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ART. X.—ON A NEW CAVE FAUNA IN UTAH.

BY A. S. PACKARD, JR., M. D.

FIGS. 5-10.

While attached to the United States Geological and Geographical Survey of the Territories in the summer of 1875, during a visit to the Great Salt Lake, my attention was called by Jeter Clinton, esq., to a curious cave on his estate, about half a mile east of his hotel at Lake Point. It is, at a rough guess, about two hundred feet above the level of the lake, and the mouth faces the northeast. It was evidently due to wave-action, being situated on an ancient beach-line, while the top and bottom of the cave were formed by a breccia. As my examination of it was a hasty one, no measurements having been taken, I quote the following account of it by Mr. G. K. Gilbert, in his report "On the Geology of Portions of our Western Territory, visited in the years 1871, 1872, and 1873": —*

"Along many of the beaches, and especially at points where they are carved in solid rock, the beach or terrace below the water-line is composed of calcareous tufa usually full of small Gasteropod shells, and often involving so many fragments of the contiguous rock as to constitute a breccia. In the localities where I found it best exhibited, the beach was carved in limestone, but the deposit is probably independent of the character of the adjacent formation. Mr. Howell observed it upon Granite Mountain, coating granite, and remote from limestone exposures; and a similar association was seen by Prof. W. P. Blake on the Colorado Desert. Down some steep slopes it stretches as an apron for several rods, and, when it rests on soft materials, the waves of the retiring lake have undermined it and formed caves. Several of these are to be seen on the north end of the Oquirrh range, and the largest, which is popularly reputed to have been excavated by Spaniards years ago as a mine, is remarkable as a specimen of 'Purgatorial' wave-work. The Carboniferous strata have a local northward dip of 80° , and trend parallel to the face of the declivity. Two beds of limestone, which constitute the walls of the cavern, are separated 12 feet at the entrance, and evenly converge to the rear end, where they are 4 feet apart. At the end, a shale, in place, fills the interval, but I was unable to determine whether this had once occupied the entire excavated space. The roof is built entirely of recent

* Extracted from vol. iii of the United States Engineer Reports of Explorations and Surveys West of the 100th Meridian, Lieut. G. M. Wheeler in charge.

calcareous breccia, and the floor is evenly spread with earthy *débris*. The height of the gallery is uneven, ranging from 2 to 25 feet, and the length is 275 feet. The breccia of the roof pertains to one beach of the great series, and the floor is near the level of another. The wonderful depth of the excavation, in a direction nearly parallel to the shore, is explained by the convergence of the straight walls, between which the waves gained in their progress, on the principle of the hydraulic ram, enough velocity to compensate for the loss by friction."

In order to feel entirely certain that the cave I examined was the same as the one thus described, I wrote Mr. Gilbert, and received such information from him as placed the matter beyond a doubt.

The specimens occurred entirely under stones, none upon the walls, as the cave is perfectly dry, a very slight degree of moisture gathering under the flat pieces of brecciated limestone, which had fallen from the roof above. The darkness was not quite total, a faint glimmer of light appearing, although it was necessary to use candles in exploring the cave as well as in searching for specimens. Having previously examined a much larger cave in the Carboniferous formation in Williams Cañon at Manitou, Colo., without finding any signs of indigenous life, except *Diclidia lætula* and its larva, which occurred on the steps near the entrance, and which had been evidently a recent introduction, I was much interested to find in this small isolated cave in Utah a well-marked cave fauna, nearly as characteristic as that inhabiting the caverns of Kentucky, Indiana, or Virginia. Four forms occurred, of each of which several individuals were found in a few minutes' search.

The spider-like form (*Nemastoma troglodytes*) belonging to the group of "harvestmen" was perhaps more abundant than the others. It belongs to a group not before known to inhabit North or South America; none of the family occurring in caverns east of the Mississippi River. Species of the genus occur, however, in Europe. It had well-marked eyes. The Myriopod belongs to a widely-distributed genus (*Polydesmus*), but which in this country has not been hitherto known to be a true troglodyte. Like all the species of the genus, which as a rule live in the twilight under stones and leaves, &c., it is eyeless. Its entirely white color, when all the other known species are highly colored, shows that it is also a true cave-dweller. The Poduran *Tomocerus plumbeus* is found abundantly in Europe, Greenland, and North America. It occurred of very large size under stones at an elevation of 11,000 feet on Gray's Peak. It will probably be found on the Pacific coast. The individuals, moreover, discovered in Clinton's Cave, Utah, represented a white variety peculiar to caverns, and which differed in no respect from bleached individuals found in the smaller caves of Grayson County, Kentucky, by myself, in 1874, while attached temporarily to the Kentucky Geological Survey, Prof. N. S. Shaler in charge. A small *Zonites* was discovered, which was white. Its occurrence was of a good deal of interest, from the fact that of the numerous *Helices* which occurred in

the caves of Kentucky, none were bleached out or differed notably from those found in their usual habitats, though I am told by Prof. E. S. Morse that adult white individuals do occur in ordinary habitats.

None of these animals occurred out of the cave, no species of *Nemastoma* or *Polydesmus* having been met with; but that other forms closely allied to these cave species may exist in Utah is suggested by the discovery in Colorado, by Mr. E. Ingersoll (while attached to the United States Geological and Geographical Survey of the Territories, in 1874), of a species of *Scotolemon*, a genus represented by cave species in Indiana, Eastern Kentucky, and Virginia, and very numerous in the caves of Southern Europe. The occurrence of *Scotolemon robustum* in Colorado is an evidence that we may have had an out-of-door form from which the cave rnieolous species of the Mississippi Valley may possibly have been derived, or at least that the cavernicolous species of *Scotolemon* were not independent creations.

DESCRIPTION OF THE SPECIES.

THYSANURA.

Tomocerus plumbea (Linn.) var. *alba*.—Several specimens of a pale variety of this species of "spring-tail" occurred, some of which were pure white, thoroughly bleached out, while others were more or less dusky. Several of the larger specimens were pale, with traces of dark markings on the body; the antennæ, legs, and "spring" were white, much paler than the body. In such examples, the antennæ are whitish, with the two basal joints tinged with brown, the flagellum white, with a slight purplish tinge. Legs and spring almost pure white. Eyes black and well developed. Specimens one-half or two-thirds grown are pure white, except the small black eyes, which are connected by a double black line; while other specimens fully grown are perfectly white.

