54	3.87	3.69	9.34	15.42	3.30	17.68	.....	125	18.4
Females:											
Allotype*	18.8	3.35	....	....	11.0	19.1	4.0	20.9	14.1	...	21.0
Paratype[h]	15.2	3.0	....	....	9.8	16.4	3.6	19.6	14.6	...	18.0
Paratype[i]	16.3	2.9	....	....	10.4	17.7	3.6	20.4	15.1	106	....
Paratype[k]	15.7	3.3	....	....	10.8	18.0	3.9	21.1	15.7	140	....
Paratype[m]	17.0	3.3	....	....	11.0	18.6	4.0	21.9	15.8	125	20.0
Paratype[n]	20.2	3.3	....	....	10.9	19.4	4.1	21.8	17.0	130	....
Paratype[o]	18.6	3.6	....	....	11.8	20.2	4.5	23.2	16.8	158	....
Paratype[p]	21.4	3.5	....	....	12.0	20.7	4.3	23.0	16.4	164	22.0
Mean	17.52	3.26	....	....	10.97	18.66	3.97	21.15	15.64	137	20.1

*Additional measurements of holotype and allotype as follows, those of male given first: Breadth of pronotum 4.3, 5.7; length middle femur 8.7, 10.5; length caudal tarsus 6.9, 7.9; length caudal metatarsus 4.6, 5.3; length externomedian calcar 1.3, 1.5; length internomedian calcar 2.7, 3.2; length eye 1.5, 1.8; breadth eye .9, 1.0; interocular distance 1.85, 2.2; breadth proximal antennal segment .7, .9; length maxillary palpus 7.0, 9.2; length distal segment maxillary palpus 2.5, 3.1. The paratypes of which the measurements are given are from the following localities: a, d, h—San Bulha Cenote Cave, Motul; b, i—Kaua Cave, Kaua; c—Ebizt Cave, Oxkutzcab; e—Sazich Cave, Calcehtok; f, m—Gongora Cave, Oxkutzcab; g, n, o—Puz Cave, Oxkutzcab; k—Chakxix Cave, Tekax; p—Xmahit Cave, Tekax. The means are those of the entire series of adults. "Breadth tegmen" refers to the breadth of the dorsal field only.

COLORATION

Compared with other species of the genus *Amphiacusta yucatana* is of unusually pale coloration. The general features of the pattern are indicated in Figures 21-25. The holotype and allotype, pinned after treatment with xylol, have the contrast between the darker and lighter areas somewhat intensified; the following color description is therefore based upon the paratypic series, preserved in alcohol.

The coloration of the specimens of this series shows relatively little variation. The dorsum is prevailingly amber brown, with a narrow but distinct pale mid-dorsal line, and with pattern giving a more or less conspicuously transverse-banded appearance. The male tegmina are nearly concolorous with the dorsal ground-color, the femora are plainly but not strikingly annulate or fasciate, the tibiae are slightly darker than the dorsum and uniformly colored, and the lower parts of the head, mouthparts, pleurae and venter are pale. In detail the coloration is as follows:

HEAD.—Eyes brownish-black; genae, facial region and mouthparts pale, except for a dilute violet-brown infra-ocular wedge and variably distinct admesal shadings;

vertex and fastigium amber brown, the vertex with four faintly paler longitudinal bars and with brownish shadings about the lateral ocelli, the fastigium more or less distinctly marginate with brownish; maxillary palpi with segments 5, 4, and distal two-thirds of 3 washed on dorsal and lateral faces with dilute violet-brown; antennae amber brown at base, shading distad to ochraceous tawny or somewhat darker brown.

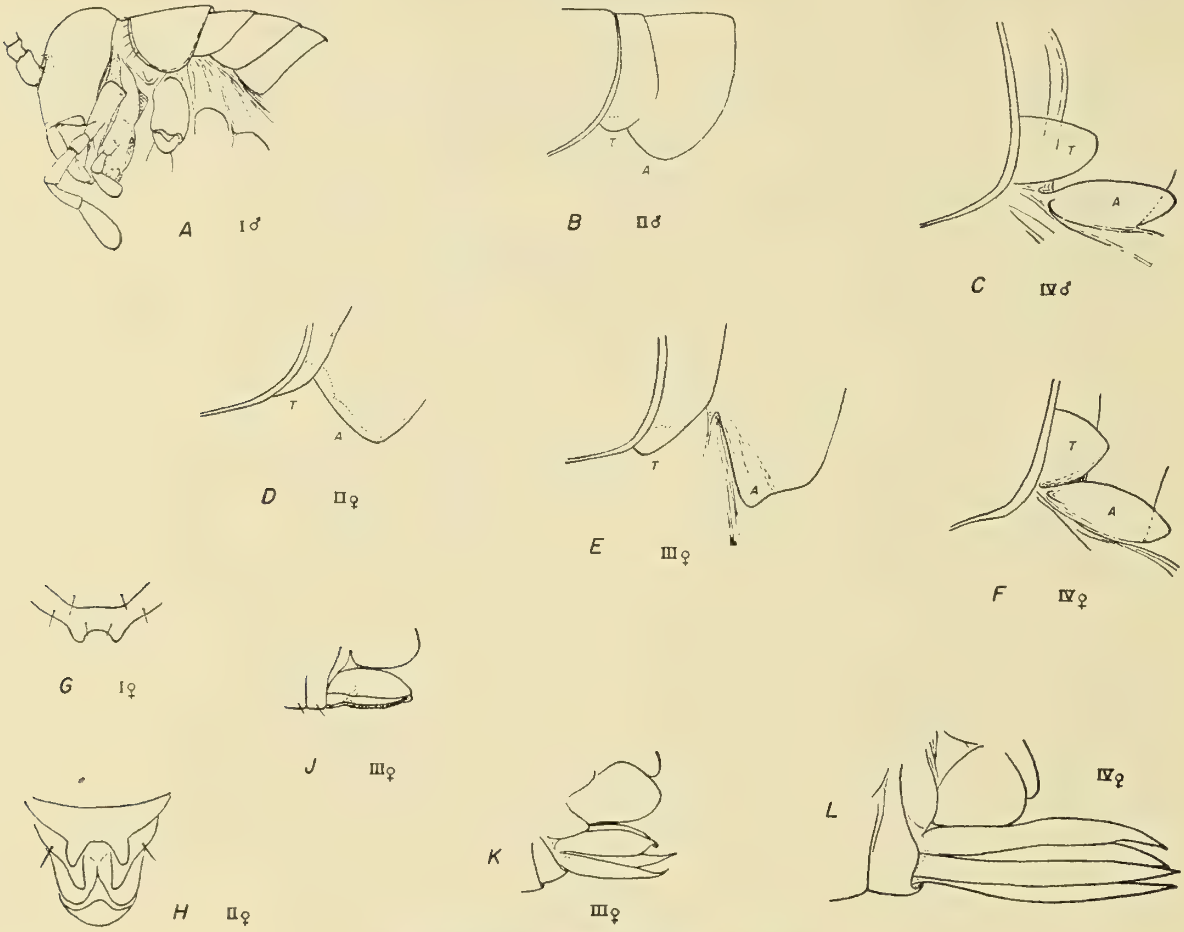


Fig. 77—*TOHILA ATELOMMA* n. g., n. sp.

Details of juvenile instars. B and H from Chac Mol Cave, Tohil; all others from Balaam Canche Cave, Chichen Itza. All × 32.

A: First instar male, lateral view of head and thoracic nota.

B-F: Lateral views of thoracic nota, showing tegminal (T) and alar (A) rudiments—
  - B: Second instar male.
  - C: Fourth instar male.
  - D: Second instar female.
  - E: Third instar female.
  - F: Fourth instar female.

G-L: Development of ovipositor—
  - G: First instar female, showing initial ovipositor rudiments.
  - H: Second instar female, showing enlarged rudiments.
  - J: Third instar female.
  - K: Another third instar female with slightly larger ovipositor.
  - L: Fourth instar female (the fifth instar has ovipositor like this but longer).

Pronotum.—Narrowly marginate with amber brown, the marginal setae brownish-black; disk and upper parts of lateral lobes amber brown (in part approaching xanthine orange in some specimens), bordered caudad by a narrow transverse band of darker brown which extends to ventral margins of lateral lobes, the entire region back of this band pale yellowish-white; cephalic margin of the brownish intramarginal band irregular, sending cephalad indistinct dark shadings which faintly or distinctly outline the transversely wedge-shaped admesal foveae and larger and smaller amber brown spots in the region between the foveae and the brown band; ventral part of lateral lobes entirely pale except for its interruption by the brown band and for the amber brown margination; mid-dorsal pale line narrow but distinct. Mesonotum pale. Metanotum and first abdominal segment with caudal margins rather broadly pale-bordered; the former with entire lateral area also pale, with a pair of dilute brownish admesal blotches of some size; the first abdominal tergite mostly amber brown, with a pair of admesal triangular blotches with apices directed caudad, and a larger pair of dilute brownish dorsolateral blotches with anteromesal margins extending obliquely laterad. Remainder of abdominal tergites amber brown dorsad, the caudal ones becoming paler, and all marginate caudad with narrow bands of darker brown, those of the second and third tergites expanding cephalad on each side of mid-dorsal pale line. Supra-anal plate pale, with proximolateral and distomesal blotches of dilute violet-brown, connected by narrow linear markings of the same. Cerci dilute brownish, proximad with lateral and mesal faces shaded with dilute, minutely pale-stippled violet-brown.

Legs.—Cephalic and middle femora amber brown dorsad, this color extending to upper part of sides near base, and covering all but ventral face at apex, lower parts pale; subproximal, median and subapical paler annuli weakly to very weakly indicated. Caudal femora as shown in Figure 25; dorsal surface amber brown; outer face pale, with 3 oblique amber brown fasciae (containing darker brown linear markings) extending from dorsum toward the lateral groove, the latter brownish, and with continuations of the dorsal fasciae more or less strongly indicated below it, these fasciae demarcating a pale pregenicular annulus and 3 oblique pale areas in proximal two-thirds of femur, the proximal one including the entire lower part of the base; inner face with these markings duplicated, except that the proximal brownish fascia is often strongly intensified. All tibiae and tarsi uniformly amber brown to tawny olive, often slightly darker than dorsum of body.

Male tegmina.—Concolorous with or slightly darker than general coloration of dorsum, generally amber brown to Dresden brown or Saccardo's umber, veins concolorous with membrane or slightly paler. Ovipositor ochraceous tawny, dorsal and ventral margins of outer valves generally darker. Lower parts of head, pleurae (except for scattered violet-brown shadings) and venter pale, yellowish or whitish.

Variation.—This has been for the most part treated in the foregoing descriptions. The small series studied gives no evidence that differences in size or proportions characterize the populations of the different caves examined. Variation in the male tegminal venation is illustrated in Figures 21 and 34-42. In the males the caudal tibiae are armed with spurs on the outer and inner margins as follows, each leg examined being counted separately: 3-4, 3; 4-4, 31; 5-4, 4; 4-5, 1; the females show the following distribution: 3-4, 1; 4-4, 47; 5-4, 4, 4-5, 1.

LIFE HISTORY

Spermatophore.—Five of the paratypic males held spermatophores in the genital chamber. These are shaped as shown in Figure 78. The form and dimensions are nearly constant in those examined. The body of the spermatophore is subspherical, measuring 1.25 mm. in an anteroposterior direction, 1.35 mm. in vertical diameter; arising from its ventrocaudal surface is the sperm duct, a tube 1.85-1.91 mm. in length, with the distal .56-.60 mm. brownish and rigid, the remainder slightly larger in diameter and with thinner, lighter-colored walls. Variably-shaped mucous masses are attached to and partly enclose the duct. On the dorsocaudal surface of the body of the spermatophore is an oval, flat-topped prominence, .44×.27 mm. in the figured specimen. The entire object, except for the distal portion of the sperm duct, is pure white, the surface of the body of the spermatophore glistening, the variably-shaped mucous masses dull.

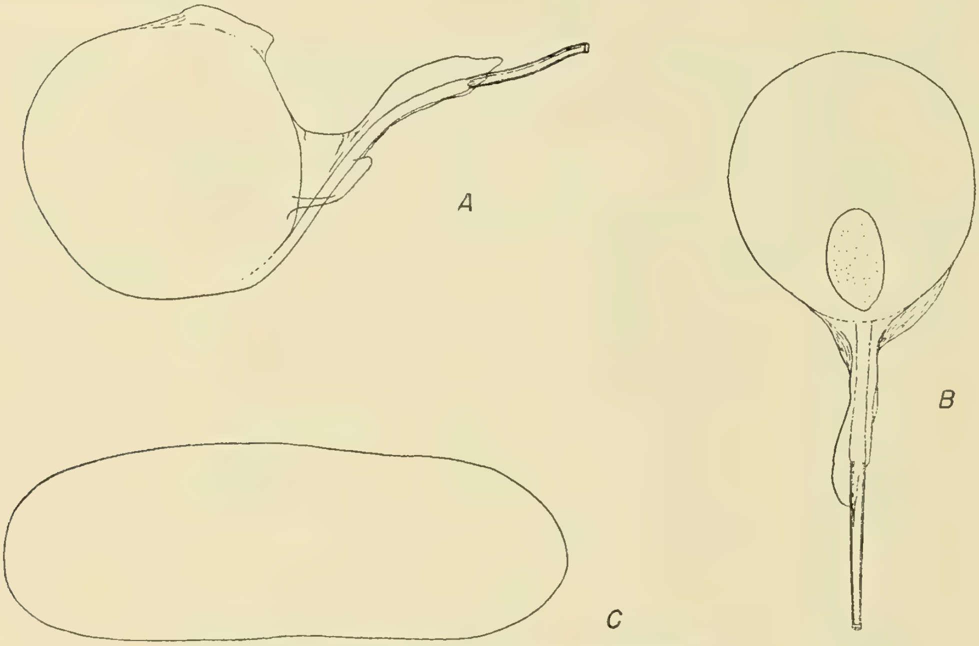


Fig. 78—*AMPHIACUSTA YUCATANA* n. sp.
Spermatophore and egg, × 28.

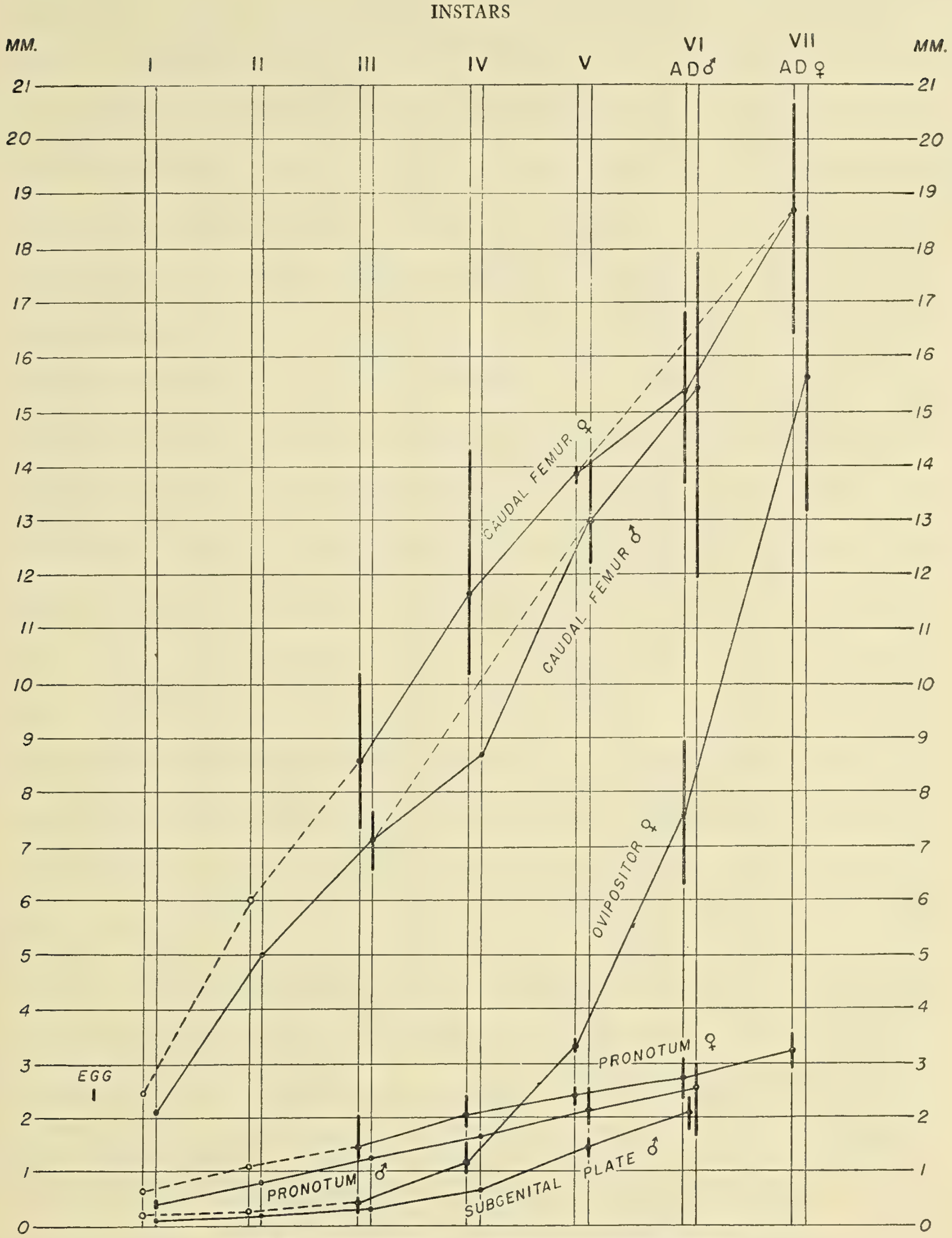
A: Lateral view of spermatophore of male from Balaam Canche Cave, Chichen Itza.

B: Dorsal view of same.

C: Lateral view of largest ovarian egg of female from Cinquo de Mayas Cave, Tekax.

Eggs.—Two mature ovarian eggs removed from the body of a female taken July 29 in Cinquo de Mayas Cave are shaped as shown in Figure 78. They measure 2.54×.87 mm. and 2.40×1.33 mm. respectively.

Juvenile instars.—The paratypic series includes 12 male nymphs and 36 female nymphs. The male nymphs fall clearly into 5 pre-adult instar groups, the adult condition being reached in the 6th instar. Only four of the pre-adult instars are represented among the female nymphs, and it has been a matter of some difficulty to decide whether the smallest represented the 2nd or the 3rd instar.



Graph II—*AMPHIACUSTA YUCATANA*, GROWTH CURVES

Calculation of the percent of diminution which occurs in passing from each instar to that preceding, in the males and in the female instar groups represented, according to the principle of Dyar's rule, leads me to believe that the two earliest instars are missing. Graph II, drawn on this assumption, shows reasonably good correlation between the curves for the male and for the female, and the predicted dimensions of the caudal femur of female Instar I are nearly what would be expected from the size of the egg. If this interpretation is correct, the female passes through one more stadium than the male before becoming adult.

General remarks.—The previously known species of *Amphiacusta* all have larger eyes and are generally darker than *A. yucatana*. This may (but does not necessarily) indicate that the present species is more strictly cavernicolous than its congeners, some of which are known to live for the most part above ground. Nothing is as yet known as to whether *A. yucatana* occurs outside of caves and cenotes, but this seems likely. Specimens were taken in 23 of the 24 caves where Dr. Pearse collected cave-crickets. *Amphiacusta yucatana* was generally found near the entrances of the caves, sometimes even in the lighted outer chambers; but individuals also occurred far in the interior, as at Balaam Canche Cave, where specimens were obtained at the temple pool, 260 m. from the entrance. All instars apparently occur together, indicating that there is great overlap in generations. The adults and larger nymphs usually rest upon the walls and roofs of the caves, but small nymphs (and occasionally adults) were taken under stones on the cave floors, or in bat feces. Examination of the contents of the crops of several specimens showed that all had been eating insects, though whether fresh, or from bat feces, was not evident. Fragments of beetles, ants and scales of Lepidoptera were identifiable.

Specimens examined.—123: 31♂, 39♀ (including holotype and allotype), and 53 nymphs, all included in the type series. Holotype, allotype and part of paratypes in the Museum of Zoology, University of Michigan; remainder of paratypes in the Mexican National Museum. Holotype, allotype and 9 paratypes pinned, the remaining specimens in alcohol. All collected in Yucatan during the summer of 1936 by Dr. A. S. Pearse, in caves, except as noted below.

Balaam Canche Cave, Chichen Itza: June 8, 2 adult ♂♂, 1 adult ♀ (Cat. No. 4—"on roof"); June 13, 5 adult ♂♂ (including holotype), 2 ♀♀ III, 3 ♀♀ VI, 3 adult ♀♀ (Cat. No. 18—"within cave, near mouth, on walls"); June 28, 1 ♂ IV, 1 adult ♂, 1 adult ♀ (allotype) (Cat. No. 66A—"temple pool, 260 m. from mouth").

Thompson's Cenote, 2.4 km. east of Chichen Itza: June 13, 1932 (A. S. Pearse and E. P. Creaser) 1 adult ♂ (a dry cenote).

Chichen Itza: February, 1930 (F. M. Gaige) 1 ♀ IV, 1 ♀ V; Feb. 2, 1936 (Trautman and Van Tyne) 1 ♀ III.

Kaua Cave, Kaua: June 16, 1 ♂ V, 1 ♀ IV, 2 ♀ VI, 4 adult ♀♀ (Cat. No. 23—"7.6 m. within and below entrance of cave"); June 16, 1 ♂ I (Cat. No. 24—"under stones, 3-6 m. below mouth"); June 17, 1 ♂ III, 3 adult ♂♂, 1 ♀ IV, 1 adult ♀ (Cat. No. 28—"by big pool").

Oxolodt Cave, Kaua: June 18, 1 adult ♂, 4 ♀♀ VI (Cat. No. 36—"upper cave").

Xtoloc Cenote Cave, Chichen Itza: June 24, 1 adult ♀ (Cat. No. 51—"on walls").

Chac Mol Cave, Tohil: June 27, 1 ♀ V, 1 ♀ VI, 1 adult ♀ (Cat. No. 62—"on wall near mouth").

San Isidro Cave, Merida: July 3, 1 adult ♂, 1 ♀ VI (Cat. No. 69—"walls and roof").

Hoctun Cave, Hoctun: July 8, 1 adult ♀ (Cat. No. 92—"near mouth, inside a bat cave 163 m. long. Not many crickets seen; none seen except near mouth").

San Bulha Cenote Cave, Motul: July 26, 1932 (E. P. Creaser) 1 ♂ I, 1 ♀ II or III; July 9, 1936, 4 adult ♂♂, 1 adult ♀ (Cat. No. 97—"inner end"); July 13, 1936, 1 ♂ III, 3 adult ♂♂, 2 ♀♀ III, 1 adult ♀ (Cat. No. 105—"walls and roof").

Gongora Cave, Oxkutzcab: July 16, 1 ♂ V, 1 adult ♂, 1 ♀ IV, 1 ♀ VI, 3 adult ♀♀ (Cat. No. 110—"9 m. within and 6 m. below mouth; under stones").

Ebizt Cave, Oxkutzcab: July 18, 1 adult ♂, 1 ♀ VI, 2 adult ♀♀ (Cat. No. 120—"mouth").

Puz Cave, Oxkutzcab: July 20, 1 adult ♂, 2 adult ♀♀ (Cat. No. 130—"within cave, near mouth, on walls").

First cave on San Roque Road, Oxkutzcab: July 22, 1 ♀ IV, 1 ♀ V, 2 adult ♀♀ (Cat. No. 138—"Crystal chamber").

Ziz Cave, Oxkutzcab: July 24, 1 ♂ I (Cat. No. 147—"on bat feces"); July 24, 1 ♀ VI, 2 adult ♀♀ (Cat. No. 150—"near mouth").

Loltun Cave, Oxkutzcab: July 26, 1 adult ♂, 1 ♀ VI, 1 adult ♀ (Cat. No. 154—"within cave, near mouth, on walls").

Cinquo de Mayas Cave, Tekax: July 29, 3 adult ♀♀ (Cat. No. 161—"within lighted outer chamber of cave").

Sabacha Cave, Tekax: July 30, 1 ♀ VI, 1 adult ♀ (Cat. No. 165—"within and below mouth").

