

flavor of Scotch whisky. Its percentage of alcohol is about that of whisky, perhaps a little higher; it burns readily with a yellowish, purple flame, leaving an intensely bitter residue, and gives an acid reaction with litmus paper.

Sotol mescal is a pure, wholesome alcoholic drink; if the best brand be kept long enough to lose its sharp edge, it compares favorably with good whisky; Mexicans prefer it, and with reason, to the ordinary frontier whisky, and the American toper takes kindly to it if the latter be not readily accessible. On account of its cheapness and characteristic taste, mescal is very seldom adulterated. As far as I have observed, it has no peculiar effect upon the system; stomach, liver and kidney troubles, which might be referred to its action, are very rare, nor do the acid, pungent and bitter elements, contained in it, seem to affect any of the organs unfavorably. In the parlance of the toper, and to his thinking no mean advantage, there is much less headache in it than in whisky.

This sotol mescal should not be confounded with maguey mescal, or tayuile, the product of the maguey plant, *Agave americana*, and the liquor perhaps more generally known under the name of mescal in the United States; it is extensively manufactured in the interior Mexican States from the abundant sap collected in the cavity made by removing the young central leaves. Although much like it in taste and effects, it is a finer article than the former and commands a higher price.

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THE FAUNA OF THE NICKAJACK CAVE.

BY E. D. COPE AND A. S. PACKARD, JR.

THIS cave is situated near that point of the southern boundary of Tennessee where it is joined by the line which separates the States of Georgia and Alabama. In dimensions it ranges with the Mammoth and Wyandotte caves of Kentucky and Indiana, whose faunæ have already been described in earlier volumes of the NATURALIST. Many miles of galleries have been explored, and no end has yet been reached. The entrance is in the northern side of a hill, not far from the road that passes on the south side of the bottom of the Tennessee river. It is of much more imposing proportions than that of either of the caves already mentioned. The visitor climbs the hill from the road, following

a path which leads along the high bank of a considerable creek. The entrance has a wide floor which is cut by a gorge at one side, through which the stream just mentioned, issues. The roof is flat and is overhung by vegetation. The following pages record the results of two collecting expeditions made there by Professor Cope.

Near the mouth of the cave a salamander of the genus *Plethodon* was found, which is very peculiar. Instead of the black color with or without pale bluish dots, of the *P. glutinosus*, the sides and back are thickly spotted with large irregular yellowish-green blotches of irregular form, producing an effect something like the coloration of the Mexican *Spelerpes leprosus*. The dorsal spots are much larger than the lateral, and are often confluent. On the head they almost exclude the ground color. In addition to this color peculiarity, the feet differ from those of the *P. glutinosus*, in the rudimental character of the inner digit, both anteriorly and posteriorly. It is represented by metapodial bones only, having no phalanges. There are thirteen costal folds, one less than in *P. glutinosus*, and the vomerine teeth do not extend beyond, or even to, the internal nares. The tail is round and rather slender. Length to axilla, .020; to groin, .051; to end of tail, m. .122. This species is about the size of the *P. glutinosus*, and as it is distinct from it, we propose that it be called *Plethodon æneus* Cope.

In company with it was found the smaller *P. cinereus*. Then there was a small scorpion; a *Polydesmus*, and some other centipedes, and a beetle like *Scarites*, but larger than the common northern species. Snails, as in other limestone regions, are abundant.

On entering the mouth of the cave abundant traces of former human habitation are found. These consist principally of charcoal and remains of shells—as *Ios* and *Unios* from the Tennessee river, brought there by the Indians as food. The creek was formerly dammed at this point and supplied water to a mill at the mouth of the cave. This was grinding the grain of the neighborhood at the time of the first visit, but had disappeared by the second. Fishing was attempted from this point far into the depths of the cave. The results were chiefly Crustacea, which are described below. No blind fishes were seen or taken, but some fishes of the outer world were caught at a point where

a very little light from the mouth was distinguishable. These were the common blob, *Potamocottus meridionalis*, and sucker, *Catostomus teres*.

At a distance of a mile from the mouth, the blind crawfish, *Orconectes hamulatus*, began to be abundant; their snowy white forms being readily distinguished by candle light in the clear water.

On the land the *Spirostrephon cavernarum* proved to be common in some places, especially near to bat excrement, where were also found a number of Pselaphid beetles.

On examination of the aquatic cave life, it appears that of the five kinds of animals found living in the waters of the cave, all but one differ decidedly from those of the caves of Kentucky, Indiana or Virginia. This is a matter of considerable interest from an evolutionary point of view, as it shows that these cave forms are the descendants of different out-of-door species from those of the caves to the northward. The Nickajack cave may be in a different faunal region from the Mammoth or Wyandotte caves, and thus the blind crawfish has perhaps originated from a different species of *Cambarus* than that which gave origin to *Orconectes pellucidus*. Thus while the conditions, such as dryness and temperature, of cave life are much the same throughout the United States, the ancestors of the different cave animals were, in most cases, distinct, since they belonged to somewhat different zoö-geographical areas.