Similar individuals occurred in the Carter Caves of Eastern Kentucky, and still others occurred which were much darker than the Utah ones, forming a series connecting the extreme white variety, *alba*, with the ordinary plumbeous form, which latter is found in the United States east of the Mississippi, Greenland, and Europe. The occurrence of the white variety in a cave indicates that the ordinary form is probably to be met with west of the Rocky Mountain range.

Had I not had a series from the Carter Caves connecting the white variety with the ordinary out-of-door plumbeous form, I might have been inclined to regard it as a new and undescribed species, although it presents no structural differences in the form or length of the appendages from the normal form. But the series affords a capital example of the successive steps in the formation of a new form, whether we call it a new variety or species, while the causes of the changes are sufficiently apparent. Examples such as these and others I have before me to be hereafter described amount almost to demonstrative evidence of the truth of the doctrine of the transformation of species.

ARACHNIDA.

Nemastoma troglodytes, n. sp., (Fig. 5, enlarged*), 10 ♀.—Body rather long and slender compared with the European *N. dentipalpis* Koch, the latter being short and ovate, while our species is contracted at the base of the abdomen. The eye-tubercle is rather large and prominent; the eyes themselves well developed, black in recently-moulted specimens, but in others scarcely distinguishable from the dark-brown, finely-shagreened tegument. Behind the eyes the body contracts dorsally as well as laterally. On the front edge of the cephalothorax is an acute median spine. The six basal abdominal joints are coalesced, forming a single piece, segments 3-6 being indicated by a pair of somewhat transverse, high, well-marked tubercles (not forming true spines as in *N. dentipalpis*). The four terminal segments are free; the terminal one subtriangular, one-fourth shorter than wide. Beneath are seven well-marked sterna, with lunate, dark spiracles on the sternum of the second segment.

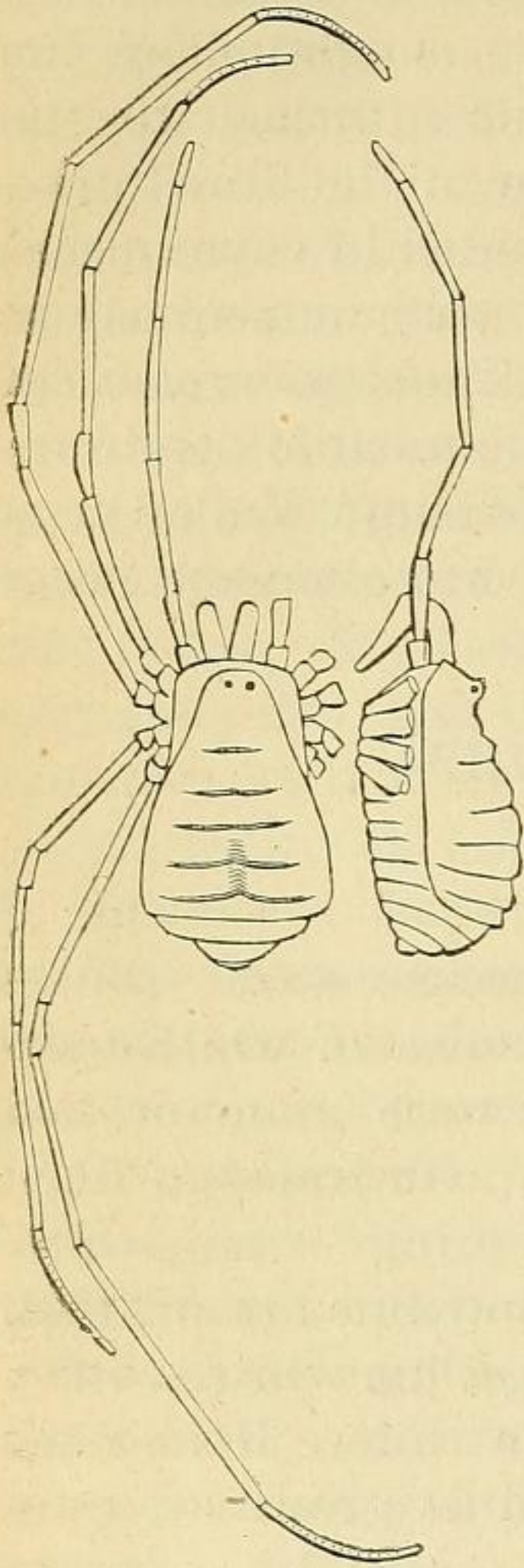


FIG. 5.—*Nemastoma troglodytes*,
PACK., n. sp. (enlarged).

Mandibles hairy, with the basal joint not so long as broad; second joint of the same width throughout, not swollen toward the end; third joint bent downward and inward at right angles, the hand directed a little outward. Maxillary palpi very long and slender, hairy, nearly twice as long as the body, while in the European *dentipalpis* they are scarcely half as long in proportion; 6-jointed (in *dentipalpis* 5-jointed), the basal joint subtriangular in outline, owing to the upper edge being dilated; second a little longer and much slenderer than first, and slightly curved; third a little more than twice as long as the second, very slender; fourth a little shorter than third; fifth, three-fourths shorter than fourth; and sixth slightly shorter than the second, rounded at the end, being cylindrical, ovate, and unarmed, though with rather stiff hairs.

Legs much longer and slenderer than in *N. dentipalpis*, with all the coxæ of nearly the same size, the hinder pair being a little shorter and broader. First pair about twice as long as the body, with eight tarsal joints; joints 4-7, together a little longer than the terminal one; a single, long, stout, curved claw. Second pair nearly three times as long as the body; tarsi very long and sinuous like a whip-lash, 16-jointed, the sec-

* The drawings of this and Figs. 6 and 8 have been made, under my direction, by Mr. J. S. Kingsley, Salem, Mass.

ond joint half as long as the first. Third pair of legs of the same length as the first pair; tarsi 8-jointed, the two terminal joints subdivided into two joints. Fourth pair nearly three times as long as the body; tarsi 8-jointed, the two last sometimes subdivided into two subjoints (internodes). Length, 3 millimeters.