Xmahit Cave, Tekax: July 31, 2 adult ♀♀ (Cat. No. 169—"6 m. below mouth of cave").

Chakxix Cave, Tekax: August 1, 1 ♂ V, 1 ♀ III, 1 adult ♀ (Cat. No. 173—"outer cave").

Spukil Cave, Calcehtok: August 6, 1 ♂ V, 1 adult ♂, 1 adult ♀ (Cat. No. 176—"on walls"); August 5, 1 ♂ II (Cat. No. 179—"under stones").

Sazich Cave, Calcehtok: August 6, 1 ♂ V, 1 adult ♂, 2 ♀♀ VI (Cat. No. 183—"on walls").

Xkyc Cave, Calcehtok: August 7, 1 adult ♂, 1 adult ♀ (Cat. No. 185—"at entrance").

Xconsacab Cave, Tizamin: August 11, 1 adult ♂, 2 ♀♀ III, 2 adult ♀♀ (Cat. No. 189—"18 m. from mouth, at inner part of reticulate cave, 9 m. below surface").

Muruztun Cave, Tizamin: August 12, 1 ♂ V, 2 adult ♂♂ (Cat. No. 195—"in middle").

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XVII

A NEW MYRMELEONID FROM YUCATAN

NATHAN BANKS

Specimens of an ant-lion fly and the larvae collected in caves in Yucatan occurred near the entrance of the caves. These specimens prove to belong to the genus *Eremoleon,* one species of which was known from Cuba, and one from Mexico and Arizona. The Yucatan species is different from them, and as the case with many cave forms, it differs in the longer appendages, legs, antennae, wings.

Eremoleon longior n. sp.

Body pale yellowish; head with a large black mark around antennae, truncate in front, above reaching to vertex; across vertex are three dark spots in a row, the laterals are transverse, the middle one consists of two elongate spots, close together and not divergent behind (in *macer* these diverge behind). Last joint of maxillary palpi partly dark, tip of antennae very dark; pronotum with a more or less distinct large dark mark, divided by a pale median stripe, each side behind are two shorter, curved pale stripes, uniting in front (much as in *macer*); rest of notum largely dark, but with a median pale line on front part, and some pale each side near base of wings. Abdomen with segments dark on apical half above (as in *macer*). Legs pale, dark at tips of femora and tibiae and faintly toward base of tibiae.

Fore wings hyaline, venation pale, marked with dark streaks (as in *macer*); many cross-veins wholly or partly dark; stigma white, with dark at base, and a larger dark cloud at rhegma, that near end of cubital fork scarcely distinct. Head as in *E. macer;* antennae much longer than in *macer,* reaching beyond base of the abdomen, latter a little longer than in *macer,* pronotum also more slender than in *macer.* Legs and their parts also much longer than in *macer,* the long inner spur of the front tibia being nearly as long as the distance from eye to eye.

Wings a little longer than in *macer,* but with no more veins, the cells thus often longer than in that species; six to seven cross-veins before radial sector (eight or nine in *macer*), radial sector with eight branches, a few costals toward stigma are forked, the apical area is without gradate veinlets (normally several in *macer*).

Length of fore wing 32 mm., width 9 mm.

From Yucatan; Xtoloc Cenote Cave, Chichen Itza June 24; Chakxix Cave, Tekax, August 1; Puz Cave, Oxkutzcab, July 20; all taken by A. S. Pearse. Type M. C. Z. No. 22654. Other specimens, which were doubtless *E. longior,* were seen in San Bulha Cave, Merida, July 13; Ebizt Cave and second cave on the San Roque Road, Oxkutzcab, July 18 and 23. Readily separated from *E. macer* Hag. by more elongate body, legs, and antennae; by few cross-veins before radial sector, and lack of apical gradate veins. According to the descriptions, *Segura vitreus* Navas from Cuernavaca, and *Novulga mexicana* Navas from Vera Cruz are the same as *Eremoleon macer;* both are said to have eight or nine cross-veins before radial sector, and the figures show a denser venation than *E. longior.* I have specimens of *E. macer* from Cuernavaca.

XVIII

INSECTS FROM YUCATAN CAVES

A. S. Pearse
Duke University

Many insects were collected in caves in Yucatan during the summer of 1936. Myrmeleons, collembolans, cave-crickets, and ants have been studied by Nathan Banks, Harlow B. Mills, Theodore H. Hubbell, and the late William Morton Wheeler. The papers prepared by these specialists appear elsewhere in the present report. The insects discussed in this section were, with three exceptions, identified by C. F. W. Muesebeck and his colleagues in the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture. To these gentlemen grateful acknowledgment is made for careful examination of material, much of which was in poor condition. Appropriate notations have been added by the writer. The name of the identifier is given in parenthesis at the end of the comments on each species.

Very few of the insects collected may be classified as troglobite. Just within the mouths of caves wasps commonly build nests on the walls and roofs. Scavenger and coprophagous maggots, beetle larvae, and caterpillars feed on accumulated rubbish, carcasses of animals, and fecal deposits of swallows and bats. Predaceous insects and parasites, such as mosquitoes, carabid beetles, flies, and hymenopterans are associated with such scavengers. The moth, *Latebraria amphipyroides* Guen., is commonly found hiding in dark nooks during the day and flies about at night. Adult myrmeleons cling to roofs and the pits of their larvae (ant lions) are common in suitable situations within the mouths of caves. The predaceous larvae of therevid flies (*Psilocephala* sp.) spin webs on the roofs of caves and hang suspended in them. Bats bring in bat flies and bedbugs. Four genera and seven species of flies (Streblidae) were found on five species of bat hosts in Yucatan caves. One plague flea was found on a mouse. Humidity is usually too high in caves to be favorable for the development of fleas. Of the insects that range throughout caves, often in total darkness, two species of cave crickets, a cockroach (*Holocompsa zapoteca* Saussure), histerid beetles, several species of small flies, and ants are most common. Ants probably usually enter caves by coming through the ground more or less directly from above, but some species are troglobite.

Of the hundred species of insects listed in this section only two (a cockroach and a therevid fly) appear to be indubitably troglobite, though other flies and beetles may be confined to caves. A few may be hemitroglobite. It is doubtful if any are pseudotroglobite, as temperatures are not particularly low or variable outside caves in Yucatan. Four species are aquatic. Most of them are trogloxenes (or tychotroglobionts). In relation to foods the insects appear to fall into the following groups: parasites (including mosquitoes, fleas, etc.), 27; vegetarians, 10; predators, 19; scavengers, 36; and coprophages, 14.

Class INSECTEA

Order BLATTIDA

Family BLATTIDAE

Subfamily Corydiinae

Holocompsa zapoteca Saussure

This ornate little cockroach was common throughout certain caves, particularly the rather dry, dusty caves in southern Yucatan. A. B. Gurney positively identified specimens from Puz Cave, Oxkutzcab, July 20; and Cinquo de Mayas Cave, Tekax, July 29. Other specimens which Mr. Gurney believed to belong to this species came from Xtoloc Cenote Cave, Chichen Itza, June 24; Ebizt Cave, Oxkutzcab, July 18; Puz Cave, July 20; first cave on San Roque Road, Oxkutzcab, July 22; Cinquo de Mayas Cave, Tekax, July 29; and Spukil Cave, Calcehtok, August 5.

Subfamily Blaberinae

Blaberus atrops (Stoll)

This roach was found once in Xmahit Cave, Tekax, July 31. (A. B. Gurney)

Blaberus craniifer Burmeister

This gigantic roach was collected within three caves, but near the entrances: Kaua Cave, Kaua, June 16; Puz Cave, Oxkutzcab, July 20; Cinquo de Mayas Cave, Tekax, July 29. (A. B. Gurney)

Order MANTIDA

Family MANTIDAE

A mantid nymph was collected inside the mouth of Sabacha Cave, Tekax, July 30. (A. B. Gurney)

Order CORRODENTIDA

Psyllipsocus (near *ramburii* Selys)

Xtoloc Cenote Cave, Chichen Itza, June 24, on floor among stones and debris and in bat feces. (A. B. Gurney)

Order THYSANOPTERIDA

Japyx sp.

A juvenile specimen collected inside Spukil Cave, 40 m. from mouth, Calcehtok Hacienda, August 5, was identified by W. A. Hilton.

Order HETEROPTERIDA

Family CIMICIDAE

Cimex hemipterus Fabricius

An adult bedbug was taken from a bat *Myotis nigricans extremus* Miller, shot in Cinquo de Mayas Cave, Tekax, July 29. Three nymphs were caught in a tow net in San Isidro Cave, Merida, July 4, in a pool 70 m. from the mouth. (H. G. Barber)

Family NAEOGEIDAE

Nymphs were collected in Balaam Canche Cave, Chichen Itza, June 11, 13, 260 m. from mouth and on walls near mouth. (H. G. Barber)

Family REDUVIIDAE

Nymphs of Stenopodinae were collected in rubbish and bat and swallow feces in Kaua Cave, Kaua, June 16, and in Cinquo de Mayas Cave, Tekax, July 29. (H. G. Barber)

Ploiaria n. sp.

Specimens were taken near Oxkutzcab in Puz Cave, July 20, and in two caves on the San Roque Road, July 22, 23. (H. G. Barber)

Family CYDNIDAE

Galgupha mayana McA. and M.

Spukil Cave, Calcehtok, August 5, near mouth. (H. G. Barber)

Pangaeus piceatus Stal.

Xkyc Cave, Calcehtok, August 7, 23 m. from mouth. (H. G. Barber)

Order HOMOPTERIDA

Family FULGORIDAE

Aethus compactus Uhl.

In rubbish below mouth, San Isidro Cave, Merida, July 3. (H. G. Barber)

Cixius sp.

Gongora Cave, Oxkutzcab, July 16, 78 m. from mouth in complete darkness. (P. W. Oman)

Order ODONATIDA

Family LIBELLULIDAE

Dythemis sterilis Hagen

Female dragonflies were laying eggs in a small puddle on the cement floor in full light below the entrance of the San Bulha Cenote, Motul, July 9. (P. P. Calvert)

Order Coleopterida

Family carabidae

Lemostenus sp.

Larvae were found in rubbish on the floors of Kaua Cave, Kaua, June 16 and Sazich Cave, Calcehtok, August 6, in the latter 60 m. from mouth. (A. G. Bovig)

?*Aephnidius* sp.

Kaua Cave, Kaua, June 16; Sazich Cave, Calcehtok, August 6. (L. L. Buchanan)

Family dytiscidae

Thermonectes sp.

San Bulha Cenote, Motul, July 9. (L. L. Buchanan)

Family hydrophilidae

Tropisternus apicipalpis Chev.

Yunchen Cave, Libre Union, July 9. This cave is jug-shaped and contains much water. (L. L. Buchanan)

Family leiodidae

Ptomophagus sp.

Silphid beetles were found in a dead lizard at the mouth of Sabacha Cave, Tekax, July 30, and in rubbish on the floor of Spukil Cave, Calcehtok, August 6. (W. S. Fisher)

Family scydmaenidae

A beetle belonging to this family was collected in rubbish below the mouth of San Isidro Cave, Merida, July 3. (W. S. Fisher)

Family staphylinidae

Belonuchus sp.

Staphylinids of one species were found in the mouths of two caves near Tekax: Ciquo de Mayas Cave, July 29; Sabacha Cave, July 30, on dead lizard. (E. A. Chapin)

Atheta sp.

Cinquo de Mayas Cave, Tekax, July 29. (E. A. Chapin)

Family histeridae

Plegaderus sp.

Larvae were found in Balaam Canche Cave, Chichen Itza, in the carcass of a paca, 40 m. from mouth, June 9; at end of cave, 260 m. from mouth, June 12. (A. G. Bovig)

Platosoma sp.

Larvae, Cinquo de Mayas Cave, Tekax, July 29. (A. G. Bovig)

Gnathoncus sp.

Hoctun Cave, Hoctun, July 7, 160 m. from mouth, organic debris. (H. S. Barber)

Saprinus Sp. 1

San Bulha Cenote, Motul, July 9, bat feces; Sabacha Cave, Tekax, July 30, near mouth in dead lizard; Xconsacab Cave, Tizamin, August 11, bat feces, near entrance. (H. S. Barber)

Saprinus Sp. 2.

Hoctun Cave, Hoctun, July 8, near mouth; San Bulha Cenote, Motul, July 9, in bat feces. (H. S. Barber)

Phelister sp.

Hoctun Cave, Hoctun, July 8, near mouth. (H. S. Barber)

Oxarthrius n. sp. (near *O. hamaticallis* Sharp)

Hoctun Cave, Hoctun, July 7, 160 m. from mouth, in organic debris, and near mouth, July 8. (H. S. Barber)

Family MELYRIDAE

Xtoloc Cenote Cave, Chichen Itza, June 24, in bat feces.

Family ELATERIDAE

Larvae in rubbish at entrance of second cave on San Roque Road, Oxkutzcab, July 23. (A. G. Bovig)

Orthostethus sp.

Larvae in organic debris: Kaua Cave, Kaua, June 16; Chac Mol Cave, Tohil, June 27, in accumulations below a porcupine's den. (A. G. Bovig)

Family SILVANIDAE

Cathartus quadricollis Guér.

On a trapped mouse, *Ototylomys phyllotis phyllotis* Merriam, Chac Mol Cave, Tohil, June 27. (W. S. Fisher)

Family ENDOMYCHIDAE

Rhymbus sp.

In rubbish on floor, San Bulha Cave, Merida, July 13. (W. S. Fisher)

Family COLYDIIDAE

Nematidium? sp.

In swallow feces at mouth of Ziz Cave, Oxkutzcab, July 24. (W. S. Fisher)

Family ALLECULIDAE

Larvae and pupae of Alleculinae were found in debris and bat feces: San Bulha Cenote, Motul, July 9; Gongora Cave, Oxkutzcab, July 17; bat feces, Xkyc Cave, Calcehtok, August 7, 38 m. from mouth. (R. St. George)

Family TENEBRIONIDAE

Rhinandrus elongatus? Horn

This beetle was widely distributed in Yucatan and was at times found at considerable distances within caves. Kaua Cave, Kaua, June 16, rubbish near mouth; Ebizt Cave, Oxkutzcab, July 18, 93 m. from mouth; two caves on San Roque Road, Oxkutzcab, July 23; Ziz Cave, Oxkutzcab, July 24, near mouth under swallow's nests; Xkyc Cave, Calcehtok, August 7, 30 m. from mouth. (R. St. George)

Blapstinus sp.

On a paca carcass, Balaam Canche Cave, Chichen Itza, June 9, 40 m. from mouth in complete darkness. (E. A. Chapin)

Anaedus sp.

Spukil Cave, Calcehtok, August 5, 300 m. from mouth. (E. A. Chapin)

Family SCARABAEIDAE

Cotinus viridicyanea Perbosc.

Xkyc Cave, Calcehtok, August 7, 38 m. from mouth. (E. A. Chapin)

Coelosis biloba Fabr.

Muruztun Cave, Tizamin, August 12, 25 m. from mouth. (E. A. Chapin)

Scarabaeid larvae were collected near the mouth of the second cave on the San Roque Road, Oxkutzcab, July 23. (A. G. Bovig)

Family PLATYPODIDAE

Platypus rugulosus Chappuis

On a bat, *Natalus mexicanus* Miller, shot 240 m. from the mouth in Balaam Canche Cave, June 23. (M. W. Blackman)

Order LEPIDOPTERIDA

Family NOCTUIDAE

Adult moths were collected in Balaam Canche Cave, Chichen Itza, June 13; Oxolodt Cave, Kaua, June 18, near mouth; Ebizt Cave, Oxkutzcab, July 18. (W. Schaus)

Latebraria amphipyroides Guen.

This moth was common in caves. It clung to the walls and hid in crevices near the mouth during day. Gongora Cave, Oxkutzcab, July 17; Puz Cave, Oxkutzcab, July 20; Ziz Cave, Oxkutzcab, July 24; Cinquo de Mayas Cave, Tekax, July 29; Chakxix Cave, Tekax, August 1; Sazich Cave, Calcehtok, August 6; Xconsacab Cave, Tizamin, August 11. (W. Schaus)

Family TINEIDAE

Species 1

Tineid caterpillars were found among organic materials: Balaam Canche Cave, Chichen Itza, June 9, in paca carcass, 40 m. from mouth; Luchil Cave, Tixcacal, July 6, organic debris; Oxolodt Cave, Kaua, June 18, bat feces; Hoctun Cave, Hoctun, July 7, organic debris; Spukil Cave, Calcehtok, August 5, in swallow feces. (Carl Heinrich)

Species 2

Larval teneids were also found in Luchil Cave, Tixcacal, July 6; Balaam Canche Cave, Chichen Itza, June 11, 260 m. from mouth. (Carl Heinrich)

Tinea sp.

Kaua Cave, Kaua, June 16. (A. Busck)

Order HYMENOPTERIDA

Family BRACONIDAE

Apanteles sp.

This ichneumonid was found in San Bulha Cenote, Motul, July 9. (C. F. W. Muesebeck)

Family CHALCIDAE

Brachymeria sp.

Puz Cave, Oxkutzcab, July 21. (A. B. Gahan)

Stomatoceras n. sp.

San Isidro Cave, Merida, July 3. (A. B. Gahan)

Family FRIGITIDAE

Eucolia sp.

This cynipid was probably parasitic on the fly (Metopiidae) with which it was found; Cinquo de Mayas Cave, Tekax, July 29, about 40 m. from mouth. It belongs to a group of parasites of Dipterida. (L. H. Weld)

Family BETHYLIDAE

Cleistepyris n. sp.

Near mouth of Kaua Cave, Kaua, July 16. (C. F. W. Muesebeck)

Family PSAMMOCHARINAE

A mutilated specimen was collected in Puz Cave, Oxkutzcab, July 20. (Grace Sandhouse)

Family SPHECIDAE

Crabro sp.

San Bulha Cave, Merida, July 13. (Grace Sandhouse)

Chorion (*Ammobia*) *caliginosum* (Erichson)

Cinquo de Mayas Cave, Tekax, July 29, near mouth. (Grace Sandhouse)

Podium brevicolle Kohl

San Bulha Cave, Merida, July 13. (Grace Sandhouse)

Notogonidea sp.

Loltun Cave, Oxkutzcab, July 26, nests inside mouth of cave. (Grace Sandhouse)

Family HALICTIDAE

Pseudaugochloropsis sordiscutis (Vachal)

Sazich Cave, Calcehtok, August 6. (Grace Sandhouse)

Order DIPTERIDA

Family CHIRONOMIDAE

Pupae were collected in Balaam Canche Cave under stones 30 m. from mouth, June 8. (C. T. Greene)

Pseudochironomus sp.

Sazich Cave, Calcehtok, August 6. (Alan Stone)

Chironomus sp.

Ziz Cave, Oxkutzcab, July 24, 65 m. from mouth. (Alan Stone)

Family CERATOPOGONIDAE

Dasyhelea sp.

Gongora Cave, Oxkutzcab, July 16, 10 and 65 m. from mouth. (Alan Stone)

Forcipomyia sp.

Chac Mol Cave, Tohil, June 27. (Alan Stone)

Family PSYCHODIDAE

Nemopalpus sp.

Second cave on San Roque Road, Oxkutzcab, July 23. (Alan Stone)

Family CULICIDAE

Aedes angustivittatus D. and K.

Sazich Cave, Calcehtok, August 6, near mouth. (Alan Stone)

Aedes euplocamus Dyar

Sazich Cave, Calcehtok, August 6, near mouth. (Alan Stone)

Aedes taeniorhynchus (Wd.)

Balaam Canche Cave, Xtoloc Cenote Cave, Chichen Itza, June 13, 24 near mouth; Kaua Cave, Kaua, June 16, near mouth; Luchil Cave, Tixcacal, July 6; Yunchen Cave, Libre Union, July 11; Puz and Loltun Caves, Oxkutzcab, July 21, 26; Sazich Cave, Calcehtok, August 6; Xconsacab and Muruztun Caves, Tizamin, August 10, 12. (Alan Stone)

Aedes sp.

Kaua Cave, Kaua, June 16; Xtoloc Cenote Cave, Chichen Itza, June 24; Yunchen Cave, Libre Union, July 11; Loltun Cave, Oxkutzcab, July 25; Sazich Cave, Calcehtok, August 6. (Alan Stone)

Culex sp.

Loltun Cave, Oxkutzcab, July 26, 1 km. from mouth near pool. (Alan Stone)

Haemagogus sp.

Balaam Canche Cave, Chichen Itza, June 13, near mouth. (Alan Stone)

Isostomyia sp.

Xtoloc Cenote Cave, Chichen Itza, June 24. (Alan Stone)

Psorophora sp.

Chac Mol Cave, Tohil, June 27, at top of cave near porcupine's den; Xtoloc Cenote Cave, Chichen Itza, June 24. (Alan Stone)

Family SCIARIDAE

Sciara sp.

San Bulha Cenote, Motul, July 9, on bat feces, Spukil Cave, Calcehtok, August 5, 300 m. from mouth; Sabacha Cave, Tekax, July 30, 10 m. from mouth. (Alan Stone)

Family STRATIOMYIDAE

Hermetia sp.

Larvae were collected in the second cave on the San Roque Road, Oxkutzcab, July 23, near mouth in bat feces. (C. T. Greene)

?*Cyphomyia* sp.

Larvae, in bat feces and debris on floor: Luchil Cave, Tixcacal, July 6; San Bulha Cenote, Motul, July 9; Gongora Cave, Oxkutzcab, July 17. (C. T. Greene)

Family TABANIDAE

Tabanus haemagogus Will.

Chac Mol Cave, Tohil, June 27, at top of cave, 65 m. from mouth. (Alan Stone)

Family THEREVIDAE

Psilocephala sp.

Kaua Cave, Kaua, June 16, in rubbish on floor near mouth. (C. T. Greene)

Predaceous larvae of these insects were found in several caves. They hung from the roof in delicate webs, often in total darkness. Chac Mol Cave, Tohil, June 27; San Bulha Cenote, Motul, July 9; Gongora Cave, Puz Cave, second cave on San Roque Road, Loltun Cave, Oxkutzcab, July 17, 20, 23, 25; Cinquo de Mayas Cave, Tekax, July 29; Sazich and Xkyc Caves, Calcehtok, August 6, 7. (C. T. Greene)

Family EMPIDAE

Drapetis sp.

Chac Mol Cave, Tohil, June 27, near top of cave, 65 m. from mouth, below leaves of porcupine's nest. (C. T. Greene)

Family PHORIDAE

Larvae were collected in bat feces in Balaam Canche Cave, Chichen Itza, June 11, 260 m. from mouth; Oxolodt Cave, Kaua, June 18, 40 m. from mouth. Adult phorids were taken in Luchil Cave, Tixcacal, July 6. (C. T. Greene)

Megaselia scalaris Lw.

This phorid fly was captured in several caves: Balaam Canche Cave, June 10, 77 m. from mouth; Oxolodt Cave, Kaua, June 18, on bat feces near pool 40 m.

from mouth; Gongora Cave and second cave on San Roque Road, Oxkutzcab, July 17, 23, near mouth and 35 m. inside.

Other specimens, probably of another species of *Megaselia,* were taken in Oxolodt Cave, Kaua, June 18; Gongora Cave, Tekax, July 17; Sabacha Cave, Tekax, July 30; Spukil Cave, Calcehtok, August 5. (C. T. Greene)

Family LONCHAEIDAE

Carpolonchaea pendula? Bez.

Xtoloc Cenote Cave, Chichen Itza, June 24, on bat feces. (D. G. Hall)

Family DROSOPHILIDAE

Drosophila sp.

Larvae were found in Luchil Cave, Tixcacal, July 6; Hoctun Cave, Hoctun, July 7, 167 m. from mouth at inner end; Sazich Cave, Calcehtok, August 6; Xconsacab Cave, Tizamin, August 11, at bottom of shaft below mouth. (C. T. Greene)

Drosophila repleta Woll.

Xconsacab Cave, Tizamin, August 11, at bottom of entrance shaft. (C. T. Greene)

Family AGROMYZIDAE

Xkyc Cave, Calcehtok, August 11, 30 m. from mouth. (C. T. Greene)

Family PHYLLOMYZIDAE

Desmometopa sp.

Larvae were found in a paca carcass, under stones and in bat feces in Balaam Canche Cave, Chichen Itza, June 9, 11, at 30 and 260 m. from mouth; and in Oxolodt Cave, Kaua, June 19. (C. T. Greene)

Milichia sp.

Balaam Canche Cave, Chichen Itza, June 13; Hoctun Cave, Hoctun, July 7, 155 m. from mouth; Luchil Cave, Tixcacal, July 6; Gongora Cave, Oxkutzcab, July 17, 35 m. from mouth; Loltun Cave, Oxkutzcab, July 26, 1 km. from mouth; Spukil Cave, Calcehtok, August 5; Muruztun Cave, Tizamin, August 12, 24 m. from mouth. (C. T. Greene)

Family CHLOROPIDAE

Hippelates pusio? Lw.

Chac Mol Cave, Tohil, June 27, on a mouse (*Ototylomys phyllotis phyllotis* Merriam), 32 m. from mouth; Yunchen Cave, Libre Union, July 11, at mouth. (D. G. Hall)

Oscinella sp.

Chakxix Cave, Tekax, August 1, 39 m. from mouth. (D. G. Hall)

Family PARBORIDAE

Leptocera sp.

Chac Mol Cave, Tohil, June 27 under stones at top, 60 m. from mouth. (D. G. Hall)

Family CHAMAEMYIDAE

Leucopsis (near *simplex*)

Hoctun Cave, Hoctun, July 7, at inner end 163 m. from mouth; Ebizt Cave, Oxkutzcab, July 18, 95 m. from mouth. (C. T. Greene)

Family MUSCIDAE

Anthomyid larvae were found in the bait of mouse traps set in Balaam Canche Cave, Chichen Itza, June 13. (D. G. Hall)

Coenosia? sp.

A teneral male was taken near mouth of second cave on San Roque Road, Oxkutzcab, July 23. (D. G. Hall)

Synthesiomyia nudiseta V. D. W.

Balaam Canche Cave, Chichen Itza, June 8, under stones near mouth. (D. G. Hall)

Family METOPIDAE

Pupae and larvae were found in Xtoloc Cenote Cave, Chichen Itza, June 24, under stones; Cinquo de Mayas Cave and Sazich Cave, Tekax, July 29, 30, near mouth and 42 m. inside; Sazich Cave, Calcehtok, August 6, at inner end on floor in rubbish. (C. T. Greene)

Lucilia serricata Mg.?

Balaam Canche Cave, Chichen Itza, June 9, on paca carcass, 40 m. from mouth. (D. G. Hall)

Family TACHINIDAE

Archytas sp.

Near mouth of second cave on San Roque Road, Oxkutzcab, July 23. (D. G. Hall)

Exorista sp.

Balaam Canche Cave, Chichen Itza, June 9, in paca carcass, 40 m. from mouth.

Family STREBLIDAE

Euctenodes mirabilis Waterhouse

Oxolodt Cave, Kaua, June 18, on *Diphylla centralis* Thomas; Xmahit Cave, Tekax, July 21, on *Micronycteris megalotis mexicana* Miller. (Alan Stone)

Euctenodes tonatiae? Kessel

Xtoloc Cenote Cave, Chichen Itza, June 24, and Xconsacab Cave, Tizamin, August 11; in both cases on *Desmodus rotundus murinus* (Wagner). (Alan Stone)

Trichobius caecus Edw.

Balaam Canche Cave, Chichen Itza, June 22, and Hoctun Cave, Hoctun, July 7; in both cases on *Natalus mexicanus* Miller. (Alan Stone)

Trichobius dugesii Townsend

Widely distributed on three species of bats: Hoctun Cave, Hoctun, July 7, on *Desmodus rotundus murinus* (Wagner); Ebizt and Puz Caves, Oxkutzcab, July 9, 20, and Cinquo de Mayas Cave, Tekax, July 29, on *Artibeus jamaicensis yucatanicus* (Allen); Xmahit Cave, Tekax, July 31, and Spukil Cave, Calcehtok, August 5, on *Micronycteris megalotis mexicana* Miller. (Alan Stone)

Trichobius parasiticus Gerv.

Xtoloc Cenote Cave, Chichen Itza, June 24, 25, and San Bulha Cenote, Motul, July 9; on *Desmodus rotundus murinus* (Wagner).

Nycterophilia coxata Ferris

Balaam Canche Cave, Chichen Itza, June 23, on *Natalus mexicanus* Miller. (Alan Stone)

Pterellipsis araneae Coq.

Ebizt and Puz Caves, Oxkutzcab, July 19, 20; Cinquo de Mayas and Chakxix Caves, Tekax, July 29, August 1; always on *Artibeus jamaicensis yucatanicus* (Allen). (Alan Stone)

Order SIPHONAPTERIDA

Family PULICIDAE

Xenopsylla cheopis Rothschild

Balaam Canche Cave, Chichen Itza, June 10, 32 m. from mouth on a mouse, *Ototylomys phyllotis phyllotis* Merriam. (A. S. P.)

XIX

ANTS FROM THE CAVES OF YUCATAN

William Morton Wheeler

A study of this collection of ants, comprising seventeen different forms, confirms and extends previous observations on formicids collected in caverns in other parts of the world. Most of the species taken by Dr. Pearse are well-known Neotropical species which regularly nest in forests or open country. Two of them, *Ponera opaciceps* and *P. ergatandria,* are subterranean forms belonging to the ecological association called by Silvestri the "microgenton", and three, *Spelaeomyrmex urichi, Brachymyrmex cavernicola* n. sp. and *Nylanderia pearsei* n. sp., might be regarded as cavernicolous. Since, however, many subterranean, or hypogaeic ants, which do not forage on the surface of the soil, are really cavernicolous, or rather microcavernicolous, it is impossible to draw a hard and fast line between the inhabitants of the two environments. This is shown by *Spelaeomyrmex urichi,* taken by Dr. Pearse on bat feces in the San Bulha Cenote. Although originally described from specimens collected by F. W. Urich in the nests of the guacharo (Steatornis) in a cave in Trinidad, B. W. I., this ant was taken during the summer of 1936 in Cuba by P. J. Darlington in leafmold, and therefore as a member of the microgenton, in the mountains of eastern Cuba.

It is somewhat surprising to find among Dr. Pearse's material a number of specimens of *Acromyrmex echinatior* taken in five different caves and in two of these at distances of 40 and 60 m. from the cave entrance, because this ant is a well-known leaf-cutter and fungus-grower. Since no mention is made of its nesting in the caves, we may assume that the specimens had strayed in while foraging and, having lost their bearings, were wandering about in a most unsuitable environment.

PONERINAE

Neoponera latreillei Forel
   Puz Cave, Oxkutzcab, near mouth ☿; second cave on San Roque Road, Oxkutzcab, near mouth ☿; Cinquo de Mayas Cave, Tekax, near mouth ☿.

Neoponera villosa (F. Smith) subsp. *inversa* F. Smith
   Cinquo de Mayas Cave, Tekax, near mouth ☿.

Pachycondyla harpax (Fabr.) subsp. *montezumia* (F. Smith)
   Gongora Cave, Oxkutzcab, near mouth under stones and debris ☿.

Ponera opaciceps Mayr
   San Isidro Cave, Merida, in debris under mouth ☿; San Bulha Cave, Merida, under stones and debris ☿.

Ponera ergatandria Forel
   San Bulha Cenote, Motul, on bat feces ☿.

Odontomachus haematoda (Linn.)
   Second cave on San Roque Road, Oxkutzcab, near mouth ☿.

MYRMICINAE

Solenopsis geminata (Fabr.)

Puz Cave, Oxkutzcab, near mouth ♃; Gongora Cave, Oxkutzcab, near mouth ☿; San Isidro Cave, Merida, in debris near mouth ☿.

Spelaeomyrmex urichi Wheeler

San Bulha Cenote, Motul, on bat feces ☿.

Pheidole punctatissima Mayr

Spukil Cave, Calcehtok, on swallow feces near mouth ☿.

Pheidole punctatissima Mayr red var.

San Bulha Cenote, Motul, on bat feces ☿ ♀. Not further identifiable without the soldier.

Pheidole sp.

San Bulha Cave, Merida, under stones and debris ☿. Belonging to the *flavens* group but not further identifiable without the soldier.

Atta cephalotes Linn var. *opaca* Forel

Muruztun Cave, Tizamin ☿. The specimens are media workers. According to Dr. Pearse's note these leaf-cutting ants were taken in the middle of the cave. They belonged to a mound above, but had come through the root and deposited a great mound of rubbish.

Acromyrmex octospinosus (Reich) subsp. *echinatior* Forel

Numerous workers from the following localities: Puz Cave, Oxkutzcab, under stones and debris; Gongora Cave, Oxkutzcab, under stones and debris near mouth; Ziz Cave, inner part 62 m. from mouth where it was 28 m. deep; San Bulha Cave, Merida, under stones and debris; Xkyc Cave, Calcehtok, in debris 37 m. from mouth.

In these series the largest workers measure only 7-8 mm. and are therefore smaller than the largest workers of the typical *echinatior* (7-9 mm.). The carinae on the base of the epinotum are very prominent and the epinotal spines are much longer, more curved and directed more backward than in *echinatior*. The specimens therefore represent a distinct subspecies or variety which will be given a name in a forthcoming revision of the known forms of *A. octospinosus* by the author.[1]

DOLICHODERINAE

Dolichoderus (*Monacis*) *bispinosus* (Olivier)

Xconsacab Cave, Tizamin, in inner part 46 m. from mouth ☿.

Forelius maccooki Forel

One worker from San Isidro Cave, Merida, in debris under mouth.

FORMICINAE

Brachymyrmex cavernicola n. sp.

Worker.—Length 1.5-2 mm.

Head nearly square, with feebly and evenly convex sides and straight posterior border. Eyes at the middle of the sides, small, moderately convex, with only about 12 facets in their greatest diameter, less than half as long as the distance between their anterior orbits and the anterior corners of the head. Clypeus large, very convex behind but not carinate, its anterior border subangularly produced. Mandibles narrow, with oblique, 5-toothed apical borders, the teeth large and subequal, except the median one, which is minute. Frontal area distinct, triangular, impressed; frontal carinae short, subparallel. Antennae 9-jointed as in the other species of the genus, long and slender; scapes extending fully one-third their length

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[1] This revision was published in the appendix of "Mosaics and Other Anomalies Among Ants" (Harvard University Press) shortly after Dr. Wheeler's death. The subspecies was here named *A. octospinosus ekchuah* Wheeler.—A. S. P.

beyond the posterior border of the head; joints 2-7 of funiculus subequal, twice as long as broad, first joint shorter, terminal joint as long as the two preceding joints together. Thorax with distinct promesonotal, mesometanotal and metaëpinotal sutures, distinctly impressed dorsally at the mesometanotal suture, the metaëpinotal oblique on each side and confluent with the mesometanotal suture in the middle; metanotal spiracles not prominent. Seen from above the pronotum is broad and semicircularly rounded anteriorly, more than twice as broad as long without the neck; mesonotum semicircular, also slightly more than twice as broad as long; epinotal declivity sloping, flattened, widening posteriorly, fully three times as long as the slightly convex base. Petiole with low, thick, anteriorly inclined node, which, seen from behind, has a rounded and slightly acuminate superior border. Gaster voluminous, of the usual shape. Legs rather slender.

Shining; very finely and superficially reticulate, the head more distinctly than the body.

Erect hairs very coarse and conspicuous, dark brown, arranged in two parallel longitudinal rows on the front and vertex, shorter on the posterior corners of the head, longer, sparser and paler on the clypeus; pro- and mesonotum each with a few of these brown hairs but there are none on the epinotum; on the dorsum of the gaster they are numerous and regularly arranged. Appendages with rather abundant, fine, white, appressed or subappressed pubescence; gula with similar but more dilute pubescence.

Yellow; appendages slightly paler; dorsum of gaster and posterior portion of head brownish.

Male.—Length about 1.3 mm.

Head, small, flat, as broad as long, narrower in front than behind, with convex sides and straight posterior border. Eyes large but not convex; ocelli widely separated, large but not prominent. Mandibles small, narrow, with truncated, edentate tips. Clypeus small, flattened, its anterior border produced in the middle as a blunt point. Frontal carinae very short; frontal area like that of the worker but not impressed. Antennae 10-jointed; scapes extending beyond the posterior border of the head; first funicular joint slightly swollen, nearly twice as long as broad; joints 2-8 subequal, nearly one and one-half times as long as broad, terminal joint as long as the three preceding joints together. Thorax elliptical, much broader than the head; mesonotum large, as long as broad, very convex and semicircularly projecting over the pronotum, flattened behind; scutellum large and convex; epinotum small, feebly convex and sloping, in profile without distinct base and declivity. Petiolar node small, its superior border straight and transverse, much sharper than in the worker. Gaster-shaped as in this caste; genitalia small, exserted; stipites subtriangular, with rounded tips; volsellae somewhat uncinate. Legs slender.

Shining, like the worker very finely and obscurely reticulate.

Brown erect hairs very short, present only on the mesonotum and scutellum; remainder of body and appendages invested with very fine, appressed, white pubescence.

Pale yellow; mesonotum brownish, posterior portion of head dark brown. Wings opaque white, with white veins.

Described from 34 workers and a single male taken by Dr. Pearse in the Balaam Canche Cave, Chichen Itza, under a stone near the mouth.

At first sight this species might be mistaken for a *Nylanderia* because of its peculiar erect hairs, or macrochaetae. It is obviously related to *B. longicornis* Forel but its worker is stouter, with much smaller eyes, longer median funicular joints, much thicker petiolar node and very different pilosity.

Nylanderia pearsei n. sp.

WORKER.—Length 2.5-2.7 mm.

Head subrectangular, as broad as long without the clypeus and mandibles and as broad in front as behind, with evenly convex sides, rounded posterior corners and slightly sinuate posterior border. Eyes slightly in front of the middle, small, with only 8-9 facets in their greatest diameter. Mandibles very narrow at the base, with oblique 5-toothed apical borders, the second and fourth tooth smaller than the others. Clypeus convex and subcarinate in the middle, depressed laterally, its anterior border projecting, entire, semicircularly rounded. Frontal area very distinct, small, transversely elliptical; frontal carinae subparallel; frontal groove replaced by a short, linear convexity. Antennae long and slender; scapes extending somewhat more than half their length beyond the posterior border of the head; first funicular joint nearly twice as long as the second, which is twice as long as broad, succeeding joints longer. Thorax elongate; pronotum with neck as long as broad, not convex; mesonotum slightly longer than broad, parallel-sided, rounded behind, flattened or even slightly concave, sloping and bounded by impressed sutures; metanotum distinct, with prominent spiracles which are somewhat farther apart than their diameter; mesoëpinotal constriction pronounced; base and declivity of epinotum subequal, the former very convex, the latter flat and sloping; epinotal spiracles projecting. Petiolar scale thick, blunt, strongly inclined forward, its superior border from behind semicircular. Gaster of the usual shape. Legs long and slender.

Shining; sides of head and especially dorsal surface of gaster more opaque, the surface finely reticulate, the gaster more sharply than the remainder of the body.

Pilosity abundant, the stout erect hairs, or macrochaetae pointed, dark brown or blackish, very conspicuous on the dorsal surface, on the legs shorter and white at their tips; scapes with numerous suberect and more delicate white hairs; clypeus, dorsal surface of head and gula with conspicuous long white hairs, which are mingled with the dark macrochaetae on the front. Pubescence white, dilute and conspicuous on the funiculi, gula and sides of head; much finer, denser, more appressed and generally distributed on the remainder of the body and on the legs.

Yellow; appendages scarcely paler; head, clypeus and mandibles slightly reddish; mandibular teeth red.

Described from 12 workers from the Muruztun Cave, Tizamin (type-locality), "from a big midden pile of a leaf-cutter mound above cave"; six workers from the Balaam Canche Cave, Chichen Itza, Temple Pool, 260 m. from mouth and six workers from the Chac Mol Cave, Tohil, under stones at top, not mouth.

This *Nylanderia* belongs to a cavernicolous, microphthalmic group including also two Cuban species, *myops* Mann and *troglodytes* Weber. It is distinctly larger than these species and the eyes, though small compared with those of other species of the genus, are distinctly larger (those of *myops* and *troglodytes* have only 4-5 facets in their greatest diameter) and the conformation of the thorax and petiole is quite different.

XX

A THIRD CONTRIBUTION TO THE MOLLUSCAN FAUNA OF YUCATAN

J. Bequaert
Department of Tropical Medicine, Harvard Medical School
and
W. J. Clench
Museum of Comparative Zoölogy, Cambridge, Massachusetts

In addition to the common species, this collection of molluscs includes some rarer forms, such as *Drymaeus tropicalis* and *Opeas yucatanense,* as well as one not previously recorded from the State of Yucatan (*Hawaiia minuscula*). A small lot of brackish water shells, received from E. P. Creaser and A. S. Pearse after the completion of our second contribution, contains another interesting addition to the Yucatan fauna (*Anomalocardia leptalea*). The total number of non-marine molluscs of the State of Yucatan is now 78 (47 terrestrial, 18 fresh-water, and 13 brackish-water species).

None of the molluscs found by Dr. Pearse in the Yucatan caves can claim to be cavernicolous in the true sense. In most cases only dead specimens were obtained and all of the species listed have been found outside the caves also. The single type of *Orizosoma tabiense* (Pilsbry) was originally found in dead and bleached condition in a cave near Tabi. It has not been taken again and its occurrence in a cave may have been only accidental as with all the other species.

The situation in Yucatan appears to parallel closely the conditions of such cave material in Cuba. Man has probably played some part in carrying shells into the deeper portions of caves, as have rodents and other small mammals. The most important agency, however, is surface drainage, through fissures or other openings that lead into the caves.

In our earlier, brief discussion of the molluscan fauna of the neighboring Territory of Quintana Roo, we overlooked an interesting member of the family Urocoptidae, *Holospira* (*Liostemma*) *yucatanensis* Bartsch (1906, Proc. U. S. Nat. Mus., XXXI, p. 143, Pl. III, fig. 2), from Mujeres Island, off the northeastern coast of the peninsula. Perhaps a species of *Holospira* may yet be discovered in the State of Yucatan proper.

Frank C. Baker has kindly called our attention to the fact that the generic and subgeneric names applied to the Yucatan Planorbidae in our two previous papers, will need some emendation. Unfortunately, no agreement appears to be in sight about the exact status and rank of the several names involved. *Planorbis caribaeus* d'Orbigny is placed by Pilsbry (1934, Proc. Acad. Nat. Sci. Philadelphia, LXXXVI, p. 44) in *Pierosoma* Dall, which he gives subgeneric rank under *Helisoma*

Swainson, while Thiele (1931, Handbuch Syst. Weichtierk., p. 479) regards it merely as a section of *Planorbis*. The anatomy of this species does not appear to have been studied. *Planorbis maya* Morelet, *P. retusus* Morelet and *P. orbiculus* Morelet all belong in *Tropicorbis* Pilsbry and Brown, treated by Thiele (1931, p. 480) as a section of *Planorbis*, but more recently raised to the status of a genus by Pilsbry (1934, p. 52). None of these species has been examined anatomically. *Planorbis cultratus* d'Orbigny and *P. lucidus* Pfeiffer belong in *Drepanotrema* Crosse and Fischer, as shown by Pilsbry (1934, p. 58), who treats the group as a genus, while Thiele (1931, p. 481) regards it only as a section of the subgenus *Gyraulus* of the genus *Anisus*. The anatomy of both species was investigated by H. B. Baker (1930 and in Pilsbry, 1934). Pilsbry (1934, p. 59) also proposed a section *Fossulorbis* (of *Drepanotrema*) for *P. cultratus*, presumably including *P. lucidus* also. *Planorbis obstructus* Morelet was shown by Frank C. Baker (1936, The Nautilus, XLIX, p. 104), on anatomical characters, to belong in *Tropicorbis* (a group discussed above) and not in *Planorbula*.

LIST OF SPECIES

Euglandina cylindracea (Phillips)
San Bulha Cenote, Motul. Loltun Cave, Oxkutzcab. Ebizt Cave, Oxkutzcab.

Streptostyla ventricosula (Morelet)
Loltun Cave, Oxkutzcab. Gongora Cave, Oxkutzcab. Kaua Cave, Kaua. Xkyc Cave, Calcehtok.

Streptostyla meridana (Morelet)
Balaam Canche Cave, Chichen Itza.

Hawaiia minuscula (Binney)
Sazich Cave, Calcehtok.

Drymaeus serperastrum (Say)
Ebizt Cave, Oxkutzcab.

Drymaeus tropicalis (Morelet)
Ebizt Cave, Oxkutzcab. One broken specimen.

Drymaeus shattucki Bequaert and Clench
Loltun Cave, Oxkutzcab. This species has recently been found in the Peten District of Guatemala.

Oxystyla princeps (Sowerby)
Kaua Cave, Kaua. One worn specimen.

Bulimulus unicolor (Sowerby)
Loltun Cave, Oxkutzcab. Ebizt Cave, Oxkutzcab. Balaam Canche Cave, Chichen Itza.

Brachypodella speluncae (Pfeiffer)
Balaam Canche Cave, Chichen Itza. Ebizt Cave, Oxkutzcab. Loltun Cave, Oxkutzcab. Second cave on San Roque road, Oxkutzcab.

Microceramus concisus (Morelet)
Loltun Cave, Oxkutzcab.

Opeas gracile (Hutton)
San Bulha Cave, Merida.

Opeas micra (d'Orbigny)
Kaua Cave, Kaua. Gongora Cave, Oxkutzcab. Ziz Cave, Oxkutzcab. San Isidro Cave, Merida. Muruztun Cave, Tizamin. Balaam Canche Cave, Chichen Itza. Hoctun Cave, Hoctun. Xkyc Cave, Calcehtok.

Opeas yucatanense Pilsbry
Balaam Canche Cave, Chichen Itza. Chac Mol Cave, Tohil.

Leptinaria martensi (Pfeiffer)
Balaam Canche Cave, Chichen Itza.
Aplexa spiculata var. *abbreviata* (Fischer and Crosse)
Balaam Canche Cave, Chichen Itza.
Poteria berendti (Pfeiffer)
Kaua Cave, Kaua. Ebizt Cave, Oxkutzcab. Loltun Cave, Oxkutzcab.
Choanopoma largillierti (Pfeiffer)
Balaam Canche Cave, Chichen Itza. Gongora Cave, Oxkutzcab. Second cave on San Roque road, Oxkutzcab. Loltun Cave, Oxkutzcab. Ebizt Cave, Oxkutzcab. Puz Cave, Oxkutzcab (in stomach of gecko). Kaua Cave, Kaua.
Cerithidea costata (da Costa)
Cenote near Talcha, Miramar (said to be absolutely fresh-water).
Potamopyrgus coronatus (Pfeiffer)
Gongora Cave, Oxkutzcab. Luchil Cave, Tixcacal.
Oligyra arenicola (Morelet)
Balaam Canche Cave, Chichen Itza. Ebizt Cave, Oxkutzcab. Gongora Cave, Oxkutzcab.
Anomalocardia leptalea (Dall)
Cienaga near Cerro Isla, 2 km. southwest of Progreso (E. P. Creaser and A. S. Pearse).

ADDITIONS TO THE YUCATAN FAUNA

ZONITIDAE

Hawaiia minuscula (Binney)

Helix minuscula A. Binney, 1840, Boston Jour. Nat. Hist., III:435, Pl. XXII, fig. 4 (Ohio and Vermont).

Hawaiia minuscula H. B. Baker, 1933, Occ. Pap. Mus. Zool. Univ. Michigan, No. 269, p. 9. A. J. Peile, 1936, Jour. Conchol., XX, pt. 9, p. 281.

Hyalinia permodesta Strebel and Pfeffer, 1880, Beitr. Mexik. Land- u. Süssw.- Conch., IV:19, Pl. IV, fig. 9 (Mirador, State of Vera Cruz, Mexico).

Helix minutalis Morelet, 1851, Testac. Noviss. Insulae Cubanae Amer. Centr., II:7 (environs of Palizada, State of Campeche; Cuba).

Sazich Cave, Calcehtok, one dead specimen (A. S. Pearse).