Found under stones on the bottom of the cave, in a damp place, not infrequent, July 28, 1875. Quite active in its movements. Most of the specimens were apparently distended with eggs.

This is the first occurrence of the genus in America. I have been able in drawing up the above description to compare our species with the European *Nemastoma dentipalpis* of Koch, a specimen of which has been kindly loaned me for the purpose by Mr. J. H. Emerton. It differs from its European congener by the maxillary palpi being twice as long, while the tarsal joints of the three hinder pairs of feet are much fewer in number, there being twenty-four well-marked ones on the second pair of legs of *N. dentipalpis*, while the fifth joint of the leg (including the coxa) is subdivided in *dentipalpis* into thirteen subjoints, these divisions in *N. troglodytes* not being well marked.

From the European *N. bimaculatum* (Fabr.), French specimens of which have been kindly loaned by Mr. J. H. Emerton, our species differs in the body being much narrower and slenderer, while the maxillæ and legs are much longer, the tarsi especially being much slenderer, and the joints very much less distinct. The back of *N. bimaculatum* is not tuberculated.

Judging by its shorter limbs, the better-marked tibial and tarsal joints, and the dark integument, the European *N. dentipalpis* probably lived under stones in the open air. The effects of a cave life on the American species is seen in the very long palpi and legs and the indistinct subjoints.

The genus *Nemastoma* of Koch is regarded by Thorell as the type of a distinct family, *Nemastomidæ*. It differs from the *Opilionidæ* in the more distinct abdominal segments and unarmed maxillary palpi, and for this reason I do not see that the genus differs sufficiently from *Phalangium*, the type of the latter family, to constitute a family-type but should advocate regarding it as the type of a subfamily of *Opilionidæ*, for which the name *Nemastominæ* Thorell might be used, the genuine *Phalangidæ* (*Phalangides*, Leach, 1812) being thrown into a subfamily, which may be named *Phalanginæ*.

MYRIOPODA.

Polydesmus cavicola, n. sp. (Fig. 6.—*a*, antenna; *b*, section of a segment; *c*, two segments, dorsal view; *d*, two terminal segments, all enlarged).—Body consisting of 19 segments exclusive of the head, long and unusually narrow, more cylindrical than usual. Head rather large and full, much broader than the body, the sides bulging out more than usual, the body in transverse section being much more rounded than either in *P. ser-*

ratus, *P. granulatus*, or *P. canadensis*. The median suture is well marked. Though like the other species of the genus and family it is blind, the hexagonal markings which indicate the normal position of

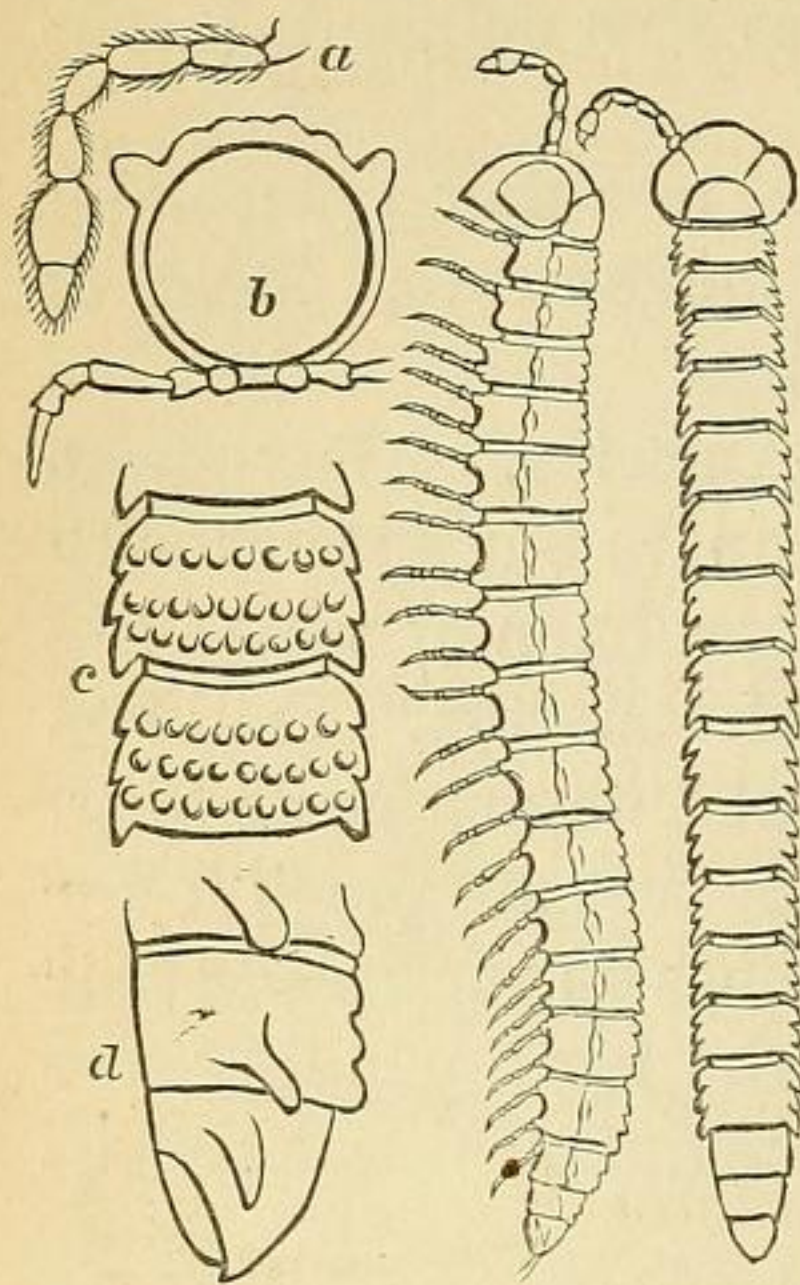


FIG. 6.—*Polydesmus cavicola*, PACK.,
n. sp., (enlarged.)