This minute snail occurs throughout the United States, Mexico, Nicaragua, Guatemala, Cuba and Jamaica. It has also been introduced into the Hawaiian Islands, Lord Howe Island and Norfolk Island. Specimens obtained by the senior author at Moca near Guatelon, Guatemala (altitude 930 m.), were identified by Mr. C. Goodrich. We have been unable to refer our Yucatan specimen to one of the subspecies recognized by H. B. Baker (1929, Proc. Acad. Nat. Sci. Philadelphia, LXXXI, p. 261), which appear to be very poorly defined. For a full synonymy of this widely distributed snail, see Peile's recent note (1936), cited above.

VENERIDAE

Anomalocardia leptalea (Dall)

Venus (*Anomalocardia*) *leptalea* Dall, 1894, Bull. Mus. Comp. Zoöl., XXV, No. 9, p. 114, pl., fig. 5 (lagoon at Watling Island, Bahamas).

Cienaga near Cerro Isla, 2 km. southwest of Progreso (E. P. Creaser and A. S. Pearse 1932); two young specimens taken alive in a mangrove swamp.

The specimens were named by R. A. McLean, who compared them with the types at the M. C. Z. Dall stated that it is a form confined to the lagoons and this is borne out by its habitat in Yucatan.

This would appear to be a strictly ecological form of *A. cuneimeris* Conrad. Its occurrence in two such widely separated localities would preclude any inference of distribution by mechanical means. Brackish-water forms and again species occurring in hypersaline lagoons or "salinas," undergo extraordinary modifications in their different environments. Periodic fluctuation of the salt content varies considerably from week to week in most localities of this sort. Any excess rainfall lowers the salt content, and, conversely, long periods of dry weather through evaporation increase the salt proportionately. Such differences in the immediate environment have a profound effect upon the existing fauna. Modification of the shell, particularly in size, sculpture and structure, are manifest and in certain cases, distortion takes place. This is most marked in certain species of *Cerithium* in which the earlier whorls are very irregular and even produced at an angle from the whorls of later development. Most of these aberrant forms appear to be local modifications of the common and widely distributed species of their region. These ecological forms from widely separated localities are possibly not always related directly to one another, but are only parallel in development from the same and widely distributed typical species.

XXI

FISHES FROM THE CAVES OF YUCATAN

Carl L. Hubbs
Museum of Zoology, University of Michigan

INTRODUCTION

Previous explorations of the fresh-water fishes of Yucatan have brought to light a number of species inhabiting the open to closed cenotes as well as the aguadas and the few streams of this limestone peninsula. Of the more truly subterranean fish fauna of Yucatan, all that has been known concerns the native catfishes of a few caves, subspecies of *Rhamdia guatemalensis* which seem to approach the typical, uncolored, eyeless cave-fishes in their moderate depigmentation and somewhat reduced eyes (Hubbs, 1936, pp. 166-168 and 182-186). There have been rumors of blind fishes in the caves of Yucatan (Girard, 1888; Eigenmann, 1909, p. 188; Hubbs, 1936, p. 168), and blind crustaceans have been discovered there (Creaser, 1936), but until A. S. Pearse made a specific search of these caves, no specimens of blind fishes were actually obtained for scientific study.

Dr. Pearse secured two species of blind fish in the caves of Yucatan, a brotulid here named *Typhlias pearsei* and a synbranchid called *Pluto infernalis.* These were the first blind cave-fishes to be collected anywhere in Middle America, but after they were obtained a blind characin, *Anoptichthys jordani,* was found in Mexico, and has been described by Hubbs and Innes (1936).

Dr. Pearse also obtained additional specimens of *Rhamdia* and *Cichlasoma* from the Yucatan caves. These too are reported upon in the present paper, as are also other specimens of the same genera obtained in the cenotes and cienagas of Yucatan by Milton B. Trautman and Josselyn Van Tyne, on the 1936 expedition of the series undertaken cooperatively by Carnegie Institution of Washington and the University of Michigan. I wish to express profound gratitude to these naturalists, for permission to report on their discoveries. Acknowledgment is also due Miss Grace Eager, staff artist of the Museum of Zoology of the University of Michigan, for the skillful preparation of the fine drawings used to illustrate the new fishes discovered in the Yucatan caves.

Following are the new names proposed:

Cichlasoma urophthalmus ericymba n. subsp.
Typhlias n. g. of Brotulidae, near *Stygicola*
Typhlias pearsei n. sp.
Pluto n. g. of Synbranchidae, near *Synbranchus*
Pluto infernalis n. sp.

BLIND FISHES AND CAVE-FISHES

The blind cave-fishes discovered in Yucatan constitute a considerable addition to the limited number which have previously been described, largely in recent years, from all parts of the world. To indicate their systematic, geographic, ecological and phyletic relations, the new forms are included in a tabular digest (Table 1) of leading facts regarding the known blind cave-fishes. In this accompanying tabulation, there are listed all of the blind fishes known to me, except those of the deep seas, whether or not they occur in caves, and all of the distinctively cave-dwelling fishes, whether or not they are blind. This comparative analysis prompts me to add a few lines to the many already written concerning the origin and evolution of the blind cave animals.

From this list of cave-fishes there are excluded the normal inhabitants of surrounding waters that not infrequently make their way into caves, but are not noticeably modified by their temporary existence in the utter darkness of strictly subterranean waters. Some normal species seem to be wholly capable of continued existence far within cave streams. *Cottus bairdii carolinae,* for example, has been taken from several caves in Indiana and Missouri, where it seems to be well established, and reaches a large size. We have even taken such minnows as *Hyborhynchus notatus* in underground waters, far from any connection with outside streams.

The eyed fishes of artesian wells and isolated springs are likewise excluded from this list, as there still appears to be no proof to verify the oft-repeated claims that these fishes are belched out of the earth. Too little weight seems to have been given to the possible dispersal of fishes from spring to spring by the torrential precipitation of desert regions. The problem of the origin of the fish faunas of the artesian wells and isolated springs of North Africa has briefly been discussed by Pellegrin (1921, and several subsequent papers). I am now engaged in a study of the fish faunas of such waters in the deserts of western North America, and expect to discuss the possibilities of underground fish faunas in that region.

There are also excluded from the key the several deep-sea blind fishes, some of which are referred to by Eigenmann (1909, pp. 10, 11); also by Günther (1887), Goode and Bean (1895) and others. Their blindness presumably has the same basis as that of the cave fishes. Many deep-sea fishes, however, have well-developed eyes, presumably used to detect the rays of animal-produced light which penetrate the otherwise absolute darkness of the oceanic abysses.

Including the fishes known from the cenotes of Yucatan, we find that ten or eleven of the 35 to 37 known fishes of subterranean waters are Yucatan forms. It seems legitimate to include the distinctive cenote forms as elements in the underground fish fauna, because the cenotes are caverns in the limestone having or having had only underground water connections, whether or not the roofs have fallen in (see papers by Pearse, Hall, Creaser, and Hubbs in *The Cenotes of Yucatan,* 1936). The six characteristic fishes of the Yucatan cenotes, however, represent only two species, since four are subspecies of *Cichlasoma urophthalmus* and two are subspecies of *Rhamdia guatemalensis* (Hubbs, 1936, and present paper). None of these has the eyes much reduced in size, and one of the forms of *Cichlasoma* seems to have somewhat enlarged eyes (calling to mind the large eyes characteristic of many fishes of moderate oceanic depths). One of the subspecies, *Cichlasoma urophthalmus ericymba,* has the sensory cavities of the head enlarged, and most cenote populations of *Rhamdia guatemalensis* have very long barbels; suggesting that an improved tactile sense is compensating for the reduced or eliminated vision in the waters of the cenotes. The cenote forms of *Rhamdia guatemalensis* are not depigmented, but on the contrary are unusually black, and the cenote subspecies of *Cichlasoma urophthalmus* vary from rather pale to rather dark. It is not yet absolutely certain that these forms are genetically distinct.

In the Yucatan cenotes there are therefore no really typical cave-fishes, in the sense of being blind, colorless and otherwise greatly modified for a subterranean existence. An exception to this rule will be shown, if the "albino catfish" observed by Dr. Creaser in two of the cenotes should prove, as I suspect they will, to have been individuals of a distinct species.

Of the four fishes now known from the waters of the Yucatan caves, as these are distinguished from the cenotes, two represent additional subspecies of *Rhamdia guatemalensis.* As I have already indicated, these two cave catfishes represent only an incipient modification in the direction of the typical cave type. Both are variably but never completely depigmented. One, *R. g. decolor,* has the eyes only slightly smaller than in the presumed parent form, *R. g. depressa;* the other, *R. g. stygaea,* has the organs of sight rather markedly reduced in size. And there is some doubt as to the genotypic significance of even these slight modifications.

Like the blind crustaceans (Creaser, 1936) of the same caves, the two other cave-fishes of Yucatan, described in this report, are highly modified for subterranean existence. The brotulid, *Typhlias pearsei,* confirming Eigenmann's suggestion (1909, p. 188) that such a type inhabits the underground waters of Yucatan, seems to be even more specialized than its obvious relatives *Stygicola* and *Lucifuga* of the Cuban caves. It is completely blind, at least as half-grown and adult, has the pigment more or less obsolescent and the dermal sense organs highly developed (Pl. 3).

The remarkable synbranchid, *Pluto infernalis* (p. 292, Pl. 4), is likewise wholly devoid of any vestige of an eye, at least in the adult. Its pigmentation is also obsolete, and its sense organs, like those of many other cave-fishes, are very well developed.

THE ORIGIN OF THE SUBTERRANEAN FISH FAUNA OF YUCATAN

The ten or eleven forms of fishes comprising the subterranean fish fauna of Yucatan, as now listed, indicate a minimum of four separate origins or incursions. These are discussed below:

TABLE 1

List of Known Cave-Fishes, and of Other Blind Fishes, Exclusive of Deep-Sea Species (augmented from lists by Norman, 1926, and Pellegrin, 1926)

Family	Scientific Name	Presumed Ancestor	Locality	Habitat	External Eyes in Adults	Black Pigment	Chief Authority
Eptatretidae and Myxinidae	Several genera	Some eyed marsipobranch	Cosmopolitan	Coastal; parasitic in fishes	Obsolete	Blackish	. . . . . .
Characidae	*Anoptichthys jordani* Hubbs and Innes	*Astyanax fasciatus mexicanus*	San Luis Potosí, Mexico	Cave	Vestigial to lost	Slight	Hubbs and Innes, 1936
Cyprinidae	*Puntius microps* (Günther)[?]	*Puntius binotatus*	Java	Cave	Slightly reduced	Reduced?	Weber and de Beaufort, 1916, 186
	Eilichthys microphthalmus Pellegrin	"*Barbus*" sp. [?]	Italian Somaliland	Cave	Extremely minute	Much reduced	Pellegrin, 1929*b*; 1932, 624, fig. 1
	Caecobarbus geertsii Boulenger	"*Barbus*" sp.	Lower Congo	Cave	Vestigial (Gérard, 1936)	Obsolete	Boulenger, 1921; Pellegrin, 1932, 623
	Phreatichthys andruzzii Vinciguerra	"*Barbus*" sp. [?]	Italian Somaliland	Warm spring and well	Obsolete	Obsolete	Vinciguerra, 1924; Pellegrin, 1929*a*; 1932, 625, fig. 2
Ameiuridae	*Gronias nigrilabris* Cope	*Ameiurus nebulosus*	Eastern Pennsylvania	Cave	More or less rudimentary	Normal	Cope, 1864
	Trogloglanis pattersoni Eig.	*Schilbeodes* sp.	Texas	Artesian well	Obsolete	Obsolete	Eigenmann, 1919
Pimelodidae	*Typhlobagrus kronei* Ribeiro	*Pimelodella lateristriga*	São Paulo, Brazil	Cave	Somewhat developed (rarely) to obsolete	Obsolete	Eigenmann, 1917*a*, 255 (with references)
	Caecorhamdella brasiliensis Borodin	*Rhamdella foina*	São Paulo, Brazil	?	Obsolete	Obsolete?	Borodin, 1927
	Rhamdia guatemalensis depressa Barbour and Cole	*Rhamdia guatemalensis oaxacae* (?)	Yucatan	Cenotes	Normal	Black	Hubbs, 1936, 194
	Rhamdia g. sacrificii B. and C.	*Rhamdia g. depressa*	Yucatan	Cenotes	Normal	Black	Hubbs, 1936, 200
	Rhamdia g. decolor Hubbs	*Rhamdia g. depressa*	Yucatan	Caves	Barely reduced	Reduced	Hubbs, 1936, 201
	Rhamdia g. stygaea Hubbs	*Rhamdia g. depressa*	Yucatan	Caves	Reduced	Reduced	Hubbs, 1936, 203
	Caecorhamdella urichi Norman	*Rhamdia quelen*	Trinidad	Cave	Obsolete	Obsolescent	Norman, 1926
	(?) "Unpigmented catfish"	(?) *Rhamdia guatemalensis*	Yucatan	Cenotes	?	"Albino"	Hubbs, 1936, 168 and 183
Pimelodidae or Trichomycteridae	*Phreatobius cisternarum* Goeldi	*Heptapterus or Trichomycterus*	Marajo Id., Brazil	Cistern	Obsolete	Obsolete	Eigenmann, 1918, 371 (with references)
Pygidiidae	*Eremophilus mutisii* von Humboldt	Normal individuals of same species	Plains of Bogotá	Burrows in streams	Sometimes obsolescent	Sometimes obsolescent	Eigenmann, 1914, 230; 1917*b*, 178; 1918, 343
Clariidae	*Clarias cavernicola* Trewavas	*Clarias* sp.	South-West Africa	Cave	Present	Obsolete	Trewavas, 1936
	Channalabes apus Günther	Normal individuals of same species	Belgian Congo	?	Scarcely visible	Entirely white	David and Poll, 1937, 234
Clariidae?	*Uegitglanis zammaranoi* Gianferrari	Ancestor, Bagridae and Clariidae	Italian Somaliland	Well	Obsolete	Obsolete	Gianferrari, 1923; David, 1936
Amblyopsidae	*Amblyopsis spelaeus* De Kay	Ancestor of *Chologaster*	Ohio Valley	Caves	Obsolete	Obsolete	Eigenmann, 1909 (with references)
	Forbesichthys papilliferus (Forbes)	*Chologaster* sp.	Illinois and Kentucky	Caves and springs	Minute	Much reduced	Eigenmann, 1909 (with references)

Family	Scientific Name	Presumed Ancestor	Locality	Habitat	External Eyes in Adults	Black Pigment	Chief Authority
	Forbesichthys agassizii (Putnam)	*Chologaster*	Kentucky and Tennessee	Caves	Minute	Much reduced	Eigenmann, 1909 (with references)
	Troglichthys rosae (Eigenmann)	Form near *Chologaster*	SW. Missouri and Arkansas	Caves	Obsolete	Obsolete	Eigenmann, 1909 (with references)
	Typhlichthys eigenmanni Hubbs	Another form near *Chologaster*	Central Missouri	Cave	Obsolete	Obsolete	Hubbs (MS)
	Typhlichthys subterraneus Girard	Another form near *Chologaster*	Kentucky to Alabama	Caves	Obsolete	Obsolete	Eigenmann, 1909
	Typhlichthys osborni Eig.		Kentucky				
	Typhlichthys wyandotte Eig.		Indiana				
Cichlidae	*Cichlasoma urophthalmus conchitae* Hubbs	*Cichlasoma urophthalmus* subsp.	Yucatan	Cenote	Normal	Slightly reduced	Hubbs, 1936, 274
	Cichlasoma u. zebra Hubbs		Yucatan	Cenote	Normal	Normal	Hubbs, 1936, 275
	Cichlasoma u. mayorum Hubbs		Yucatan	Cenotes	Normal	Normal	Hubbs, 1936, 277
	Cichlasoma u. ericymba Hubbs		Yucatan	Cenote	Enlarged	Subnormal	Present paper
Eleotridae	*Typhleotris madagascariensis* P.	*Eleotris*	Madagascar	Sink hole	Obsolete	Obsolete	Petit, 1933
Gobiidae	*Austrolethops wardi* Whitley	Some goby	Queensland	Muddy littoral bottom	Very small	Much reduced	Whitley, 1935, 243-244
	Lethops connectens Hubbs	Near *Gillichthys*	California	Rock crevices	Obsolescent	Reduced	Hubbs, 1927
	Typhlogobius californiensis Steindachner	*Lethops* or related genus	Southern and Lower California	Crustacean burrows under stones	Obsolete	Obsolete	Eigenmann, 1909
	Trypauchen, *Taenioides* and related genera	More typical Gobiidae	Indo-Pacific	Muddy river mouths	Minute to obsolescent	Reduced	Franz, 1910, 109-111, pls. 9-10; Hora, 1924; Hardenberg, 1931, 417-419
Brotulidae	*Monothrix polylepis* Ogilby	*Dinematichthys*	New South Wales	Littoral	Reduced, covered with skin	Reduced	Ogilby, 1897, 87-90; Whitley, 1935, 241
	Dermatopsis macrodon Ogilby	*Dinematichthys*	New South Wales	Under cover on reefs	Reduced, covered with skin	Reduced	Ogilby, 1896, 138-142; Whitley, 1935, 239-241
	Stygicola dentatus (Poey)	*Ogilbia* or other brosmophycine	Cuba	Caves	Obsolete (rarely vestigial)	Blackish to obsolescent	Poey, 1858-1860; Eigenmann, 1909; Kosswig, 1934
	Lucifuga subterraneus Poey	*Stygicola*	Cuba	Caves	Obsolete	Blackish to obsolescent	Poey, 1858-1860; Eigenmann, 1909
	Typhlias pearsei Hubbs	*Stygicola* (?)	Yucatan	Caves	Obsolete	Blackish to obsolescent	Present paper
	Related type ??	?	Jamaica	?	?	?	Eigenmann, 1909,188
	Dipulus caecus	Some eyed brotulid	West Australia	Littoral ?	Obsolete	?	Waite, 1905, 77-79
Synbranchidae	"*Synbranchus marmoratus?*"	*Synbranchus marmoratus*	Cuba	Cave	Covered with skin	Normal ?	Poey, 1868, 404
	Pluto infernalis Hubbs	*Synbranchus marmoratus*	Yucatan	Cave	Obsolete	Obsolete	Present paper
	Typhlosynbranchus boueti Pellegrin	Some synbranchid genus	Liberia, Africa	Creek (presumably in mud)	Obsolete	Blackish	Pellegrin, 1922
Soleidae	*Typhlachirus caecus* Hardenberg	*Synaptura*	Sumatra	Muddy river mouth	Obsolescent to obsolete	Reduced	Hardenberg, 1931

Rhamdia

It now seems probable that all of the catfishes of outer Yucatan have had a single origin, that all have been derived from one another or from *Rhamdia guatemalensis oaxacae* or some other subspecies inhabiting the open streams and aguadas of basal Yucatan. When the bagres of Luchil Cave were thought to be of two subspecies (Hubbs, 1936, p. 205), a dual origin seemed likely, but now that they seem to represent a single form, there is no reason for postulating more than one origin. The wide-spread cenote form *R. g. depressa* very probably gave rise independently to the cave subspecies *R. g. decolor* and the cenote form *R. g. sacrificii;* and *R. g. stygaea,* the form most modified as a cave inhabitant, was presumably derived either from *decolor* or directly from *depressa.* The unpigmented catfish which has been observed in two cenotes was perhaps derived from *R. g. depressa,* whether it represents a mere mutation or a distinct, unnamed species.

The occurrence of catfishes of the genus *Rhamdia* in the underground waters of Yucatan is entirely in line with expectations. Except for large and rather free-swimming ariids, and *Ictalurus meridionalis* of the family Ameiuridae, *Rhamdia* is the only siluroid type which approaches Yucatan. During the Peten expedition of 1935, I observed that *Rhamdia guatemalensis petenensis,* a form close geographically and phyletically to the Yucatan subspecies, inhabits crevices and other hidden retreats during the day, venturing forth to feed by the dark of night. The small eyes of *Rhamdia* are probably of much less use in the nightly needs of this genus than are the organs of taste and touch located on the long barbels. This should be even more true of *Rhamdia* than of *Ameiurus,* the senses of which have been studied at length by George H. Parker and associates (for titles see Dean's *Bibliography of Fishes*). *Rhamdia* is therefore a very logical candidate for cave life.

That *Rhamdia* and various other siluroid fishes have given rise to cave types, more or less depigmented and often blind, has been very emphatically shown by recent studies (see Table 1, under families Ameiuridae, Pimelodidae, Pimelodidae or Trichomycteridae, Pygidiidae and Clariidae). The siluroids now replace the amblyopsids, the North American blindfishes, as the most speciose known group of blind fishes and of cave-fishes.

In addition to cave types, several catfishes seem to be losing or to have lost their eyes and their normal pigmentation. A number of species, as *Pareiodon microps* (see Eigenmann, 1918, p. 343, pl. 37), have very minute eyes, presumably coupled with a burrowing or parasitic habit. Eigenmann (1914, p. 230; 1917*b*, p. 178; 1918, p. 343) indicated that *Eremophilus mutisii* sporadically shows loss of pigment and of normal eyes, and David and Poll (1937, p. 234, fig. 22) have recently reported what seem to be similar mutations in an African species, *Channalabes apus.* George S. Myers has mentioned to me his unpublished discovery of two minute blind catfishes from streams of the Amazon system (not listed in Table 1). Of the 35 to 37 known subterranean fishes, twelve or thirteen belong to the catfish group (Nematognathi), and of these, seven to nine are referable to *Rhamdia* or were obviously derived from that genus and from the closely related genera *Rhamdella* and *Pimelodella.* The blind, unpigmented *Caecorhamdia urichi* of a Trinidad cave is derivable from *Rhamdia quelen,* as Norman (1926) indicated.

Definite proof that a blind relative of *Rhamdia* does occur in the Yucatan caves would occasion no great surprise, for there is evidence that more or less complete blindness has been evolved at least eleven times in the Nematognathi.

Cichlasoma

The four slightly differentiated cichlids of the Yucatan cenotes, all regarded as subspecies of *Cichlasoma urophthalmus,* very probably had a single origin from such a coastwise form as *Cichlasoma urophthalmus cienagae.* They may have been independently derived, but there is no clear-cut evidence to support either view.

Typhlias

The origin of the blind brotulid of the Yucatan caves involves questions of very considerable interest. The relationships of *Typhlias pearsei* are obviously with *Stygicola dentatus* and *Lucifuga subterraneus* of Cuba, hitherto the only known fresh-water representatives and also the only known cave-dwellers of the family Brotulidae, most of which are deep-sea fishes. Poey (1858, p. 96) thought that *Lucifuga* most closely approaches *Brotula,* but Gill (1863, p. 252) classed *Stygicola* and *Lucifuga* as a group (Lucifugae) of his subfamily Brosmophycinae. Eigenmann (1909, p. 187) likewise indicated that these blind genera are most closely related to *Brosmophycis* and *Ogilbia,* and we find good reason to concur in this belief (see account of the genus *Typhlias,* pp. 287-90). The inclusion of *Lucifuga* and similar blind genera in the Brosmophycinae of Gill (1862, p. 280; 1863, p. 253) seems to be much wiser than to class the two series as coordinate groups, whether these be left unnamed as by Goode and Bean (1895, p. 314) or distinguished as the Lucifuginae and the Brosmophycinae as by Jordan and Evermann (1898, p. 2498). The distinctive features in which *Stygicola, Lucifuga* and *Typhlias* agree are chiefly if not entirely those related to cave life, and such distinctions have customarily been treated as of only generic value. Furthermore, there is no assurance whatever that *Typhlias* is directly related to the Cuban blind forms. The more natural assumption is that the caves of Yucatan and possibly those of Jamaica, were the scene of the independent derivation of blindness, as was almost prophetically suggested by Eigenmann (1909, p. 198).

Eigenmann's (1909, p. 197) view as to the origin of the Cuban blind fishes also applies with inescapable plausibility to the origin of *Typhlias* in Yucatan. Some eyed relative such as *Ogilbia* no doubt lived along the cavernous limestone reefs of outer Yucatan, as the region re-emerged from the Pleistocene submergence (for references see Hubbs, 1936, p. 165). Then or earlier this eyed form presumably entered the caves, for an existence in which it was markedly preadapted, and thereafter became profoundly modified, particularly by the degeneration of the eyes. Acclimatization to fresh water must have been simultaneously affected. The calcium-rich waters of the limestone caves was no doubt a factor facilitating this adjustment to fresh-water existence (see Breder, 1934).