the eyes are nearly as distinctly marked as in *P. canadensis*. Antennæ rather longer than in *P. canadensis*, being twice as long as the head, 7-jointed,—the first, as usual, conical, small, and short; second and third oval cylindrical, of the same form and length; fourth and fifth considerably shorter (three-fourths) than the second and third, the fifth a little thicker than the fourth; sixth much thicker and more spherical than in any other species of *Polydesmus* figured by Wood or known to me; seventh joint small, conical, a little more than half as long as the sixth. They are pubescent, with scattered, stiff hairs. The first segment behind the head is crescent-shaped, but little more than half as wide as the head, bearing two rows of tubercles. The remaining joints from the

fourth backward are about half as long as broad, with three rows of conical tubercles, those in the hindermost (third) row the largest; the sides of each segment emarginate, and produced posteriorly into a large spine, much as in *P. canadensis*. Terminal segment conical, ending in a conical, pointed, curved spine, and bearing a large spine on the side. Body covered with fine hairs. Legs as usual, 6-jointed; the fourth and fifth joints taken together as long as the sixth, which is slender, very hairy, ending in a long spatulate claw. Color uniformly pale white, including the head and appendages. Length, 5 millimeters.

It differs from any other American species known to me in its large round head, which is much wider than the body, in the unusually cylindrical body, with the three rows of conical papillæ or spines, and the swollen sixth antennal joint. It is allied in the granulated and narrow body to *P. granulatus*, but in the emarginate and posteriorly-produced segments to *P. canadensis*, but differs from both as well as Say's *P. serratus* in the much narrower, more cylindrical body, as well as in the proportions of the joints of the antennæ. Thus far no species of *Polydesmus* has occurred in Utah, so that a careful comparison with more closely-allied forms than those mentioned has not been possible. Four examples occurred under stones in a damp spot in Clinton's Cave, Lake Point, about twenty miles west of Salt Lake City, Utah.

So far as these specimens prove anything, the results of a life in almost total darkness upon this Myriopod are seen in the antennæ being a little longer than in allied forms and in the hairy, attenuated body. That it is a descendant of some out-of-door form is attested by the large, well-marked tubercles on the body, like those in *P. granulatus*,

and a certain species inhabiting Ceylon, *Polydesmus cognatus*, which it resembles more nearly than any American species known to me, both in the cylindrical body and form of the antennæ.

Julus, sp.—A fraction of a galley-worm comprising a few segments only, agrees in form and color with an undescribed species from Colorado, and is probably not a cave species.

MOLLUSCA.

Of the following species, described by Mr. W. H. Dall, several examples occurred. Specimens were sent to Mr. W. G. Binney, who regards it as “apparently an albino variety of *Zonites indentata*”. Specimens were submitted to Prof. E. S. Morse, who judged it to be quite distinct from *Z. indentata*. Other specimens were sent to Mr. Dall, who describes it as a new species, and has kindly prepared the following notice:—

“*Hyalina subrupicola*, n. s. (Fig. 7).—This little shell is best described by a comparison of its various characteristics with those of *H. indentata* Say, as given by Dr. Binney in his Land and Freshwater Shells of the United States (part I, p. 35).

“*H. subrupicola*, while exhibiting radiating lines of growth, some of which are more conspicuous than others, does not show any such well-marked grooves or indentations as are figured by Morse (Land Shells of Maine) in *indentata*, and which form its most striking specific character. The former has five and a half whorls, with a greatest diameter in the largest specimen of 0.14 inch, while *indentata* has but little more than four, with a diameter of 0.20 inch. The former is perfectly pellucid, while the latter has a peculiar whitish spermaceti-like luster. *H. subrupicola* has the last whorl smaller proportionally than *indentata*, and in fact the increment of the whorls in the former is much more regular and even. The umbilicus in both is precisely similar.

“The animal of *subrupicola* varies from whitish to slaty; the granules of the upper surface of the foot are remarkably coarse and well marked. The tentacles are, as contracted in alcohol, hardly perceptible; the eye-peduncles, are from the same cause, not extended, but appear to be as usual in the genus, and to possess normal ocular bulbs. The office filled by these, however, being quite as much of a tactile nature as for purposes of sight, the usual rule in regard to the blindness of most cave animals does not apply in the case of the *Helicidæ*. With the exception of *H. indentata*, this species does not seem very near to any of the described American species, and it is totally dissimilar to *Ammonitella yatesii* J. G. Cooper, a remarkable form found in caves in Calaveras County, California.

“*Hab.*—Cave in Utah. Collected by Dr. A. S. Packard, jr., of Dr. Hayden’s Survey.

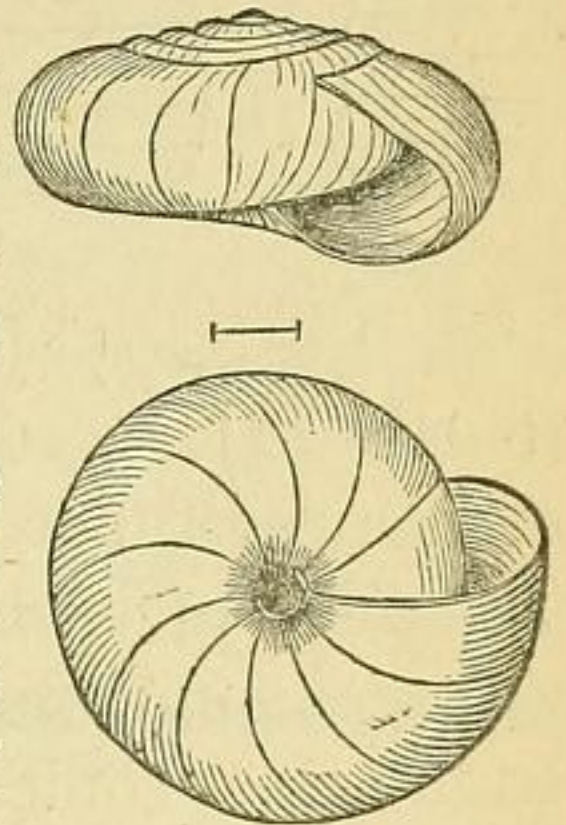


FIG. 7.—*Hyalina subrupicola*, DALL, n. sp.

“It may be noted that *H. indentata* does not appear to have been collected west of the Rocky Mountains.”

I am indebted for the accompanying drawing (Fig. 7) of this species to Mr. A. F. Gray, of Danversport, Mass.

The following species of harvestman is described, as either this or an allied form may be found to occur in caves in the Rocky Mountains:—

Scotolemon robustum, n. sp., ♂ ♀.?(Fig. 8.—*a*, maxilla; *b*, *c*, mandible, all enlarged).—Tegument deep-reddish, with the hinder segments

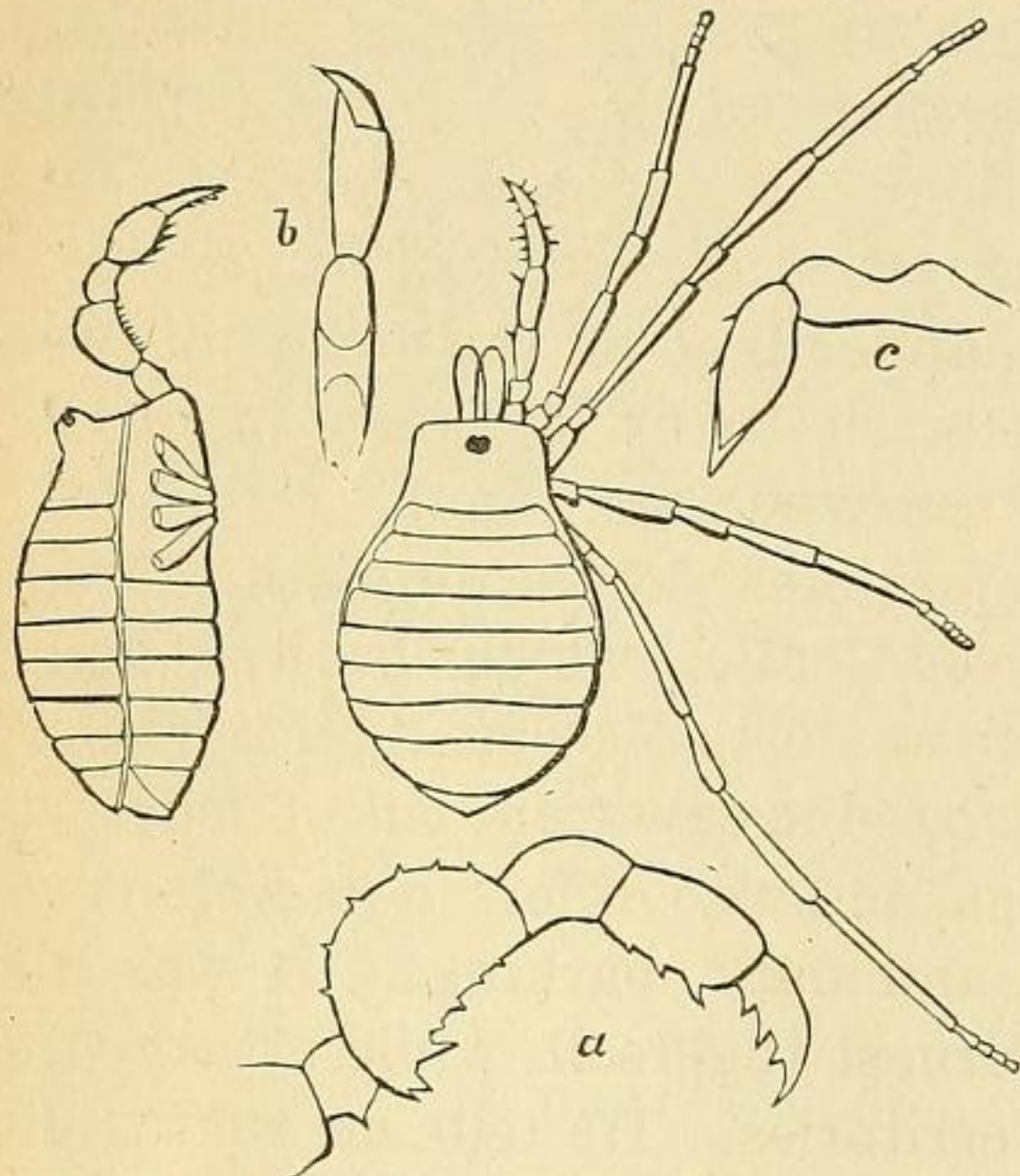


FIG. 8.—*Scotolemon robustum*, PACK., n. sp. (enlarged).

finely bordered with brown; tarsal joints paler, with dense blackish specks; cephalothorax a little paler red, marbled with reticulated darker lines. Body pyriform, two-thirds as long as broad; cephalothorax a little more than half as long as wide, the front edge slightly rounded, with the angles well marked. The eye-tubercle not so large and high as in *S. terricola* Simon, being of moderate size. Eyes black and large, fully developed, while those of *S. terricola* are nearly obsolete. Abdomen a little longer than broad; the first five segments well marked, the sutures being much more distinct than in *S. terricola*, or

probably any other European species, judging by Simon's drawings. The last three segments, with the outer edge of each segment, free, not united with each other, as are the five basal joints; last segment with the ventral slightly projecting beyond the tergal portion. Beneath are seven well-marked sterna, the first and second being united without suture.

Mandibles of the usual form, rather stout at base of first joint, but much as in *S. terricola*; second joint moderately long; hand of the usual form, a little unequal. Maxillæ unusually short and thick, much more so than in *S. terricola* or any other species described by Simon; basal joint broader than long, with a pair of stout, sharp spines and four small ones; second joint nearly two-thirds as broad as long, full and swollen above, beneath with four large spines; third joint much slenderer, one-half as long as the second; fourth joint nearly twice as long as broad, with five stout spines, of which the fourth is much larger than the others, the fifth minute. Fifth joint as long as, but slenderer than, the fourth, with five stout spines, the fifth and terminal spine much larger than the others, and as long as the joint is wide. This joint is a little hairy, while the others are nearly naked.