The various eyed members of the Brosmophycinae indeed seem well preadapted to a blind existence in caves. With the exception of the three blind species and of *Brosmophycis marginatus* (Ayres), which lives in the very cool waters of the moderate depths from Alaska to southern California, all brosmophycines so far as known are confined to very shallow tropical and subtropical seas. Their well-developed sense organs, as well as the fact that they are all known only from one to several specimens, suggest that they live at least during daylight in the crevices of the reefs, or that they burrow into the sand or mud. The species occurring nearest to Cuba and Yucatan, *Ogilbia cayorum* Evermann and Kendall (1898, p. 133, pl. 9, fig. 14), was "seined on a shoal covered with algae, at Key West." The habitat and habits of this species were more definitely determined by Jordan and Thompson (1905, p. 255), who wrote, "These fish hide under small stones and bury themselves partly in the sand; when disturbed they swim feebly, like a tadpole. . . . ." *Ogilbia ventralis* of the Pacific Coast is common in tide-pools on the reefs (Jordan, 1895, p. 502, pl. 54; Gilbert and Starks, 1904, p. 197).

All of the free-living species of Brosmophycinae are small-eyed, and one of the Australian species, *Dermatopsis macrodon* Ogilby, has the eyes especially reduced. Apparently without realizing the bearing of his remarks on the problem of the origin of the American blind, cave brotulids, Ogilby (1896, p. 198) wrote of *Dermatopsis macrodon:*

> From the small size of the eyes, and the fact of their being protected by a complete covering of skin, one is led to infer that in its natural state this fish is accustomed to burrow in the sand or mud for purposes of concealment, or perhaps as a means of seeking food; a similar protective eyelid is present in *Leme.*[1] It is probably an inhabitant of the littoral zone or, at most, of shallow water in the neighbourhood of the shore.

Whitley (1935, pp. 239-241, fig. 8) further commented that this Australian species

> . . . . is now ascertained to be fairly common at times, though practically unknown to fishermen on account of its cryptozoic habits . . . . it lives in burrows in mud, below clumps of mussels, under stones and in suchlike shaded places. The general colour is olivaceous above, white on the belly, whilst the viscera, gills, etc., show through the skin as pinkish areas. . . . . The fish is not very active, however, preferring to hide. When brought into strong sunlight . . . . the fish, evidently feeling ill at ease, seeks a fresh hiding place. . . . . In habits and general facies this species recalls the tropical *Dinematichthys mizolepis* which I have collected on the Great Barrier Reef, where both a pink and a yellow form are found. The habits of these apparently half-blind fishes would repay intensive study.

The reduction of the eyes and the membranous covering of the eye in *Dermatopsis* and in the related *Monothrix* was also noted by Ogilby (1896, p. 198, and 1897, pp. 86-90).

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[1] A goby related to *Taenioides,* but with better-developed sensory organs on the head (see McCulloch and Ogilby, 1919, pp. 205-207, pl. 31).—C. L. H.

Alcock (1890, p. 433) described *Dinematichthys piger* as having a "small sunken eye," and as "hiding under rocks in pools in coral-reefs of Great Coco Island, Andaman Archipelago."

The idea that the blind, cave, Yucatan genus *Typhlias* originated *in situ* from an eyed, littoral marine species is in agreement with the theory of Creaser (1936, pp. 130-132) that the blind crustaceans of the same caves in Yucatan had (with one likely exception) a direct, marine origin.

The actual ancestor of *Typhlias pearsei* may well have been identical with the ancestor of the two Cuban cave genera, even though the blindness of each may have been independently acquired. The most probable ancestral species would seem to have been one of *Ogilbia,* but there appears to be no reason to regard any one of the three species now referred to the genus as nearer the ancestor than any of the others. In fact, it is not clear from the work of recent writers that these three species are distinct (Jordan and Evermann, 1898, p. 2503; Garman, 1900, p. 512; Bean, 1906, p. 85; Meek and Hildebrand, 1928, p. 966; Parr, 1930, p. 133).

There is one bit of evidence, likely false, that some brosmophycine genus other than *Ogilbia* is the ancestor of the blind brotulids. This is the supposed absence in *Ogilbia* of the very peculiar clasper-like penis which is characteristic of *Lucifuga* and *Typhlias* and of *Dinematichthys* and the other Indo-Australian genera[2] (see p. 288). *Brosmophycis* was also described as lacking this sexual structure, but I find it well developed in that genus, and believe that it will be found in adult males of *Ogilbia.* So far as indicated, all specimens of *Ogilbia* recorded to date have been small, and therefore probably immature. Even if *Ogilbia* should prove to lack a clasper-like penis and to be excluded from consideration as the ancestor of the blind genera of Cuba and Yucatan, we should still look for the probable ancestor among the littoral marine species of the same group (Brosmophycinae).

Synbranchus

The peculiar blind synbranchid, *Pluto infernalis,* was presumably derived from *Synbranchus marmoratus,* the only species of the family Synbranchidae now recognized from the New World. It agrees well with that eel-like creature, except for its much more extreme degeneration.

It might have been expected that *Synbranchus marmoratus* would produce a blind derivative in the extensive underground waters of Yucatan. The species occurs generally in the lowlands from Vera Cruz to Patagonia, and is probably common in suitable waters near the coast around Yucatan, although it has been recorded only from ponds on Cozumel and Mujeres Islands (Evermann and Goldsborough, 1902, p. 148). On Mujeres Island Mr. Goldman found the "eels" only in crevices between rocks. In Peten I found that the "anguilas" are nocturnal in their feeding habits, remaining in complete seclusion throughout the hours of daylight. Even at night they were most often seen (with a light) merely protruding their long, flexible head end from some crevice between boulders or from a definite burrow in

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[2] Listed by Whitley, 1936, p. 46.

the bottom. The burrowing habits and apparent negative phototropism of *Synbranchus* are referred to by Taylor (1913).

In connection with the occurrence of a blind synbranchid as well as a blind brotulid in the caves of Yucatan, it seems to be of special significance that Poey (1868, p. 404) reported a seemingly blind synbranchid as well as two blind brotulids from subterranean waters in Cuba. This supposedly blind synbranchid of Cuba seems to be vastly less modified than *Pluto,* and very likely represents an independent and incipient modification toward a cave type. Poey's account, which was overlooked by Eigenmann in his work on blind fishes and on the Cuban fauna, and by others who have listed the cave-fishes of the world, is translated as follows:

> My friend Don José Ignacio Hernandez has sent me from Cartagena in the Jurisdiction of Cienfuegas, an individual fished out of a subterranean place which is connected with a pool of water. In that country it is called the "blind eel," but its visual organs exist hidden beneath the skin where it is somewhat thin. It differs from the type which lives in the open by having some pores on the sides of the head, and a parallel, vertical series of folds on each side of the neck. These are bordered by scalelets like short, white hairs.

Poey's form, which he merely listed under *"Symbranchus marmoratus?"*, would therefore seem to be transitional toward a blind type, with a compensating hypertrophy of dermal sense organs.

All synbranchids have small eyes, and some have these organs greatly reduced. One African creek form, *Typhlosynbranchus boueti* Pellegrin (1922), probably living in the mud, is entirely blind.

The discovery of *Pluto infernalis* further supports the view that the cave fauna of Yucatan is in part of fresh-water as well as marine origin. This makes unnecessary the rather forced interpretation of the blind atyid shrimp of these caves as of marine origin (Creaser, 1936, pp. 130-132).

GENERAL REMARKS ON THE EVOLUTION OF CAVE-FISHES[3]

The preceding analysis of the probable origin of the cave-fishes of Yucatan, considered in connection with the data presented and referred to in Table 1, confirms the theory that cave animals have arisen from species moderately preadapted to cave life. The facts, however, do not harmonize thoroughly with any of the four alternative but not mutually exclusive hypotheses of the origin of cave animals. Eigenmann's analysis (1909, pp. 12-16), reflecting the biological philosophies of his predecessors, was weakened by an undue confusion of thoughts on the occupation of the caves and on the evolution of the characters of cave animals. Haseman (1911, pp. 323-328) concerns himself almost solely with the question of how fishes and other animals got into the caves.

The not infrequent finding of strays of free-living species in caves (referred to on p. 262) shows that caves are very frequently populated with a nucleus from which cave species could theoretically evolve. There is little ground for supposing, however, that mere accidental strays have become modified into cave types, for such

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[3] Professors Alfred Emerson and Sewall Wright of the University of Chicago have offered valued suggestions on the manuscript for this section.

strays would not likely have been common enough to have formed a breeding stock, or would not have found conditions suitable for reproduction or for the occupation of a cave with sufficient permanence to allow for the requisite mutation and evolution. The fact that cave animals as a whole are related to forms preadapted to life in darkness, with nocturnal, burrowing or crevice-seeking habits, and with tactile and other senses well developed as if in compensation for a weakening of vision, indicates that only preadapted strays, if any, have evolved into typical cave forms.

The most notable evidence contradictory to the view that the precursors of cave-fishes were more or less preadapted to cave life is furnished by the recently described blind characin of Mexico, *Anoptichthys jordani* Hubbs and Innes (1936). The obvious ancestor, *Astyanax fasciatus mexicanus,* is a large-eyed, free-swimming, open-water form, without any evident special modification of sensory organs or habits that would lead one to interpret this species as capable of establishing a permanent population within a cave. This circumstance indicates that almost any fresh-water fish may have the capacity to become a blind, unpigmented cave form, provided other conditions are favorable for this speciation. The absence so far as known of other cave-fishes in the cavern inhabited by *Anoptichthys* may help to explain how it came into being, in the lack of competition.

Other than *Anoptichthys,* practically all cave-fishes, and also the blind fishes of other habitats, seem to have had ancestors which to a varying degree were preadapted to successful life in utter darkness. The predominance of weak-eyed, long-barbelled, nocturnal catfishes in the list of ancestors of cave-fishes (see third column of Table 1) has already been emphasized (p. 266). The four cyprinid fishes of caves, showing various degrees of loss of eyes and of pigment, are supposedly derived (probably all independently) from species which like the catfishes are provided with sensory barbels. Eigenmann (1909, p. 15) and others have duly emphasized the high degree to which *Chologaster* of the swamps shows features of structure and habit which preadapt it (and presumably preadapted its extinct relatives) to a blind cave life.[4] The cenote cichlids (p. 263) are little modified. That only one blind cave goby is known perhaps reflects the essentially marine and estuarine habitats of the group, for most of the sluggish, often crevice-seeking gobies are small-eyed and well provided with special sense organs in the skin. As emphasized on page 267, the brosmophycine ancestors of the blind cave brotulids were no doubt logically headed toward cave existence and blindness, though their seemingly simultaneous adaptation to both fresh-water and cave existence may be looked upon as an outstanding feat in evolution. Finally *Synbranchus* also shows structural and habitudinal preadaptations to the subterranean existence and modifications shown by its Cuban cave derivative and more strikingly by *Pluto infernalis* (see p. 269).

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[4] Eigenmann indicated that the special sense organs of the head characteristic of most amblyopsids are not developed in the swamp-inhabiting *Chologaster,* but that these organs are moderately well developed in the closely related, small-eyed, cave species formerly referred to *Chologaster* but now classified in a distinct genus, *Forbesichthys.*

Special reproductive habits may have aided certain of the cave-fishes in meeting the difficulties of sexual contact and of larval nutrition, encountered as they became established in caves. *Amblyopsis* (Eigenmann, 1909, p. 92) practises branchial gestation, thus protecting the young during a period while they slowly develop on a relatively large, yolk-filled egg. Since this type of gestation is correlated with the far advanced position of the genital opening, a feature common to all members of the family including *Chologaster,* it may be presumed that all amblyopsids practise branchial gestation. The viviparity of the Cuban cave brotulids *Lucifuga* and *Stygicola* (Eigenmann, 1909, p. 204), by which the young are even more thoroughly protected and nourished, was no doubt developed in their ancestors prior to their emigration into the caves. *Dermatopsis,* one of Australian brosmophycine genera closely related to the blind brotulids, is reported to be viviparous (McCulloch and Waite, 1918, p. 62), and it is a legitimate supposition that all of the Brosmophycinae, of both littoral and cave habitats, give birth to living young, for the clasper-like penis characteristic of the entire group (see pp. 269 and 288) is almost surely an implement of copulation. The Australian blind brotulid *Dipulus caecus* seems also to show a correlation between copulation and blindness, as pointed out by Waite (1905, p. 79). *Synbranchus* has very large eggs, so that the yolk suffices to carry the young over a long period of development, during which they are guarded by the male parent (Taylor, 1913). It is not known, I believe, whether the cyprinid and nematognathous cave-fishes and their ancestors similarly possess reproductive habits that might facilitate the fertilization and development of their eggs in the dark abysses of underground caverns.

Blind fishes of habitats other than those of caves similarly give evidence of a degree of preadaptation to the environmental conditions with which their blindness is related. The half-blind goby (*Lethops*) and the blind goby (*Typhlogobius*) of the California reefs seem to have been derived from burrowing gobies supplied as in their relatives with special sense organs on the head (Hubbs, 1927). According to Whitley (1935, pp. 243-244, fig. 10), the same relation presumably holds for *Austrolethops,* an Australian goby with much reduced eyes. The other more or less blind gobies not dwelling in caves, namely *Trypauchen* and related burrowing genera of tropical mud flats near the mouths of rivers, were obviously derived from small-eyed forms with well-developed dermal sense organs (Franz, 1910, pp. 109-111, pls. 9-10; Hora, 1924; Hardenberg, 1931, pp. 417-419, etc.). *Typhlosynbranchus boueti* (Pellegrin, 1922), of an African creek, presumably a mud-dweller, is doubtless a blind derivative of some eyed synbranchid which like *Synbranchus* shows preadaptation to blind life. The Sumatran blind sole *Typhlachirus* (Hardenberg, 1931), inhabiting a very muddy river mouth, was undoubtedly derived from one of the soles having very small eyes and a profuse development of hair-like sensory organs on the head.

Although the permanent occupation of lightless caves seems to have been generally made possible by a preadaptation to such a life, there is no good reason to believe that this preadaptation was complete. Blind fishes are not known to occur outside of caves, except in other more or less completely dark situations to which the blind forms seem rigidly adapted and inescapably bound. A marked reduction in the size of the eye and in pigment, coupled with some hypertrophy of tactile and other sense organs, characterizes a number of fishes more or less restricted to the extremely silty water of the streams of the Great Plains,[5] but none of these forms is totally blind or unpigmented.

It is plausible to assume that the loss of eyes and pigment and the hypertrophy of sense organs was largely brought about or was at least carried to the extreme condition commonly characteristic of cave-fishes, by degenerative processes acting during a long period of life in darkness. Such changes, often repeated, constitute a very notable and often quoted example of parallel evolution.

It is well known that many representatives of other groups of animals permanently inhabiting caves or similarly lightless habitats are eyeless and unpigmented, and are often especially well endowed with dermal sense organs. The unlighted situations in which the eyes and pigment of the inhabitants have usually become lost, include the internal parts of the bodies of other animals, for almost all endoparasites are blind and colorless.

Something inherent in life under perpetual darkness seems therefore either to cause or to permit the degeneration of the eyes and color, or at least to induce the capacity to become blind and unpigmented during development in darkness. In either case these degenerative changes no doubt have a genetic basis.

Without reverting to Lamarckism, it would be difficult either to explain these changes as due to "use and disuse," or to explain the associated degeneration of eyes or pigment and the increased development of other sense organs, as being directly related to the capacity of a blinded individual to feel and hear more acutely, as if through some compensative mechanism. Degenerative changes have been explained on the assumption that the losses involved are advantageous in that they conserve energy, either throughout life or more particularly during development. An ultra-Darwinian might argue that such conservation of energy would be of great advantage to forms living in caves, where nutrition is often a most serious problem. But the same degenerative changes in vision and pigmentation are characteristic of successful parasites, for which nutrition seems to be the least pressing of the problems of life.

The simplest explanation for the degeneration of eyes and color in animals living in darkness would seem to be the mere survival of "mutations of loss" (the commonest kind), because of the release of ordinarily stringent selection. It is well known that highly complex structures and particularly the eyes are relatively often subject to such mutations. Fishes of open waters when becoming extremely abundant under lack of competition and predation (*Pimephales promelas* is an example) often have greatly reduced eyes (though to be sure this condition might be pathological). Cases of imperfect eye development are not extremely infrequent among fishes cultivated in aquaria and ponds. Similarly albinism and other color-defi-

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[5] This problem is now being studied under my direction by George A. Moore.

ciencies, as erythrism, xanthism and various "albinistic" conditions, survive more often in cultured and domestic animals than in those subject to the inroads of predators which would almost surely consume any conspicuously light individuals (Sumner, 1935).

In time, with repeated mutations of loss and in the absence of selection, it would be possible for an animal to attain blindness and lack of color. The expected rate of change may be computed.[6] For simplicity let us assume a static population, with a single mating for each pair and the survival of two offspring from each mating, and further assume a constant rate of mutation of germ cells, leading in one step to loss of eyes or color, and that the mutants are Mendelian recessives. Further, let us begin with a stock which is composed entirely of normal individuals but which produces normal and abnormal (mutant) genes in the ratio of q to $1-q$, that there is no reverse mutation in later generations, and that the normal genes of the heterozygotic individuals are subject to the same mutation. From these assumptions it may be determined that the n^{th} generation will contain normal, heterozygotic, and abnormal individuals as follows:

normal individuals ...... q^{2n}
heterozygotic individuals ...... $2q^n(1-q^n)$
abnormal individuals ...... $(1-q^n)^2$

Assuming a mutation rate of one in 1000 the stock at the 1000th generation would comprise about 135 purely normal individuals, 465 heterozygotes and 400 abnormal ones (mutants). In 100,000 generations the population would consist of mutants in virtual entirety, for less than one in 1,000,000 would be normal. Assuming a mutation rate of one in 1,000,000 the population in 1,000,000 generations would include about 138,000 pure normals, 467,000 heterozygotes and 395,000 mutants.

Pairs or small populations of pure mutants might often be trapped in isolated cave pools or streams, thus allowing the very rapid increase of the abnormal type, which would be free to disperse into and to populate any subterranean waters which would then or later become connected with the pools or streams where the mutants had been isolated.

The loss of vision and color may be due in part to the now well-known multiple effects of genes or of gene systems. Changes in genes or gene systems that would not only cause such losses but would also increase the fecundity of the animals involved would likely have a selectional advantage. In the wholly dark habitat, the loss of vision or pigment would not negate the advantages of increased fecundity, as they would in the open. In a cave environment any advantageous effects in any way genetically bound with reduction in eyes or color should lead to such degeneration.

Looking upon the end stages of degeneration usually shown by the better-known cave-fishes and other cave animals, one might be led to wonder whether the process of retrogression had ever proceeded in such a way that more or less normal

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[6] Thanks are due to Dr. Ralph Hile for mathematical aid.

individuals could exist side by side with those lacking eyes and color. Evidence of such occurrences, however, have come to light, to confirm the view that the degeneration was not a wholly gradual change. In the original description (Hubbs and Innes, 1936), it was shown that *Anoptichthys jordani* occasionally approaches the normal characin type in the development of eyes and pigment, and subsequent word from the discoverer of this form, C. Basil Jordan, indicates that the approach toward the normal is at times greater than previously indicated. Ribeiro (1912, p. 250, pl. 42, figs. 2-2B; quoted by Eigenmann, 1917*a,* pp. 255-256) described and figured one example, with somewhat developed eyes, of the usually blind *Typhlobagrus,* one of the South American cave catfishes. In all three blind brotulids the color varies from blackish to obsolescent, and occasionally in *Stygicola* the eyes are vestigially developed (Poey, 1858-1860; Eigenmann, 1909; Kosswig, 1934; present paper).

Granted that the simple conditions here assumed are not likely to be realized and that the actual changes would be much more irregular and complicated, these computations and other considerations seem to indicate the possible evolution of the eyeless and colorless condition on the simple basis of the survival, under the release of selection, of degenerative changes induced by repeated "mutations of loss,"—or linked by some genetic mechanism with genes which are favorable for survival (or are of neutral significance) under cave conditions, but which would not survive in open waters merely because they are associated with factors leading to deficiency or absence of vision or of protective coloration. Such favorable or neutral genetic constitutions might arise either as new mutations or as gene recombinations which would ordinarily be eliminated. Much evidence has been presented, in the recent genetic literature, to support the view that degenerative changes are inhibited in most natural populations through an intensive elimination of individuals with unfavorable gene combinations or mutations.

Some indications have lately been given that the blind condition of typical cave animals is a direct individual effect of the unlighted environment. It is well known that certain cave salamanders (as *Proteus*) when kept in the light retain the eyes of the young in the normally blind adult, and it has been argued that such experiments disprove any genetic significance of the blindness. There must be, however, a genetically fixed capacity for the cave salamander to become blind in darkness, and it is very probable that other salamanders lack this capacity, and therefore differ genetically. Claims have been made that goldfish reared in complete darkness were eyeless, but the eyes may have been destroyed by injury or disease. There is a large body of circumstantial evidence to indicate that normally eyed fishes and amphibians retain their vision when reared in the dark, but critical experiments to test this point are in order.

There is better evidence that loss of pigment may be directly related to lack of light. It is well known that exposure to light induces the development of normal pigment on uncolored portions of the integument which are protected from the light; for example, on the normally white blind side of flatfishes and concealed abdomen of crabs. But again we may be dealing with an inborn and specific capacity of these regions to become modified, under the normal condition of darkness. Certain diseases of the eye are said to induce paleness in fishes, for instance in the aquarium-reared cyprinids of the genus *Rasbora,* but salmonoid fishes in hatcheries invariably turn black when blinded either by disease or accident. The blind eel erroneously described by Smith (1904) as a distinct species, *Anguilla caeca,* was almost surely an example of individual rather than racial blindness.

TABLE 2

Proportionate Measurements of Several Subspecies and Races of Rhamdia guatemalensis from Different Caves and Cenotes in Yucatan

For each 50-mm. size class there is given in the second column the minimum and maximum size and number of specimens included; and in the following columns there are given the minimum, maximum and, in italics, the average size of the part for each character, expressed in thousandths of the standard length.