Legs stout, much more so than usual in the genus; anterior pair with three tubercles ending in hairs on the second joint; a larger tuber-

cle on the fourth joint; the three other pairs are unarmed. Second pair of legs longer than the first by one-third of their length. The second and fourth pairs are of nearly equal length, the fourth pair differing in having the third joint considerably swollen. The third and first pairs of the same length. On the coxæ of the second pair of legs is a pair of stout conical spines, meeting over the median line of the body. The anterior tarsi are 3-jointed, as in *S. terricola* of Europe, the middle one much shorter than the other two, which are of equal length. Those of the second pair 5-jointed, those of the third and fourth pairs 4-jointed, the end of the tibiæ being constituted so that the limbs appear as if they had five tarsal joints. Ungues rather long and moderately curved. The legs are stouter and shorter than in *S. terricola*, and none of my specimens have the long, singular, sinuate appendage on the first joint present in *S. terricola*. (They are not referred to by M. Simon in his description, though my specimens were received from him.)

Length of body, exclusive of the mandibles, 3.5^{mm}; breadth, 2.5^{mm}.

Compared with *S. terricola* Simon from Corsica, which also lives under very large stones, and is found common at Porto-Vecchio after the heavy spring rains, but which has not yet occurred in caves, our out-of-door form is much stouter, with much shorter legs, and also differs in its well-developed eyes, dark brick-red tegument, and dark markings. It was discovered in Colorado in 1874 by Mr. Ernest Ingersoll, while attached to Hayden's Geological Survey of the Territories. He tells me that it did not occur in any cave, the exact locality and mode of life being forgotten. It will most probably be found under stones.

Compared with *Scotolemon flavescens* (*Erebomaster flavescens* Cope, American Naturalist, vi, 420, 1872, from Wyandotte Cave, Indiana), which is allied to the European *S. piochardi* which inhabits caves near Orduno, it differs in the basal segments being much more distinct, where the sutures in the tergum are obsolete in *S. flavescens*. The eye-tubercle is a little smaller proportionately, while the eyes themselves are much larger. The mandibles and maxillæ are shorter, while the legs are very much shorter and stouter. The color is deep-red, the cave species being pale-yellow. These are all differences such as we should expect to find between a cave-dweller and one which has lived out of doors under stones, &c. In these two species, we have forcibly brought before us the great structural differences brought about by striking differences in the environment of the two species.

A high degree of interest attaches to this cave fauna, because we are able to determine with much precision the period when the cave was made, and the time of its subsequent colonization by the ancestors of the present inhabitants. On turning up the loose material constituting the bottom of the cave, I found that it was largely composed of a shell-marl, in which occurred in abundance little fresh-water shells which Mr. G. W. Tryon determines as *Amnicola decisa*

Hald., *A. cincinnatiensis* Anthony, and *Pomatiopsis lapidaria* Say. It is plain that this marl is from the Bonneville beds of Mr. Gilbert, containing shells which lived in the lake when the waters were at the level of the mouth of the cave. Prof. F. V. Hayden, in 1870, found in these beds *Fluminicola fusca* Hald., *Valvata sincera* Say, *Limnæa catascopium* Say, *L. desidiosa* Say, *Amnicola limosa* Say,* *Pomatiopsis cincinnatiensis*. Afterward Mr. Gilbert found the following additional species:—*Pomatiopsis lustrica* Say, *Succinea lineata* Binn., and a *Cypris* (?). This formation was regarded as Quaternary by Dr. Hayden. Mr. Gilbert regards the deposit as a lacustrine one, thrown down during the Glacial epoch, when “the great climatal revolution which covered our Northeastern States with ice was competent to flood the dry basin of Utah”. The cave, then, is of very recent origin, and as it is only perhaps 200 feet above the present level of the lake, the highest terrace or raised beach being 1,000 feet above the present level, Clinton’s Cave was not excavated until the latter half or last third of the Quaternary epoch, and it was not until some time after then that the ancestors of the present inhabitants obtained a foot-hold, and that nearly the present relations of the existing fauna of Utah were established. That this was the case is further supported by the fact that the species of animals found in the cave are such as may have been descendants of an assemblage which flourished when the country was more humid than now.

These species have been nearly as highly modified as the cave animals of the Eastern States, and now that we know the exact geological age of this Utah cave fauna, we seem warranted in assuming, as has been suggested by Professor Cope† and the writer (*American Naturalist*, v, 758, 1871), that the caves of Kentucky, Indiana, and Virginia were formed during the Quaternary period, and that they were first tenanted late in this period.

This fact—for it is not simply a theory—is important in its bearings on the evolution theory. The modifications undergone by these animals, which consist chiefly in the absence of eyes or their partial development, the elongation of the appendages of the mouth and thorax, and the loss of color, are changes probably wrought with comparative suddenness, namely, after perhaps a few hundred generations, rather than a great number of generations, such as are demanded by extreme followers of Mr. Darwin. Two sets of causes, it seems to us, have, by their resultant action, produced the present cave forms,—first, we have the characters inherited from their out-of-doors ancestors; and, second, those super-added by a cave life. Those due to the latter cause are slight compared with those due to inheritance-force, since the former have evidently acted for a brief period and have little of the cumulative force due to

*Mr. Tryon writes me that *Amnicola galbana* Hald. was collected by Dr. Hayden from an ancient lake-terrace on Salt Lake.

†Proceedings of the American Philosophical Society, April, 1871.

inheritance. This seems indirect proof that cave faunæ are of comparatively recent origin. In the production of these cave species, the exceptional phenomena of darkness, want of sufficient food, and unvarying temperature, have been plainly enough *veræ causæ*. To say that the principle of natural selection accounts for the change of structure is no explanation of the phenomena; the phrase has to the mind of the writer no meaning in connection with the production of these cave forms, and has as little meaning in accounting for the origination of species and genera in general. Darwin's phrase "natural selection" or Herbert Spencer's term "survival of the fittest" expresses simply the final result, while the process, the origination of the new forms which have survived, or been selected by nature, is to be explained by the action of the physical environments of the animals coupled with inheritance-force. It has always appeared to the writer that the phrases quoted above have been misused to express the cause, when they simply express the result of the action of a chain of causes, which we may with Herbert Spencer call the "environment" of the organism undergoing modification; and thus a form of Lamarckianism, greatly modified by recent scientific discoveries, seems to meet most of the difficulties which arise in accounting for the origination of species and higher groups of organisms. Certainly, "natural selection" or the "survival of the fittest" is not a *vera causa*, though the "struggle for existence" may show us the causes which have led to the *preservation* of species, while changes in the environment of the organism may satisfactorily account for the original tendency to variation assumed by Mr. Darwin as the starting-point where natural selection begins to act.