Subspecies and Locality	Min. and Max. Size / No. of Specimens	Max. Barbel	Length of Snout	Length of Orbit	Length of Head	Width of Head	Length Pectoral Spine	Length Adipose Dorsal	Depth Caudal Peduncle	Character Index
R. g. depressa:										
Ixil Cenote...	93mm. (1)	*684*	*105*	*54*	*286*	*206*	*125*	*303*	*77*	*154*
	102–137mm.	637–826	100–119	46–59	271–307	192–215	98–115	305–343	74–91	133–145
	(10)	*735*	*104.5*	*56*	*285*	*199*	*106.5*	*327*	*80*	*140*
	151–179mm.	599–752	108–119	50–54	272–305	198–217	95–110	300–335	68–82	139–161
	(5)	*688*	*114*	*52*	*294*	*207*	*104*	*313*	*76*	*150*
R. g. sacrificii:										
Xtoloc Cenote	97mm. (1)	*631*	*109*	*49*	*294*	*199*	*106*	*327*	*87*	*138*
	102–150mm.	435–630	96–112	42–58	264–287	186–230	81–115	318–375	71–100	114–138
	(25)	*543*	*103*	*47*	*277*	*204*	*98*	*341*	*88*	*124*
	156–160mm.	331–480	101–102	43–47	263–288	204–218	86–101	314–339	74–97	117–133
	(3)	*430*	*101*	*45*	*272*	*210*	*92*	*330*	*82*	*124*
Segrada Cenote.......	137mm. (1)	*606*	*115*	*41*	*281*	*230*	*88*	*401*	*103*	*108*
	167–200mm.	477–548	94–111	35–47	257–278	195–225	82–92	338–354	84–95	114–120
	(8)	*514*	*104*	*39.5*	*267*	*209*	*88*	*345*	*92*	*117*
R. g. decolor:										
S. Bulha Cenote.......	104–151mm.	454–594	106–113	42–45	275–291	169–194	90–108	321–360	76–98	118–138
	(4)	*515.5*	*110*	*44*	*282.5*	*185.5*	*99*	*337.5*	*87*	*128*
S. Bulha Cave.	54–97mm.	586–672	100–107	51–59	283–299	183–210	78–105	308–358	80–93	122–143
	(5)	*635*	*103*	*55*	*291*	*195*	*93*	*329*	*86*	*133*
	110–151mm.	491–684	109–118	47–55	289–302	207–231	94–106	319–383	86–103	119–143
	(4)	*609*	*115*	*50*	*297*	*216*	*100*	*338*	*92.5*	*133.5*
Kaua Cave...	129mm. (1)	*538*	*108*	*50*	*291*	*194*	*119*	*341*	*83*	*135*
	167–181mm.	401–492	107–108	46–47	283–285	198–223	82–99	334–341	77–88	123–128
	(2)	*446.5*	*107.5*	*46.5*	*284*	*210.5*	*90.5*	*337.5*	*82.5*	*125.5*
	221–229mm.	432–460	105–111	42–47	275–283	200–217	82–85	325–354	85–86	119–124
	(2)	*446*	*108*	*44.5*	*279*	*208.5*	*83.5*	*339.5*	*85.5*	*121.5*
Oxolodt Cave.	103–137mm.	516–544	100–113	46–54	269–284	193–205	89–126	333–344	76–86	121–136
	(4)	*527*	*106*	*50*	*278*	*199.5*	*105.5*	*339*	*80*	*129.5*
	154–159mm.	474–566	98–101	44–45	253–254	186–191	79–89	305–311	80–84	125–126
	(2)	*520*	*99.5*	*44.5*	*253.5*	*188.5*	*94*	*308*	*82*	*125.5*
R. g. stygaea:										
Luchil Cave...	21mm. (1)	*575*	*118*	*52*	*335*	*203*	......	*340*	*80*	......
	81–83mm.	546–655	113–114	46–48	290–297	175–187	108–108	320–351	83–91	131–142
	(2)	*600.5*	*113.5*	*47*	*293.5*	*181*	*108*	*335.5*	*87*	*136.5*
S. Isidro Cave	74–92mm.	519–692	110–118	39–46	277–292	178–207	97–113	315–350	84–89	129–141
	(4)	*601*	*113*	*43*	*286*	*190*	*107*	*337*	*87*	*134*
	103–116mm.	513–607	111–117	39–44	274–288	193–201	80–113	346–365	88–92	117–132
	(3)	*545*	*113*	*42*	*283*	*196*	*100*	*355*	*90*	*124*

Of more immediate pertinence to our discussion is the evidence that certain fishes become depigmented as a direct result of living in caves. Kosswig (1937*a* and *b*) has lately discussed this question, referring not only to a prior description of pale trout (*Trutta fario*=*Salmo trutta*) in subterranean water, but also to his recent discovery of an unpigmented cyprinid (*Squalius cephalus*) in a cave. Either or both of these fish, however, may have represented an eyed but depigmented subterranean race or species (neither, however, is included in the list of cave-fishes given as Table 1). Fish and amphibian strays in American caves, many of which appear to represent populations locked and reared in the subterranean habitat, essentially retain their normal pigmentation. However, Kosswig may well have been correct in his indication that different groups exhibit different pigmentary responses to light and to dark.

It is indeed timely to subject to modern biological thought and experiment the whole problem of the degenerative evolution which takes place under the release of selection pressure, in such environments as caves.

PIMELODIDAE

Rhamdia guatemalensis (Günther)

It was indicated in our previous report (Hubbs, 1936, pp. 179-207, pl. 1, figs. 2-3) that the populations of this type of catfish in the numerous isolated cenotes and caves of Yucatan show differences which appear to be of racial and in part of subspecific significance. Supplementary data on the characteristics of some of the same and of other populations are given in Table 2. In general the results of the former study are confirmed, though more doubt is cast upon the genetic validity of the subspecies recognized. As indicated below, this is particularly true of the slightly depigmented cave form named *R. g. decolor.* An experimental study is needed to demonstrate conclusively whether or not the differences shown by the various cave and cenote populations are inborn or due to the environments.

Rhamdia guatemalensis depressa Barbour and Cole

Further topotypic material of the common cenote form of *R. guatemalensis* was obtained by Trautman and Van Tyne in Ixil Cenote at Chichen Itza. Counts and measurements of this material, given in Tables 2-5, agree well with those in the tables of the 1936 report.

As indicated below, it now seems clear that I erred in identifying the Luchil Cave bagres as members of two subspecies, *R. g. depressa* and *R. g. stygea.* Transferring to *R. g. stygaea* the counts and measurements of the Luchil Cave specimens wrongly referred to *depressa* somewhat increases the apparent integrity of the race-complex of *depressa* inhabiting the western group of cenotes. This is particularly true of the character index (see Table 14 and p. 192 of the 1936 report).

Rhamdia guatemalensis sacrificii Barbour and Cole

A re-examination of the status of this form is in order. Counts and measurements of the available material, in comparison with those of other subspecies, particularly *R. g. depressa,* are given in Tables 2-5. These data illustrate the distinctive characters of the subspecies as heretofore stated (Hubbs, 1936, p. 200).

As insufficiently noted in the preceding paper, the fins of *R. g. sacrificii* are much shorter than those of *R. g. depressa.* The contrast is particularly great when specimens of *sacrificii* from Xtoloc and Segrada Cenotes are compared, as in Table 3, with topotypes of *depressa* from the nearby Ixil Cenote, for the bagres of that cenote are very long-finned, even for *depressa*. Caution is needed in interpreting the data, however, for the long fins of the Ixil specimens may be due to the known crowding and emaciation of the Ixil population. I have found similar examples of markedly lengthened fins due to poor nutrition in other groups of fishes, notably in experimental stocks of *Mollienisia*. The facts that the specimens from the Segrada Cenote have shorter fins than those from Xtoloc Cenote, and that they seem better fed, confirm the view that the differences shown in Table 3 are due at least in part to environmental factors. To prove certainly that a genetic difference is also involved would require an experimental study.

TABLE 3

Comparative Measurements of Fins in Rhamdia guatemalensis depressa and Rhamdia guatemalensis sacrificii

Fins........	Longest ray in upper lobe of caudal fin divided by least depth of caudal peduncle			Length of pelvic fin divided into distance from insertion of pelvic fin to origin of anal fin		
Subspecies...	*depressa*	*sacrificii*		*depressa*	*sacrificii*	
Cenote....	Ixil	Xtoloc	Segrada	Ixil	Xtoloc	Segrada
Specimens.	16	29	9	16	29	9
Range....	2.5–3.2	1.7–2.4	1.6–2.1	1.1–1.4	1.4–1.9	1.6–2.1
Average...	2.73	2.10	1.80	1.24	1.61	1.87

A much more trustworthy distinction between *sacrificii* and *depressa* lies in the number of gill-rakers (Table 4), for as previously noted *sacrificii* has an extremely high number of rakers (for a *Rhamdia*). On this basis at least there can be little doubt as to the genetic validity of the form *sacrificii*.

A slight degree of differentiation, seemingly insufficient for subspecific distinction, is noted on comparing specimens from the Xtoloc and Segrada Cenotes. The gill-rakers (Table 4) seem to average slightly fewer in the Xtoloc race. This type is a gray-black, less intense than the blue-black of the Segrada form, and generally with a lesser contrast between back and belly. The light mid-ventral stripe of the latter type is sharply set off from the general blue-black color, and this stripe is wider than usual. An overlap in the variation of this character is evident, however, when all the material from the two cenotes is compared.

Rhamdia guatemalensis decolor Hubbs

(Pl. 1, Fig. 2)

With some trepidation I refer to this subspecies specimens collected by A. S. Pearse in several caves of Yucatan:

San Bulha Cenote (or Cave) at Merida, July 3, 1936. This cenote is a small, rather dirty basin of water in a limestone cavern. The roof has been pierced by two wells and by a stairway at one end, opposite a connection with deep underground water. Bagres were caught here on bird bait.

TABLE 4

NEW COUNTS OF GILL-RAKERS ON THE OUTER ARCH OF THE TWO SIDES, IN SEVERAL SUBSPECIES OF RHAMDIA GUATEMALENSIS

Subspecies	*depressa*	*sacrificii*		*decolor*				*stygaea*	
Locality	Ixil Cenote	Xtoloc Cenote	Segrada Cenote	S. Bulha Cenote	S. Bulha Cave	Kaua Cave	Oxolodt Cave	Luchil Cave	S. Isidro Cave
Upper limb:									
3	1	..	..	1	1	..	..	..	3
4	22	..	..	4	9	1	2	2	10
5	6	25	3	2	8	5	9	..	3
6	1	31	9	..	..	1	..	..	..
7	..	2	6	..	..	..	..	..	..
Lower limb:									
9	..	..	..	..	..	..	..	..	5
10	5	..	..	..	2	..	..	2	2
11	10	1	..	1	6	..	..	..	3
12	13	8	3	1	4	3	7	..	2
13	2	12	4	1	5	1	1	..	1
14	..	21	5	4	1	3	2	..	1
15	..	13	4	..	..	..	..	..	1
16	..	3	1	..	..	..	..	..	..
17	..	..	1	..	..	..	..	..	..
Total:									
12	..	..	..	..	..	..	..	..	2
13	1	..	..	..	..	..	..	..	3
14	4	..	..	..	2	..	..	2	2
15	8	..	..	1	5	..	..	..	3
16	12	1	..	1	4	1	1	..	1
17	2	3	..	2	2	2	7	..	2
18	3	12	2	1	4	1	..	..	..
19	..	12	3	2	1	2	2	..	1
20	..	18	8	..	..	1	..	..	1
21	..	10	3	..	..	..	..	..	..
22	..	2	1	..	..	..	..	..	..
23	..	..	..	..	..	..	..	..	..
24	..	..	1	..	..	..	..	..	..

TABLE 5

VARIATION IN QUOTIENT OF SNOUT LENGTH DIVIDED BY ORBIT LENGTH IN NEW MATERIAL OF RHAMDIA GUATEMALENSIS FROM YUCATAN

Subspecies and Locality	Range for specimens 50 to 99 mm. in standard length (and no. of specimens)	Range for specimens 100 to 149 mm. in standard length (and no. of specimens)
R. g. depressa:		
Ixil Cenote	2.0 (1)	1.7–2.0 (9); 2.5 (1)
R. g. sacrificii:		
Xtoloc Cenote	2.3 (1)	1.9–2.6 (24)
Segrada Cenote	....	2.8 (1)
R. g. decolor:		
San Bulha Cenote	....	2.5–2.7 (3)
San Bulha Cave	1.5–2.0 (5)	2.1–2.5 (3)
Kaua Cave	....	2.2 (1)
Oxolodt Cave	....	1.9–2.5 (4)
R. g. stygaea:		
Luchil Cave	2.35–2.5 (2)	....
San Isidro Cave	2.5–2.8 (4)	2.5–2.9 (4)

San Bulha Cave (or Cenote) at Motul, July 9, 1936. This cave, the type locality of *R. g. decolor,* was described in our former report (Hubbs, 1936, p. 172), and is very similar to the San Bulha Cenote at Merida. It also has a well in the roof, and stairs have been cut down through the limestone to a bath house. The far end of this pool is likewise openly connected with deep water.

Kaua Cave at Kaua, 18 miles from Chichen Itza, July 16 and 17, 1936. This is described by Dr. Pearse as a large cave with many galleries. The bagres were caught on bird bait about 20 m. below the surface of the ground and perhaps 80 m. from the mouth. A connection with Kaua Cenote is indicated by the food, which Dr. Pearse estimated to be as follows: for 3 adults taken July 16—insects 69 per cent, plants 20 per cent, seeds 9 per cent, Cladocera 2 per cent; for 2 adults taken July 17—insects 75 per cent, mud (?) 20 per cent, small seeds 5 per cent.

Oxolodt Cave, one-half league from Kaua, June 18, 1936. Dr. Pearse describes this cave as 20 m. deep, dark, with many abrupt crevices. The bagres here were very tame. Their food was determined by Dr. Pearse to consist of mud and blood, the latter from the feces of vampire bats. No connection between this cave and cenotes was indicated.

Like the types (Pl. 1, Fig. 2) of the subspecies *decolor,* these bagres from well-separated caves are variably depigmented as compared with the blackish form, *depressa,* of the typical cenotes. The separated localities cause us to wonder whether the difference in pigmentation is of genetic significance. Again, an experimental study is needed. The fact that both the open and closed cenotes contain similarly dark races of *depressa* is still the best evidence that *decolor* is genetically distinct. Even if the lightened color of the cave form is genetically fixed, however, there is no good reason to feel confident that its separated populations are not the product of several independent lines of speciation. Some differences do appear in the measurements of the different series (see Table 20 of the 1936 report and Table 2 of the present paper), but these differences, taking age variation into account, are insufficient for subspecific separation. The maxillary barbel varies considerably, but again averages shorter than in *sacrificii.* The gill-rakers in the new material (Table 4) average slightly more numerous than in the specimens originally recorded.

Rhamdia guatemalensis stygaea Hubbs

(Pl. 1, Fig. 1)

Additional specimens of this subspecies were obtained by Dr. A. S. Pearse in the same two caves from which it was originally collected, namely Luchil Cave and San Isidro Cave, in the general vicinity of Merida. Those from the elongate chamber of San Isidro Cave were taken near the inner end, in a marginal pool having deep connections. Those from Luchil Cave, Tixcacal, were also taken in marginal pools having deep connections.

These specimens were found by Dr. Pearse to have eaten food items indicative of outside connections. Two of 101 and 153 mm. length, taken in San Isidro Cave on July 3, had eaten insects (65 per cent) and seeds (35 per cent). Three others, 79 to 123 mm. long, caught in the same cave on July 5, had consumed fruits and mud (?). Two, 85 and 89 mm. long, caught in Luchil Cave on July 6, were found to contain fly pupae (40 per cent), insects (17.5 per cent), ostracods (17.5 per cent), unknown arthropods (12.5 per cent), schizopod (7.5 per cent) and dirt (5 per cent).

The new material agrees fairly well with that recorded in 1936 in most characters, but requires some revision of the earlier treatment. The chief revision called for is the reference to *stygaea* of all material from Luchil Cave. In the 1936 report (p. 205, Table 21), specimens from this cave were referred in part to *depressa* and in part to *stygaea*. A marked difference in number of gill-rakers seemed correlated with slight differences in proportions, one lot resembling the types of *stygaea* from San Isidro Cave, the other approaching *depressa*. Referring the one lot to *depressa* did introduce some discrepancies, but seemed the wisest course. The new material shows that two forms can not be distinguished on the basis of number of gill-rakers (Table 6). What seemed previously to represent too much of a spread in raker counts for one subspecies is now shown to form a graded series, though seemingly with a most unusual and inexplicable skewness in dispersion.

TABLE 6

NUMBER OF GILL-RAKERS IN RHAMDIA GUATEMALENSIS STYGAEA

Locality	Total gill-rakers on first arch											
	12	13	14	15	16	17	18	19	20	21	22	23
Luchil Cave:												
Former counts, for "*depressa*"	..	..	..	..	1	1	3	1	..	..	1	1
Former counts, for "*stygaea*"	2	2	..	..	..	..	..	..	..	..	..	..
New counts	..	..	2	..	..	..	..	..	..	..	..	..
Total	2	2	2	..	1	1	3	1	..	..	1	1
San Isidro Cave:												
Former counts, for "*depressa*"	4	2	2	1	1	..	..	..	..	..	..	..
New counts	2	3	2	3	1	2	..	1	1	..	..	..
Total	6	5	4	4	2	2	..	1	1	..	..	..
Grand Total	8	7	6	4	3	3	3	2	1	..	1	1

The other characters of the new stock seem to confirm the validity of *stygaea*. The measurements, given in Table 2, correspond well with those originally assigned the subspecies. The long snout and rather small eye (considering age variations) are again noted. However, the high value of the quotient of the length of snout divided by the length of the orbit does not stand out so sharply as originally indicated[7] (compare Tables 8 and 9 of the 1936 report with Table 5 of the present paper). In this respect and others the specimens from Luchil Cave are not so extreme as typical *stygaea* from San Isidro Cave. When the specimens from Luchil Cave formerly called *depressa* are included in the sample of *stygaea* from that lake,

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[7] Furthermore, the possibility should not be forgotten, that the size of the eye may be determined by general nutrition.

two distinct races likely of separate origin seem to be indicated. The Luchil population might be referred either to *decolor* or to *depressa* almost as satisfactorily as to *stygaea.*

In color the new specimens from San Isidro Cave, like the types, are very much though variably depigmented. The darkest examples are about as dark as the two new specimens from Luchil Cave, but still lighter than typical *depressa.*

TABLE 7

VARIATION IN NUMBER OF FIN RAYS IN SUBSPECIES OF CICHLASOMA UROPHTHALMUS (NEW DATA FROM YUCATAN)

Subspecies and Locality	Number of Rays												No.	Average
	6	7	8	9	10	11	12	13	14	15	16	17		
Dorsal spines:														
cienagae (Progreso)	..	..	..	..	..	..	..	..	..	3	42	2	47	15.98
mayorum (Xtoloc)	..	..	..	..	..	..	..	..	..	..	2	..	2	16.00 (?)
mayorum (Segrada)	..	..	..	..	..	..	..	..	..	..	5	..	5	16.00
ericymba (Merida)	..	..	..	..	..	..	..	..	..	1	1	..	2	15.50 (?)
Dorsal soft rays:														
cienagae (Progreso)	..	..	..	1	9	36	1	..	..	..	..	..	47	10.79
mayorum (Xtoloc)	..	..	..	..	1	1	..	..	..	..	..	..	2	10.50 (?)
mayorum (Segrada)	..	..	..	..	5	..	..	..	..	..	..	..	5	10.00
ericymba (Merida)	..	..	..	..	..	2	..	..	..	..	..	..	2	11.00 (?)
Anal spines:														
cienagae (Progreso)	43	4	..	..	..	..	..	..	..	..	..	..	47	6.09
mayorum (Xtoloc)	1	1	..	..	..	..	..	..	..	..	..	..	2	6.50 (?)
mayorum (Segrada)	3	1	..	..	..	..	..	..	..	..	..	..	4	6.25
ericymba (Merida)	2	..	..	..	..	..	..	..	..	..	..	..	2	6.00 (?)
Anal soft rays:														
cienagae (Progreso)	..	..	37	9	1	..	..	..	..	..	..	..	47	8.23
mayorum (Xtoloc)	..	..	2	..	..	..	..	..	..	..	..	..	2	8.00 (?)
mayorum (Segrada)	..	1	4	..	..	..	..	..	..	..	..	..	5	7.80
ericymba (Merida)	..	..	2	..	..	..	..	..	..	..	..	..	2	8.00 (?)
Pectoral rays (both sides):														
cienagae (Progreso)	..	..	..	..	..	..	..	..	2	32	60	..	94	15.62
mayorum (Xtoloc)	..	..	..	..	..	..	..	1	1	2	..	..	4	14.25 (?)
mayorum (Segrada)	..	..	..	..	..	..	..	..	..	10	..	..	10	15.00
ericymba (Merida)	..	..	..	..	..	..	..	..	..	..	4	..	4	16.00 (?)

CICHLIDAE

Cichlasoma urophthalmus (Günther)

Since the revision of the subspecies of *Cichlasoma urophthalmus* was published (Hubbs, 1936, pp. 263-279, fig. 1, pls. 12-15), the differentiation of this Formenkreis into local forms has been confirmed by new explorations in Guatemala and Yucatan. Trautman and Van Tyne collected additional material of two well-marked Yucatan forms, *C. u. cienagae* and *C. u. mayorum,* and Pearse obtained in the San Bulha Cenote at Merida two specimens so distinctive that they are described here as representing a new subspecies, *C. u. ericymba,* despite the local testimony that the mojarras of this cave were introduced.

New data on the variation of the Yucatan subspecies in counts and measurements are given in Tables 7 and 8. These data should be compared with those in Tables 48 and 49 of the 1936 report.

Cichlasoma urophthalmus cienagae Hubbs

(Pl. 2, Fig. 2)

A series of 47 topotypes of this subspecies was collected by Milton B. Trautman in La Cienaga and connected waters at Progreso, on March 29 and 31, 1937. The adults taken are not much deeper than those of such forms as *C. u. mayorum,* indicating that a deep body is characteristic only of the large young of *cienagae.*

TABLE 8

SUBSPECIES AND AGE VARIATIONS IN PROPORTIONS IN CICHLASOMA UROPHTHALMUS (NEW DATA FROM YUCATAN)

The measurements, taken as indicated in Table 49 of the 1936 report, are expressed in thousandths of the standard length

SUBSPECIES	STANDARD LENGTH	DEPTH		HEAD	SNOUT	ORBIT	INTERORBITAL	SUBORBITAL	UPPER JAW	HIGHEST D. SPINE	LONGEST PECT. RAY	LENGTH PELVIC FIN
		Body	C. ped.									
C. u. cienagae (Progreso)	40.5	474	158	420	131	123	106	52	123	158	272	272
	42	474	156	404	135	118	106	58	120	166	269	279
	48	482	163	415	143	115	113	61	126	159	277	279
	48	463	149	403	138	109	107	66	124	151	256	260
	50	478	167	420	143	122	110	70	129	155	269	271
	51	495	164	411	143	115	112	67	127	162	262	264
	55	464	137	398	135	109	122	62	119	161	257	268
	59	481	153	406	141	102	105	65	124	161	255	255
	60	487	159	415	144	109	104	72	130	159	266	283
	60	508	158	423	140	111	111	73	126	170	280	303
	61	471	155	409	142	106	105	74	124	160	258	286
	62	464	154	396	138	100	107	68	125	159	256	262
	65	480	159	402	144	107	107	69	127	151	261	271
	67	486	164	395	143	106	103	72	125	161	259	273
	82	465	158	390	147	91	111	77	127	147	265	273
	82	442	153	390	146	93	106	74	125	148	257	273
	113	433	152	382	147	87	113	80	128	132	252	281
C. u. mayorum (Segrada Cenote)	79	450	160	423	141	125	105	65	127	175	295	273
	82	449	154	401	129	120	106	64	134	166	261	246
	82	441	163	407	134	116	113	66	129	177	270	262
	85	431	153	410	141	119	107	65	136	167	262	253
	96	431	156	401	139	112	102	75	137	171	259	254
C. u. mayorum (Xtoloc Cenote)	84	435	171	384	125	109	101	64	122	168	297	301
	93	425	154	393	135	102	100	75	131	161	261	274
C. u. ericymba (S. Bulha Cenote)	109	482	161	390	134	105	124	79	129	159	275	294
	122	484	172	386	152	100	113	84	135	156	265	288

In coloration these specimens agree with the types as described (Hubbs, 1936, p. 272). The ultimate and penultimate bars are rather conspicuously swollen and blackened medially in some individuals. In two or three specimens the second and third bars from the last are narrowly connected medially, and occasionally the last two approach medially. Abnormalities in the posterior bars occur on one side only of four specimens: in two the penultimate bar is doubled below the lateral line, and the third from the last bar is forked dorsally in one specimen and ventrally in one. Abnormalities in the course of the second bar (from the front) occur on one or both sides of about half the specimens. This bar tends to become interrupted near the lateral line, to form a separate dorsal saddle and a median bar, which often is bent backward to join the third bar dorsally, but is rarely obsolescent, or entirely fused with the third bar.

Cichlasoma urophthalmus mayorum Hubbs

Additional data on the characters and variation of this subspecies are given in Tables 7 to 9, which should be compared with Tables 48 and 49 of the former report (Hubbs, 1936, pp. 265-267).

The tendency of *C. u. mayorum* to have fewer soft rays in the dorsal, anal and pectoral fins than *C. u. cienagae* is again brought out. By totalling the ray counts in these fins we obtain a character index which more emphatically indicates the distinctness of these two forms (Table 9).

The populations inhabiting the Segrada and Xtoloc Cenotes agree well in fin-ray counts. The Segrada race has on the average a deeper body, and a longer head, eye, mouth and fins than the Xtoloc (type) race, and also differs from it in color. The general color is very light yellowish, rather than a medium olive, and the breast and belly is a bright yellow orange, with a suffusion of this color over most of the body and fins, whereas the Xtoloc specimens have little of the bright orange on the breast. The bars are no darker than in the Xtoloc type but are more conspicuous owing to the lighter ground color. The last bar and the caudal spot in the Segrada specimens are narrowly disconnected on one side in two specimens. The second bar is more or less interrupted just above the lateral line in three specimens, and is slightly fused dorsally with the third bar in one; in the other example these two bars are fused dorsally on one side and throughout their height on the other side. Whether the differences between the two cenote populations are genetic or environmental is not certain. Provisionally we may regard them as forming distinct races but not subspecies.