In our examinations of cave animals, from extensive material collected in the Middle States, and not yet wholly worked up, we find that a life of perpetual darkness, and perhaps the want of sufficient food, as well as other physical agencies, cause animals to vary either in color, the general proportions of the body, the length of the mouth-parts and legs, the distinctness of the joints of the appendages, where the possessors are articulated animals, and the greater or less modification of the eyes. These modifications occur in different degrees in different species or genera, but the sum of the change in the environment due to an introduction into a cave acts differently on the different forms, depending most probably on the out-of-door habits of their ancestors, but resulting in either (*a*) the production of what is usually called a distinct variety, or (*b*) a distinct species, or (*c*) a distinct genus. No cave form, vertebrate or invertebrate, has, so far as we are aware, yet occurred which could not have been derived from forms existing out of the cave; or, in other words, all are, as a rule, for there is a notable exception in the case of the blind fish, related more or less closely to organisms existing in the vicinity of the caverns.

Note on a Beetle and Larva found in a cave at Manitou, Colorado.

I made a brief examination of a large but very dry cave, about 600 feet long, opened to travelers in 1874, in the Carboniferous limestone in Williams Cañon, at Manitou, Colo. The only life found in the cave was a beetle, identified by Dr. Horn as *Diclidia lætula* Le Conte, two flies, and three Coleopterous larvæ. The beetle occurred near the entrance,

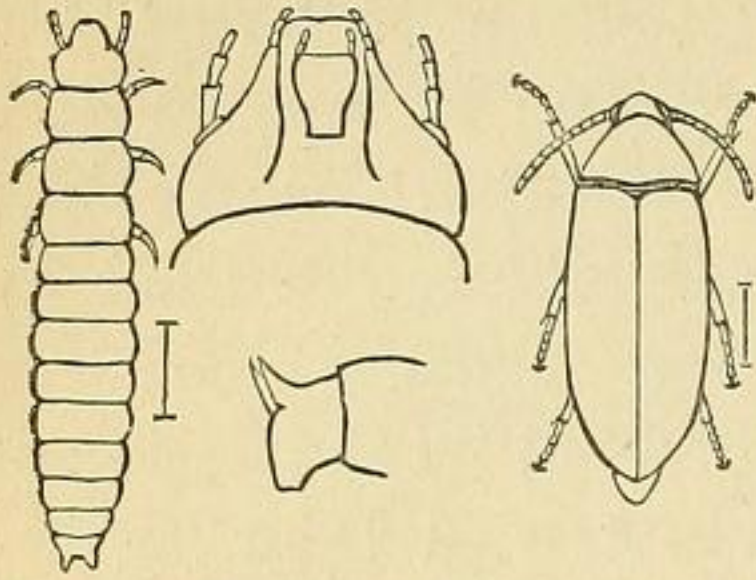


FIG. 9.—*Diclidia lætula* and larva.

and did not differ materially from other specimens which I collected under stones in the cañon near the entrance to the cave. A species of Mycetophilid fly also occurred near the door, as well as a specimen of *Blepharoptera defessa*, Osten Sacken,* not differing from specimens which occur in various caves in Indiana (Wyandotte), Mammoth Cave, and adjoining caverns.

* *Blepharoptera defessa*, n. sp., ♂ ♀.—A sparse pubescence on the under side of the pleuræ, a single vibrissa on each side of the epistoma, a single strong bristle above the middle tibiæ; costa beset with moderately long bristles; length 5-6^{mm}.

Antennæ red, third joint brownish red; arista rather long; front yellowish-red; frontal orbits grayish; a paler triangle on the vertex, bearing the brownish ocellar tubercle; anterior frontal bristle short, the one behind not quite twice as long. Thoracic dorsum yellowish-gray; the eight large dorsal bristles are inserted on brown spots, which are

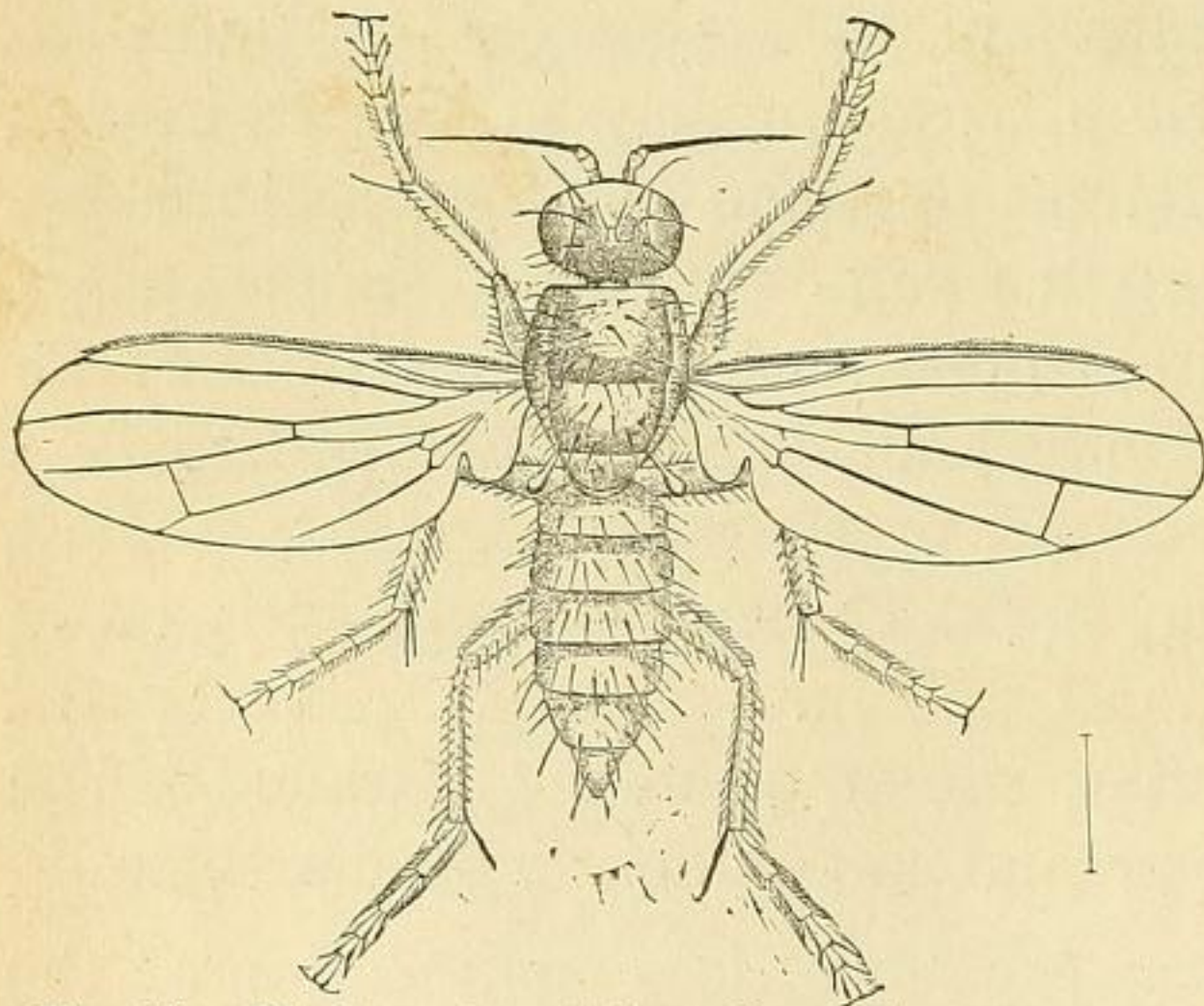


FIG. 10.—*Blepharoptera defessa*, OSTEN SACKEN, n. sp.

sometimes confluent; the finer pubescence on very minute dark spots, an often faint brown stripe in the middle, and a still less distinct one on each side; humeral callosities reddish, the flat scutellum likewise. Pleuræ pale brownish-gray, darker below. Abdomen grayish-pollinose, the ground color being blackish; male hypopygium yellow, with delicate black pile; tip of the female abdomen also yellowish; hind margins of segments pale. Halteres whitish. Wings with a brownish-yellow tinge; bristles on the costa of moderate length; posterior cross-vein rather near the tip of the fifth vein, the last section of that vein being less than half of the cross-vein. Legs reddish-brown or brown; knees and base of middle femora paler.

Habitat.—Hundred Dome Cave, near Glasgow, Ky. (F. G. Sanborn, Geological Survey of Kentucky, N. S. Shaler in charge); a male and two females. The specimens having been kept in alcohol were very much injured. The species is related to *B. cineraria* Lw. (syn. *armipes* Lw.), but is easily distinguished by the absence of the peculiar armature on the hind femora of the male, the much darker legs, larger size, &c. The anterior frontal bristles of *B. cineraria* are much shorter, but the pair above them much larger than in *B. defessa*. In one of my specimens, the male, the tibiæ are somewhat yellowish in the middle; the frontal bristles were observed on the female, as they had disappeared from the male specimen.

Blepharoptera are often found in caves, where they are said to breed in the excrement of bats. [This species also occurred in Mammoth Cave, Wyandotte Cave (Packard), and numerous smaller caves (Sanborn), and will be further noticed in the Monograph of Cave Life in the Memoirs of the Kentucky Geological Survey.—(A. S. P.)]

The occurrence of this species in caves so remote is interesting. No *Diptera*, I am informed by Baron Osten Sacken, are peculiar to caves, though this species is common in most of our caves, especially near the entrance, and has not been found elsewhere. Associated with the beetle were three larvæ, which I am inclined, with some doubt, to regard as the young of *Diclidia latula* LeConte. It seems to agree with the family characters of the larvæ of the *Mordellidæ*, as laid down by Chapuis and Candèze; but, of course, until some one rears it, the identification will be uncertain. I give meanwhile a brief description of it.

In general form it is like the larva of *Anaspis*, the body being rather long and narrow, the head nearly as wide as the prothoracic segment, the body a little wider than the head, thickest in the middle, and gradually tapering toward the end; head as long as broad, subtrapezoidal, somewhat square, the sides not very convex, the surface depressed, with a few scattered hairs. Antennæ as long as from the base of the head to their insertion; 4-jointed; 2d joint a little wider and one-third as long as the 3d joint; the 4th joint as long as the 3d is thick, ending in three or four hairs. Mandibles acute, not very long. Maxillary palpi one-third as long as the entire maxilla, being small and short, appressed to the head; 3-jointed, the joints subequal; 2d joint short, the 3d nearly twice as long as the 2d. Labium small; palpi feeble, short, and small; 2-jointed, the joints subequal. No eyes can be detected. Prothoracic segments well rounded in front, nearly as long as broad; 2d abdominal segment not much longer than the 3d; the terminal segment narrows rapidly behind, ending in a pair of upcurved spines, which are rather long and slender, acute, tipped with brown, with the anal proleg rather large. Legs rather long and slender; tarsi ending in a single claw. Color whitish; head and prothoracic segment slightly tinged with honey-yellow. Length, 5^{mm}. Three specimens, apparently not fully grown, as they were small in comparison with the beetle. They were found on boards forming the steps in the entrance of the cave, in perpetual darkness, however, and had evidently been artificially introduced.

This genus belongs to an interesting family, as the larvæ of *Metoccus*, *Rhipiphorus*, *Symbius*, and *Horia*, live in wasps' nests, and *Rhipidius* is a parasite on *Blatta germanica*. The young of *Mordella* and *Anaspis*, however, burrow in the stems of herbaceous plants, while the larvæ of *Mordella fasciata*, Fabr. in Europe lives in the "dead wood of the poplar".