TABLE 9

SUM OF COUNTS OF SOFT RAYS IN THE DORSAL, ANAL AND TWO PECTORAL FINS OF CICHLASOMA UROPHTHALMUS CIENAGAE AND C. U. MAYORUM

Subspecies	Total Soft-Ray Count							
	45	46	47	48	49	50	51	52
C. u. cienagae	..	..	1	3	24	13	29	11
C. u. mayorum	1	3	5	21	6	..	..	..

Cichlasoma urophthalmus ericymba n. subsp.

(Pl. 2, Figs. 1, 3)

This subspecies is based on two adult specimens collected by A. S. Pearse on July 13, 1936, in San Bulha Cenote (or Cave) at Merida, Yucatan. The holotype, Cat. No. 116091, Museum of Zoology, University of Michigan, is 122 mm. in standard length, and the paratype is 109 mm. long.

The physical and chemical properties of the water in San Bulha Cenote were given by Hall (1936, p. 11), and this underground water hole is described briefly on page 278 of the present report. With these cichlids Dr. Pearse took the cave subspecies of bagre, *Rhamdia guatemalensis decolor*. It is quite possible that both the bagre and the mojarra were stragglers from a large population of deeper, underground waters, for this cenote has a deep-water connection. Local officials, however, told Dr. Pearse that the mojarras in this frequented underground water hole at Merida were introduced, and it is generally stated that mojarras and other fishes have been brought from the region of Progreso into the cenotes about Merida.

If the *Cichlasoma urophthalmus* of San Bulha Cenote was introduced from near Progreso, it would presumably be *C. u. cienagae.* There are a number of differences, however, which indicate that the form represented is not *cienagae,* but more probably an indigenous and subterranean type. The most striking difference lies in the character of the sensory cavities of the lateral line system on the head. In *cienagae,* as in cichlids in general, these cavities are rather small and are smoothly covered over by the general integument of the head, save for a minute pore at one edge. In the presumed cave form, these cavities appear at the surface as deep pits, about 1 mm. in diameter in the types, and the actual pore occupies most of the membranous bottom of each pit, leaving a rim of membrane around the edge (see Pl. 2, Fig. 1). On the left side of the holotype, the sensory canal opens by a huge pore, 2.2×4.7 mm., indicating that the factor responsible for the unusual development of the sense organs of the head is unstable. Such wide openings of the lateral line system occasionally occur in fishes, as a rare and seemingly teratological phenomenon. However, in *Allotis humilis,* a centrarchid with diagnostically enlarged sensory cavities, I have found a few populations in which a variably wide opening of the cavities to the exterior is characteristic. This feature would seem to be of genetic significance and likely associated in the *Cichlasoma* with subterranean life, yet could conceivably be produced by abnormal conditions in development.

Other features make the mojarras from the San Bulha Cenote look much unlike those from La Cienaga at Progreso. They have a steeper profile and in general a more gibbous form (see Pl. 2), possibly as a mere response to better nutrition. In agreement with the heavier build, the adult measures deeper in body and caudal peduncle, at comparable sizes (Table 8). The eye is distinctly larger, and the fins are more expansive (Table 8). The bars are more intense than in adults of *cienagae* and the median blotch and caudal spot are larger and a more inky black (Pl. 2). The height of the caudal spot is greater than the length of the orbit, whereas in the adult of *cienagae* the height of the spot is much less than the orbital length.

C. u. ericymba also seems to differ significantly from *C. u. conchitae* Hubbs (1936, p. 274, pl. 12, fig. 3), also from a cenote at Merida, and also said locally to have been introduced. Comparing the two types of *ericymba* with the holotype of *conchitae,* the following differences are seen: the sensory cavities of the head in *ericymba* are deep pits with wide pores, as described above, whereas those of *conchitae* though perhaps somewhat enlarged are covered over almost to the general plane of the surface; the soft dorsal rays number eleven instead of ten; the soft dorsal fin is unspotted or nearly so; the soft dorsal and anal fins are less produced; the bars of the body are much more intense, and the median blotch is jet black instead of being only slightly blackened. The lightened scale borders mentioned as characteristic of *conchitae* are evident in the paratype but not the holotype of *ericymba.*

The new subspecies differs from all others (Hubbs, 1936) not only in the open sensory cavities but also in minor features of counts, measurements and coloration—as can be seen by comparing the appropriate tables, figures, and descriptions.

The greatest width of the massive body is half the greatest depth, and is contained about 2.1 (2.1),[8] times in length to caudal base. The dorsal contour is straight on the snout, then strongly arched backward to caudal peduncle. The root of the mandible scarcely breaks the even and rather strong curve formed by the ventral margin of head and body. The least depth of the caudal peduncle is 1.2 (1.3) times the standard length of the peduncle, and measures 2.25 (2.5) times in head.

The muzzle is very broadly triangular, with the dorsal contour steeper than the ventral. Head, 2.65 (2.6); snout, 2.6 (3.1); orbit, 4.2 (4.1); bony interorbital, 3.3 (3.5); suborbital width, 4.9 (5.2); upper jaw, 2.9 (3.2). The maxillary reaches slightly beyond the vertical from front of orbit. The premaxillary spines extend almost to above front of pupil. The jaws are equal. The free fold of the lower lip is deeply continuous across the mid-line. The foremost premaxillary tooth and the next to anteriormost mandibular tooth of each side are rather strong canines, distinctly larger than the other teeth. The stubby gill-rakers number 3+9—3+9 (2+9—2+8).

The fin-ray counts are given in Table 7. The last dorsal spine enters the head 2.55 (2.4) times. The longest soft rays of the scarcely produced dorsal and anal fins enter the head about 1.8 times. The length of the broadly rounded caudal goes 1.35 times in head (in paratype); the length of the broad pectoral, 1.45 (1.4) times; that of the filamentous pelvic fin, 1.3 (1.3) times.

Scale rows 5½ (5½)—28 (26)—12½ (11½); lateral line with pores on 20 or 21+12 or 13 scales (indeterminate in paratype). The lines on the caudal fin are obsolescently represented by one to three very weak tubes on the basal scales, located as usual between the sixth and seventh and between the twelfth and thirteenth of the sixteen developed caudal rays.

The general color tone of the specimens in alcohol is purplish, with traces of orange crescents on the scales of breast and belly. The larger specimen shows almost no trace of whitish scale centers, but these are rather conspicuous in the smaller one, especially toward pectoral fin. The ground color is light, but the bars, which are about as broad as the interspaces, are deep dusky, darker than in the adult of *C. u. cienagae* though not so much blackened as in *C. u. zebra.* The first bar, not counting one at front of nape, extends from middle of predorsal area to upper end of pectoral base. The second bar is distinct on one side of each specimen, but on the other side is interrupted to form a dorsal saddle and a longer segment which is united dorsally with the third bar in one specimen and entirely fused with the third bar in the other one. The fourth bar is intensified just below the lateral line

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[8] Measurements in parentheses are of the paratype.

to form an inky black blotch about as long as eye but one-half higher. The fifth and sixth bars are rather uniform in intensity and width, and are well separated throughout from one another and from the uniformly inky-black caudal spot. This very conspicuous spot is surrounded on its front half by a light band. Its height exceeds that of the eye, and is nearly two-thirds the least depth of the caudal peduncle. The portion below the lateral line is about two-thirds as high as that above. The blotch is separated from the dorsal edge of the caudal fin by a distinct light interspace, about one-half as high as the interval separating the spot from the lower edge of the fin. The body bars are extended onto the dorsal fin. The soft dorsal, anal, and caudal fins are dark but not definitely spotted. In the larger specimen the soft dorsal bears faintly dusky, oblique streaks which are somewhat disrupted into spots posteriorly, the caudal membranes are faintly marbled with dark and the anal membranes show bare traces of dark marks, but in the smaller specimen such marks are hardly evident. The pectoral fin is very light and retains some orange. The pelvic is very dark, becoming black on the produced ray.

BROTULIDAE

Typhlias n. g.

The discovery of a new genus of blind brotulid in Yucatan is announced on page 261, and the origin of this genus and of its blindness is treated on pages 267-69. As indicated on page 267, *Typhlias* along with the very similar Cuban blind fishes, *Stygicola* and *Lucifuga,* is most satisfactorily classed in the subfamily Brosmophycinae,[9] with which so far as known these genera agree in all essential respects other than those associated with cave life. In view of the possibly if not probably independent origin of the Yucatan and Cuban blind genera, and because loss of eyes is repeatedly associated with cave life and is ordinarily treated as of generic significance only, it seems unwise as already emphasized to separate the blind genera from the other Brosmophycinae in a distinct group.

The inclusion of *Typhlias* and the Cuban genera in the Brosmophycinae is called for on the basis of characters other than the distinct separation of the caudal fin from the dorsal and anal fins, the one character used by Goode and Bean (1895, p. 314) and Jordan and Evermann (1898, p. 2498) to differentiate the subfamily, although the other characteristics of the subfamily originally pointed out by Gill (1863, p. 253) do not seem valuable. All of the Brosmophycinae agree in general form and appearance. They have the scales on the head (and sometimes on the anterior parts of the body) obsolete, except for a patch on the cheek and on the opercle in some genera, whereas the other brotulids with the exception of some of the more extreme genera of the greater oceanic depths have the head almost entirely scaled (see Günther, 1887; Goode and Bean, 1895; Jordan and Evermann, 1896; Radcliffe, 1913; and other treatises on deep-sea fishes). The eyes (or eye sockets) are uniformly rather small instead of tending to be either larger or minute as in the deep-sea genera. There are two blunt pyloric caeca or mere swellings in the wall

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[9] Based on a related genus and characterized in the same way, Dinematichthyinae Whitley (1935, p. 239) is a clear synonym of Brosmophycinae.

of the pylorus, one on each side, at least in *Typhlias, Stygicola* and *Lucifuga* (contrary to Poey's statement) and in *Brosmophycis* (as noted by Gill, 1863), whereas in other brotulids there are commonly several finger-like caeca, though the number is reduced to one or two in some genera (Gill, 1863, p. 252). All of the brosmophycines seem to be viviparous (p. 272) and all probably have a clasper-like penis that seems to be distinctive of the group. Some of the other brotulids are viviparous, but their viviparity was probably independently derived. The other viviparous forms probably do not have the same type of intromittent organ, and at least some have the embryos differently specialized to obtain nourishment from the mother. Compare the account of a *Parabrotula* embryo by Parr (1913, p. 47, fig. 21) with Eigenmann's (1909, p. 205, pl. 25) brief account for *Lucifuga.*

The Brosmophycinae also agree in habitat, as already pointed out (p. 268).

The structure of the clasper-like penis will probably prove to be one of the most trenchant characters by which to separate the several genera of Brosmophycinae, furnishing another example of the high systematic value of male genitalial characters in fishes; perhaps comparable to the value of the characters of the claspers in sharks (Leigh-Sharpe, 1926, etc.) and of gonopodia in Poeciliidae (Regan, 1913; Hubbs, 1924 and 1926).

The remarkable structure of the penis in *Typhlias* is shown on enlarged scale as the left insert in Plate 3. Here the penis is drawn from the dorsal aspect, with the sides distended to exhibit the hidden structures that so interestingly resemble like features in elasmobranch claspers. The whole broadly semioval outer rim is thickened and somewhat hardened. From the depths of the genital tube there projects a hard, sharply pointed spine which is displaced onto the right side and curved to the left. On either side of this *median process* there is an ear-shaped *basal lobe* with a swollen, hard edge forming a flaring, rounded process basad and a more medial point distad. Just beyond the interior distad axil of the basal lobe there is developed on each side a lengthwise *secondary lobe,* also hard and with a rounded distal end and a submedian, dorsally directed, almost spine-like point.

The penis of *Lucifuga subterraneus* was described by Poey (1858-1860, p. 97) as follows: "El ano ofrece diferencias en los individuos observados: en unos, probablemente machos, termina posteriormente en una papila cónica apoyada en dos pequeños tubérculos; en otros que considero hembras, la papila no existe." Two adult males of *Lucifuga subterraneus* are available for a more detailed examination of the structure of the penis. The papilla proper is a somewhat peltate, depressed lobe. On the basal part of its upper surface the thin and slightly hardened sides meet neatly on the mid-line to cover the *median process,* which is rather soft, blunt-tipped and attached on its ventral edge to the papilla proper. Just beyond the tip of this process is the genital opening, on either side of which the lateral edges of the papilla flare outward and upward to form a pair of fleshy, rounded lobes, corresponding supposedly to the *basal lobes* of *Typhlias* and *Stygicola,* but conspicuous in either lateral or ventral view. These structures on the dorsal side of the papilla are only partly concealed on each side by a slight fleshy ridge which continues backward to either side of the front of the anal fin and which probably represents the sides of the dorsal slit of the papilla in *Typhlias* and *Stygicola.* All three genera are sharply differentiated by the detailed structure of the penis.

A male of the other Cuban species, *Stygicola dentatus,* has been studied. Its penis, figured on Plate 3, is slenderer and more pointed than in *Typhlias,* and the opening is more nearly terminal and is armed by smaller and weaker structures. The *median process* is relatively soft, straight and truly median, and has a rounded, clavate tip. The *basal lobe* on each side is a much simpler enlargement of the hardened lip of the genital pore, and has a tubercular rather than rounded basal projection. The *secondary lobe* on each side is a mere tubercle on the inclined edge of the outer lip.

In *Dinematichthys* Günther described "a prominent anal papilla with a pair of horny claspers (in D. iluocoeteoïdes)." Gill (1863, p. 254) distinguished *Brosmophycis* from *Dinematichthys* on the basis of "the absence of claspers to the genital papilla," and Jordan and Evermann (1898, p. 2503, and in Evermann and Kendall, 1898, p. 132) similarly distinguished *Ogilbia* from *Dinematichthys.* Probably both distinctions are baseless, for *Brosmophycis marginatus* does possess a clasper-like penis in males (Gill's type specimens were probably females) and the known specimens of *Ogilbia* are probably too young to show the characteristic penis of the group. The penis of *Brosmophycis* though provided with homologous structures is remarkably unlike that of *Typhlias* and *Stygicola* in details. It is a rather long, subcylindrical organ, with a large, oval, subterminal opening on the dorsal face. The *median process* instead of being a free and pointed or clavate structure is bound down along its ventral mid-line by membrane; it is foliaceous and medially keeled on the dorsal surface, much like the placoid scales of some sharks. The *basal lobes* are thin, high, rounded and rather soft processes lying against the infolded edge of the genital opening. The *secondary lobes* are larger and thicker, and represent the parallel, infolded thickened ends of the margin.

In the original description of *Diancistrus* [=*Dinematichthys*] *longifilis* from Lord Howe Island, Ogilby (1898, p. 744) wrote, "Genital papilla spine-like, provided with a pair of curved claspers," and added that the hooked appendages are "beside the genital papilla." The same author (Ogilby, 1897, p. 88) also found a genital papilla in the Australian species *Monothrix polylepis.*

McCulloch and Waite (1918, p. 63) described the penis of another Australian brosmophycine, *Dermatopsis multiradiatus,* as follows: "Male urinogenital aperture large, with three horny claspers, two [*basal lobes*] being directed outward at right angles from their bases, and the median one [*median process*] backward; the latter bears a procurved spine at its tip."

The blind brotulid *Dipulus caecus* Waite (1905, pp. 78-79, pl. 11, fig. 2) of Western Australia is described as having

> . . . . the uro-genital orifice . . . . bordered before and behind with very large labia. Immediately within the anterior lip is a pair of large leaf-like appendages at the base of which is the penis. . . . . The large size of the genitalia and the development of special organs in this fish, indicates that copulation actually takes place, a circumstance also distinctly correlated with blindness.

These and other features suggest that *Dipulus* may be a highly modified brosmophycine, though it differs from the genera certainly referable to the subfamily in having the vertical fins confluent around the tail.

Typhlias differs sharply from all previously known genera of Brosmophycinae, other than *Stygicola* and *Lucifuga,* in the total lack of eyes as external structures. It differs from both Cuban genera in lacking scales on the cheeks, opercles and breast, and in having the anterior part of the head compressed instead of depressed. The vomerine patch of teeth is V-shaped and of roughly uniform width, rather than being bilobed with a narrow, anterior, transverse commissure. The inner anterior teeth of the series on the jaws are more enlarged than the inner teeth of the vomer, rather than the reverse. *Typhlias* differs further from *Lucifuga* in having palatine teeth and from both *Lucifuga* and *Stygicola* in the structure of the clasper-like penis, as indicated above.

In other apparent characters *Typhlias* is much like *Stygicola* and *Lucifuga.* The lanceolate caudal is free from the dorsal and anal fins, though there is no free caudal peduncle. The pelvic fins are represented by a simple filament on each side, with approximated bases. The rounded pectoral fins are moderately short. The single caecum on each side of the pylorus is represented by a mere swelling as in *Lucifuga* (*Stygicola* has more definite caeca, approaching those of *Brosmophycis*).

The sensory organs of the head in *Typhlias* are well shown in Plate 3. They correspond in general with those of *Stygicola*[10] and *Lucifuga.* The huge sensory cavities are especially conspicuous around the hidden socket of the eye, in the postorbital line and in the operculomandibular series. Above and before the eyes is a prominent, median, pentagonal cavern, flanked by one pair laterally and by another pair antero-laterally. The operculomandibular canal opens by a rather long slit at the front of the sharp mandibular edge, just behind a small, papilla-bearing pore on each side of the mid-line of the slightly lobate lower lip. Following this are two oval pores on the mandible and a larger oblique one at the root of the mandible. Above this, on the preopercle, is a long slit with a median transverse septum, and above this a small pore. The large cavities above and behind the eye are poreless, except for a pore just above the short, pointed opercular flap (which bears a ridge with a free spinous tip). Small papillae are scattered over the head, chiefly around the edge of the cavities as shown in the figure. They are most numerous along the upper or outer edge of the mandible. One longer and slenderer than the others is placed on the mid-line of the snout. On the edge of the snout on either side of the mid-line is a clump of three larger structures which might be termed minute barbels. Just above and behind these is a lengthwise slit, the first of three on each side. Two small pores open near the suborbital edge above the expanded portion of the maxillary. Just behind the lengthwise, slightly rimmed slit of the anterior nostril is another pore. The posterior nostril is larger.

Orthotype, *Typhlias pearsei* n. sp.

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[10] On the sensory organs of *Stygicola,* see Kosswig (1934).

Typhlias pearsei n. sp.

(Pl. 3)

The holotype, an adult male 90.5 mm. long to caudal base, Cat. No. 116094, Museum of Zoology, University of Michigan, was collected by A. S. Pearse in Balaam Canche Cave near Chichen Itza, Yucatan, on June 22, 1936. It was taken 20 m. below the surface of the ground and 80 m. from the mouth of the cave, in a pool 1×3 m. in area and 1 m. deep, and having deep crevice connections. No food was found in the stomach.

The single paratype, a young example 41 mm. long, was taken by Dr. Pearse in the same cave on June 8, 1936, about 70 m. from the mouth, in a pool 1×1.5 m. in size, and nearly dry at the time (0.1 m. deep). The fish was resting in the mud, barely covered.

Balaam Canche Cave is 260 m. long. Three genera of blind crustaceans have been taken in the same cave (Creaser, 1936).

The more important characters of this species are given in the generic description, or are indicated in the figures. The holotype has 82 dorsal rays (the first four unbranched), 65 anal rays (the first preceded by a swollen, rayless mass of flesh), 11 caudal rays and 20 pectoral rays. The dorsal contour is evenly arched from the tip of the snout to the origin of the dorsal fin, which lies above the middle of the pectoral fin. Measurements (stepped over curve of body from tip of snout to base of caudal): greatest depth, 3.6 (4.6);[11] distance from tip of snout to origin of dorsal, 2.65 (2.7); to base of pelvic filaments, 4.0 (4.2); from base of filaments to origin of anal fin, 3.2 (3.5). Measurements into head: upper jaw, 1.8 (about 2.1); greatest height of dorsal fin, 3.1 (about 3.2); greatest height of anal fin, 3.4 (about 2.7); length of caudal fin, 2.8 (2.4); of longest pectoral ray, 2.25 (2.15); of pelvic filament, 1.65 (1.8).

The scales, not countable, are small thin plates, covering the body forward to the occiput and to the scaleless breast. Each scale is an irregularly oval plate with the focus somewhat basad. The numerous circuli are concentric with the margin. They and the space between them are broken into blocks by grooves that form zigzag radii, of which those on the dorsal and ventral fields are oblique.

The large specimen is virtually colorless, the small one nearly black. Similar variations in color are reported for the Cuban genera (Eigenmann, 1909). In life the large fish, according to Dr. Pearse, was clear white, becoming pinkish along the posterior margins, and the small one was translucent white, turning dark on preservation.

SYNBRANCHIDAE

Pluto n. g.

This remarkable new blind cave-fish is a synbranchid much like *Synbranchus*, except for the total lack of external eyes, the apparently greater development of dermal sense organs on the head, and the degenerate pigmentation (brown pigment

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[11] The measurements in parentheses are of the paratype.

in irregular reticulations can be seen in the skin under a microscope). The muzzle is spatulate rather than pointed, as seen from above. The teeth of the palatine and mandibular arches preserve the anterior narrow-band or biserial arrangement farther backward than in *Synbranchus*. The gill-opening is a broadly V-shaped ventral slit, as in that genus. The fins are likewise lacking, except for the extremely delicate rayless fold around the end of the tail. At the posterior end this fold as in *Synbranchus* is supported by the degenerate hypurals, which are represented by a few irregularly branched rods, as shown in an enlarged view on Plate 4.

The sense organs of the head comprise minute papillae which appear to be more conspicuous than in *Synbranchus*. These sensory papillae are scattered along the course of the lateral line system, as shown in the top view of the muzzle on Plate 4. In the same regions minute streaks in the skin are sometimes to be discerned in *Synbranchus*. The pores are somewhat larger than in the eyed genus. The operculomandibular series of each side as in that genus starts with a pore near tip of chin and one not far backward; then two near the end of the maxillary, following after a long break; then three along the position usually occupied by the preopercular margin. Behind and slightly below the uppermost of these is another pore. A pore developed in *Synbranchus* before and above the uppermost operculomandibular is lacking. There is a median pore and a lateral pair just behind the pair of interorbital slits, which are located just inward from the hidden eye sockets. These wide, oblique, valved openings lead into a large cavity, as in *Synbranchus*. On each side of the front of the upper lip is a smaller slit leading into a long sac. Just behind this nostril (?) is a sensory pore, and another pore lies about midway between the lip and the interorbital slit. In the much swollen median portion of the head are streaks in the skin which seem to be blood vessels.

As indicated on page 269, *Pluto infernalis* was surely derived from *Synbranchus marmoratus*. It differs from the only previously known blind synbranchid, *Typhlosynbranchus boueti* Pellegrin (1922) of Africa, in the transverse rather than pore-like gill-opening, the less posterior anus, and the less uniserial teeth and the depigmentation.

Orthotype, *Pluto infernalis* n. sp.

Pluto infernalis n. sp.

(Pl. 4)

The holotype and only known specimen of this species was collected on July 7, 1936, by A. S. Pearse in Hoctun Cave at Hoctun, between Merida and Chichen Itza, Yucatan. This cave, 23 m. wide and 162 m. long, has a small opening, and slopes gradually to a blunt end around which water stands at a level 13 m. below the surface of the ground. These pools, in which the blind prize was captured, have deep crevices which no doubt lead to other bodies of subterranean water. Cat. No. 116093, Museum of Zoology, University of Michigan.

Some measurements of the type follow: total length, 325 mm.; length to anus, 174 mm.; length to front of gill-opening, 26 mm.; greatest depth of head, 9.5 mm.; depth of neck over gill-opening, 7.5 mm.

The few characters of the species are described under the heading of the genus or are indicated in the beautiful and accurate figures drawn by Grace Eager, and reproduced on Plate 4.

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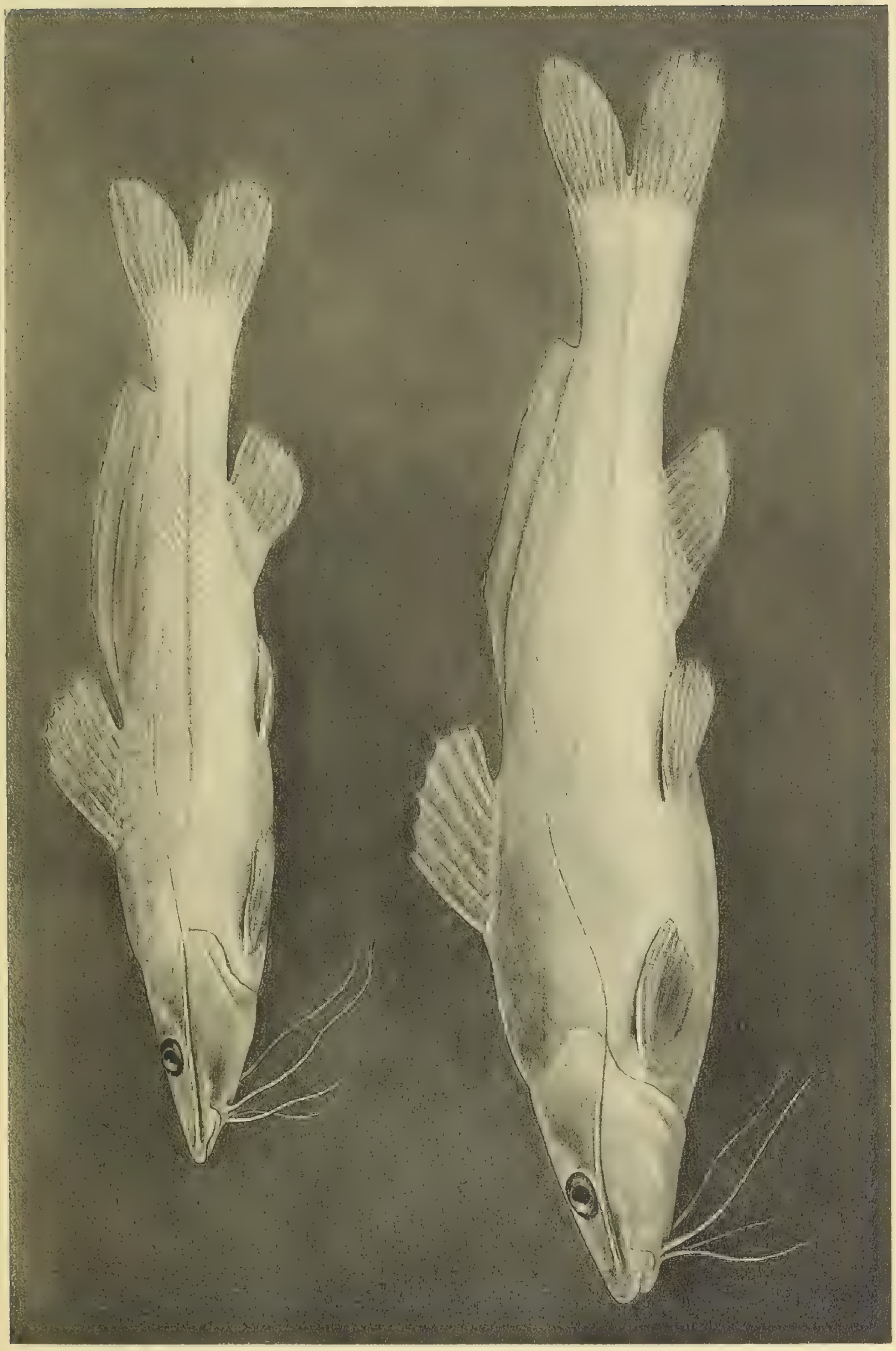

TYPE SPECIMENS OF TWO CAVE SUBSPECIES OF *RHAMDIA GUATEMALENSIS*

(Drawings by Grace Eager)

FIG. 1 — *Rhamdia guatemalensis stygaea*, from the holotype, 109 mm. in standard length, collected in San Isidro Cave, near Merida, Yucatan.

FIG. 2 — *Rhamdia guatemalensis decolor*, from the holotype, 139 mm. in standard length, collected in San Bulha Cave, Motul, Yucatan.

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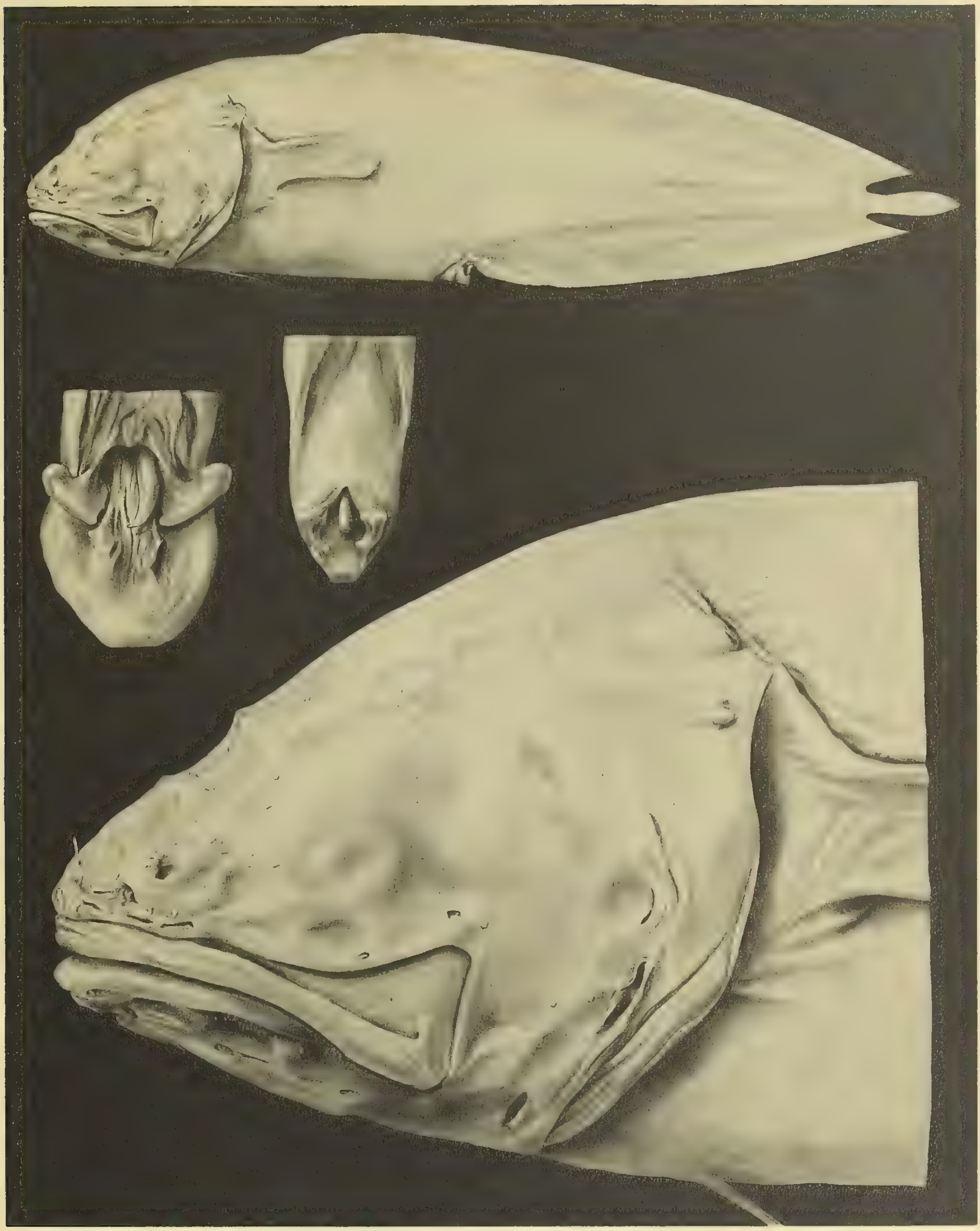
SUBSPECIES OF *CICHLASOMA UROPHTHALMUS* FROM YUCATAN
(Photographs by F. W. Ouradnik)

Fig. 1 — Enlarged view of the head of the holotype of *C. u. ericymba*, showing the peculiar development of the sensory cavities and pores.

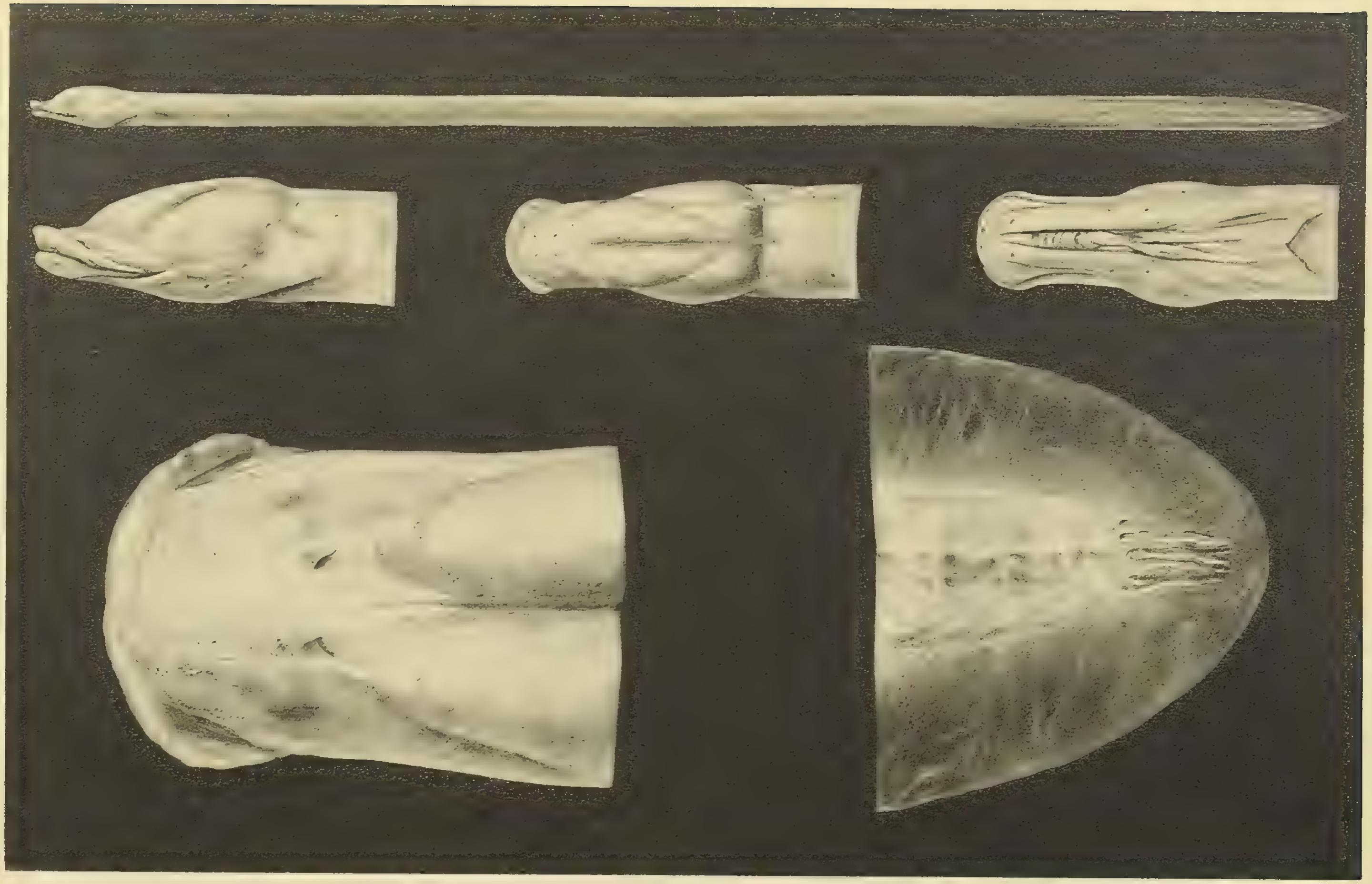
Fig. 2 — Comparative view of the head of an adult of *C. u. cienagae* from La Cienaga at Progreso. Standard length of fish, 113 mm.

Fig. 3 — Holotype of *C. u. ericymba*, n. subsp., an adult 122 mm. in standard length, from San Bulha Cenote, Merida, Yucatan.



TYPHLIAS PEARSEI, A NEW GENUS AND SPECIES OF BLIND BROTULID
(Drawings by Grace Eager)

The upper figure shows the holotype, an adult male 90.5 mm. in standard length, from Balaam-Canche Cave, near Chichen Itza. The lower figure is an enlarged view of the head, to show the sensory structures. The inserts show the clasper-like penis of *Typhlias pearsei* (left) and of *Stygicola dentatus* (right). The organs were turned forward, and the dorsal surface drawn from below.



PLUTO INFERNALIS, A NEW GENUS AND SPECIES OF BLIND SYNBRANCHID
(Drawings by Grace Eager)

Drawn from the holotype, 325 mm. in total length, collected in Hoctun Cave, Hoctun, Yucatan. The structures of the head are shown enlarged, in three aspects. The further enlarged lower figures of the muzzle and of the tip of the tail show respectively the structure of the dermal sense organs and of the last vertebrae and hypurals.

XXII

SOME REPTILIAN RECORDS FROM CAVES OF YUCATAN

Helen T. Gaige
Museum of Zoology, University of Michigan

None of the four species of reptiles captured by Dr. Pearse in the caves of Yucatan[1] can be considered a true cave dwelling form. The iguanid, *Ctenosaura,* is diurnal, with a wide distribution on the Yucatan Peninsula, and while the geckoes and snake are nocturnal, hence secretive during the day, they have been found away from caves elsewhere in Yucatan. It is probable that the individuals listed entered caves for temporary shelter, but the distance some of the less active forms were found from the entrances indicates that an abundance of food may have induced them to adopt the refuge as a more or less permanent home. A comparison of other Yucatan specimens of the same species with those taken in the caves shows no apparent modifications of structure or coloration in the latter. Observations on foods are from Dr. Pearse's field notes.

LIST OF SPECIES

Thecadactylus rapicaudus Houttuyn

Two, Puz Cave, Oxkutzcab; food, insects 85 per cent, snails 18 per cent, gecko skin 2 per cent; six, same data; food, insects. All were captured on the roof of the cave near the mouth, on July 21. Two other specimens of this species were examined but not saved: one from first cave on San Roque Road, Oxkutzcab, July 22, food, grasshopper, caterpillar, etc.; the other from Chakxix Cave, Tekax, August 1, on roof near mouth.

Coleonyx elegans Gray

One, Puz Cave, Oxkutzcab, July 20, on wall of an inner chamber 63 m. from the mouth, in complete darkness, at a depth of about 20 m. below the surface, and beyond two artificial walls with small doorways, food was insects; one, Gongora Cave, July 17, 15 m. from mouth, food, two cave-crickets; one, Ziz Cave, July 24, 12 m. from mouth. Another specimen, which was not saved, was seen in Xkyc Cave, Calcehtok Hacienda, San Bernardo, August 7, 13 m. below the surface and more than 35 m. from the mouth.

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[1] The collection included two snakes not taken in caves. These were *Typhlops microstomus* Cope, Tohil (10 miles from Chichen Itza), June 27, scale rows 18-18-18, dorsals about 436; and *Leptotyphlops albifrons* (Wagler), Chichen Itza, June 21, scale rows 14-14-12, dorsals about 245.

Ctenosaura sp.?

One, Ebizt Cave, Oxkutzcab, near mouth, July 19. The only portion of this lizard found was a fragment of dried skin from a leg, so it is impossible to be sure of the species represented.

Tropidodipsas sartorii Cope

Two specimens, both males, from Loltun Cave, Oxkutzcab, July 26, 15 m. from mouth; food, snails. Details of scutellation are:

M. Z. No. 80800. Ventrals 182; subcaudals 62; 2 preoculars, loreal not entering eye; 7 supralabials; temporals 1+2; 30 light annuli on body and tail.

M. Z. No. 80801. Ventrals 192; subcaudals 64; on the right side of the head 3 preoculars, loreal not entering eye, on the left side 2 preoculars and 2 loreals, the lower entering the eye between the preoculars; 7 supralabials; temporals 1+2; 26 light annuli on body and tail.

XXIII

BIRDS IN YUCATAN CAVES

Two birds frequented the mouths of caves in Yucatan. The mot-mot, *Eumomota superciliaris* (Swainson), nested in crevices and was often seen carrying insects to its young. The swallow, *Stelgidopteryx ridgwayi* Nelson, constructed mud nests on the roofs of caves near the mouths and often flew about in the lighted portions.

During the dry season doves and other birds enter caves to drink from drip pools near the mouths. Once in 1932 A. S. Pearse saw a barn owl in the Yuncu "Cenote", which is really a jug-shaped cave. The Maya often build blinds beside drip pools by laying up loose stones into walls. They hide behind these and knock down unwary birds with sticks or shoot them with arrows or guns. Birds contribute to the food resources in caves by depositing refuse from food and feces.

REFERENCE

Cole, L. J.
1906. Vertebrates from Yucatan. *Bull. Mus. Comp. Zool.* (Harvard), 50:101-146.

XXIV

MAMMALIA FROM YUCATAN CAVES

Mammals collected during the summer of 1936 in the caves of Yucatan were referred to Remington Kellogg, United States National Museum, who kindly identified them. The following list has been prepared by A. S. Pearse. The Maya who accompanied him into the caves maintained that mammals other than bats do not visit caves often during the rainy season because there is plenty of water outside. During the dry season, however, mammals are said to be often encountered while they are seeking water. Fifty traps of various sizes were set daily for about five weeks, but, as mice had been caught only twice, they were then discontinued. Numbers in parenthesis refer to original field notes. Ranges and type localities are from Miller (1911).[1]

Such mammals as various species of bats, mice (*Ototylomys*), and porcupines (*Coendou*) appeared to be more or less permanently established in Yucatan caves, but all fed outside. At the mouth of Ebizt Cave, near Oxkutzcab, many small bones were found where they had been washed by rains. Within this cave were many fruit seeds, which the Maya said were carried in by bats. Two of the commonest species of these were identified by Paul C. Standley, Field Museum, as *Theretia gaumeri* Hemsl. (Apocynaceae) and *Guazuma ulmifolia* Lamarck (Sertulariaceae). Fragments of others were not identifiable.

Mammals furnished important food resources for small cave animals. Bats carry in fruits; their feces contain remains of insects and other organic materials. In Oxolodt Cave near Kaua the bagres (*Rhamdia guatemalensis decolor* Hubbs) in a pool deep below the surface had eaten nothing but blood that they secured second hand in the excreta of vampire bats. The feces of animals other than bats supply organic food.

Order Marsupialia

Family DIDELPHIIDAE

Didelphis yucatanensis yucatanensis Allen

A carcass was found in Ebizt Cave, Oxkutzcab; July 18 (120); about 70 m. from mouth, and 25 m. below surface. Type locality: Chichen Itza.

Order Chiroptera

Family EMBALLONURIDAE

Peropteryx canina canina (Wied.)

A female and two males were collected in Chakxix Cave, Tekax; August 1 (174). The food of these bats was apparently fruit. Range: Eastern Brazil to Mexico.

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[1] Miller, G. S., List of North American land mammals in the United States National Museum. U. S. Nat. Mus. Bull., 79:xiv + 455. 1912.

Family PHYLLOSTOMIDAE

Subfamily Phyllostominae

Micronycteris megalotis mexicana Miller

A male and a female were collected in Xmahit Cave, Tekax; July 31 (171) food, insects. Another pair from Xconsacab Cave, Tizamin, August 11 (193), had also eaten insects. Range: Colombia, Central America, Mexico.

Subfamily Glossophaginae

Glossophaga soricina leachii (Gray)

A male and a female (containing a large foetus) from Xkyc Cave, Calcehtok, August 7 (187), had eaten insects; as had a female from Muruztun Cave, Tizamin, August 12 (198).

Subfamily Stenoderminae

Artibeus jamaicensis yucatanicus (Allen)

Wing bones were taken from Kaua Cave, Kaua, June 16 (24). Two males captured in Ebizt Cave, Oxkutzcab, July 19 (124) contained no food. Skulls were also found in accumulations at the mouth of this cave. A male, a female, and two young from Puz Cave, Oxkutzcab, July 20 (135) had eaten fruit, as had two males from the same cave July 21 (136A). A male from the second cave on the San Roque Road from Oxkutzcab, July 23 (145) contained fruit. A female from Loltun Cave, Oxkutzcab, July 27 (156A) had eaten fruit. Other specimens were captured as follows: male and female, Cinquo de Mayas Cave, Tekax, July 29 (162); male, Sabacha Cave, Tekax, July 30 (168); male, Chakxix Cave, Tekax, August 1 (174). Range: Yucatan, including coast islands.

Family DESMODONTIDAE

Desmodus rotundus murinus (Wagner)

These vampires were common in a shallow cave in the wall of the Xtoloc Cenote, Chichen Itza. On June 24 (54) and 25 (55) five of these were examined. Three of these had eaten what F. G. Hall was able to identify as chicken blood; one was a small individual which had eaten milk; and one contained no food. A male was captured in Hoctun Cave, Hoctun, July 7 (90). Another male was taken in Xconsacab Cave, Tizamin, August 11 (193); food, blood. Type Locality: Mexico.

Diphylla centralis Thomas

A male was captured in Oxolodt Cave, Kaua, June 18 (33); food, blood. Type Locality: Chiriqui, Panama.

Family NATALIDAE

Natalus mexicanus Miller

Female, Balaam Canche Cave, Chichen Itza, June 11 (14); two males, Balaam Canche Cave, June 12 (16); two specimens, Balaam Canche Cave, June 22 (42);

four specimens, Balaam Canche Cave, June 23 (44), food was insects; male, Hoctun Cave, Hoctun, July 7 (90), food was insects; male, Muruztun Cave, Tizamin, August 12 (198), food was insects. Type Locality: Lower California, Mexico.

Family VESPERTIOLONIDAE

Myotis nigricans extremus Miller and Allen

Male, Cinquo de Mayas Cave, Tekax, July 29 (162); food, insects.

Dasypterus ega panamensis Thomas

A skull was collected at the mouth of Ebizt Cave, Oxkutzcab, July 19 (123). Range: Panama and Yucatan.

Lasiurus borealis mexicana (Saussure)

A skull was collected at the mouth of Ebizt Cave, Oxkutzcab, July 19 (123).

Family MOLOSSIDAE

Molossus nigricans Miller

A skull was collected at the mouth of Ebizt Cave, Oxkutzcab, July 19 (123). Type Locality: Acoponeta, Tepic, Mexico.

Order RODENTIA

Family MURIDAE

Subfamily Oricetinae

Ototylomys phyllotis phyllotis Merriam

A female was trapped in Balaam Canche Cave, Chichen Itza, June 10 (10). It had eaten finely chewed vegetation, which it had evidently obtained outside. It was apparently associated with other individuals in a group of burrows in the side of the cave about 60 m. from the entrance. Another female was trapped in Chac Mol Cave, Tohil, June 27 (63), about 70 m. from the entrance. Type Locality: Tunkas, Yucatan.

Sigmodon hispidus microdon Bailey

Three skulls were collected at the mouth of Ebizt Cave, Oxkutzcab, July 19 (123). Range: Northern Yucatan and Campeche.

Subfamily Microtinae

Cuniculus paca nelsoni (Goldman)

A carcass of a paca was found in Balaam Canche Cave, Chichen Itza, June 8 (2), about 70 m. from the entrance.

Family HETEROMYIDAE

Heteromys gaumeri Allen and Chapman

Seven skulls were collected at the mouth of Ebizt Cave, Oxkutzcab, July 19 (123). Range: Yucatan and northern parts of Campeche and Quintana Roo, Mexico.

Family ERETHIZONTIDAE

Coendou mexicanus yucataniae Thomas

A pair of porcupines had a den at the top of Chac Mol Cave, Tohil, June 26 (55A), about 70 m. from the entrance above a pool of water at the inner end of the cave. The female was shot and examined. Her food consisted of finely chewed vegetation, which had come from outside the cave. The pair of porcupines evidently had a permanent home in their cave den, which consisted of a hole in the side of the cave through a pile of rocks. Type Locality: Yucatan, probably near Itzamal.