The first animal to notice, and one not uncommon in the waters of the cave, is a little Isopod Crustacean which is evidently a modified *Asellus*, or water wood-louse, of the same genus as that so abundant in the caves, subterranean streams and wells of Indiana and Kentucky. We originally described the Mammoth cave form as *Cecidotæa stygia* Packard; our new species may be called *Cecidotæa nickajackensis* Packard.¹

¹ It is eyeless, and the body is longer, narrower and slenderer than in *C. stygia*. The first antennæ are very long and reach to the end of the third joint of the second antennæ; they are nearly twice as long as in *C. stygia*, and are purplish white, while the flagellum is provided with long hairs. The second antennæ are as long as the head and extend backwards as far as the base of the abdomen. The legs are much longer and slenderer than in *C. stygia*. The abdomen is long and narrow, and the caudal appendages are moderately long in one specimen and short in another; in one individual the outer branch is much shorter and smaller than in the others, and in most it is as long as the basal joint. On the whole the caudal appendages are no longer than the telson or terminal segment of the abdomen, while in *C. stygia* they are half as long as the entire body. Length 6 mm.

This species forms, in the antennæ and slightly purplish color and the proportions of the leg-joints, perhaps a nearer approach to the genus *Asellus* than that of Mammoth and Wyandotte caves; on the other hand *C. stygia* approaches *Asellus* more in its shorter, broader body, with the shorter, broader abdomen. It seems quite evident that the two species must have descended from different species of *Asellus*. Thus far we know of but one species of *Asellus*, *A. communis* of Say, from the Middle and Northern States; whether there is an additional species in the Gulf States from which the present species may have been derived, remains to be seen.

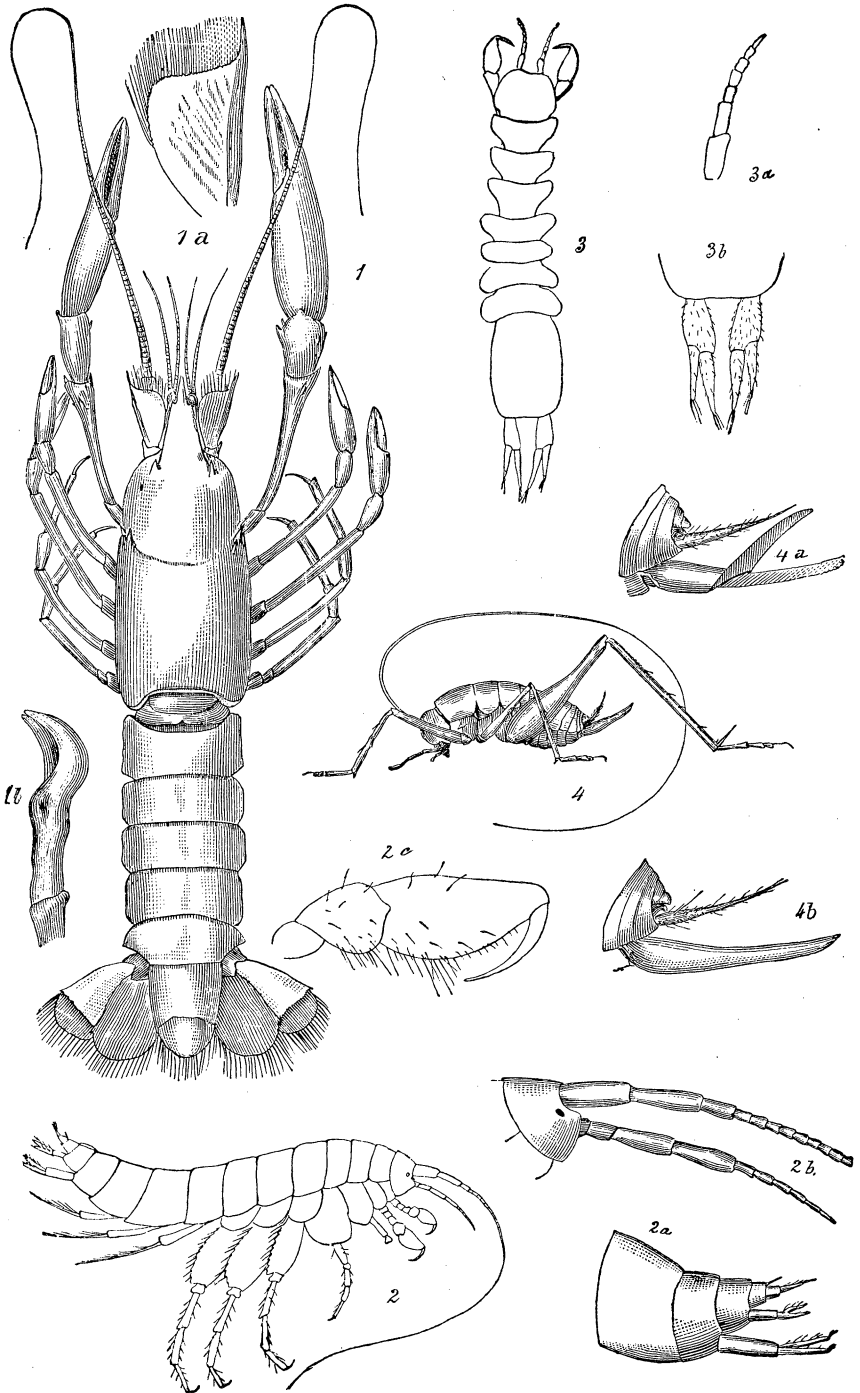
The genus *Cecidotæa* differs from *Asellus* in the larger and much longer head, the longer claw of the first pair of feet, the much longer telson, and in the rami of the caudal appendages being of nearly equal size, while in *Asellus* one is minute; it is also eyeless. The *Asellus borelii* of the Swiss lakes belongs to *Cecidotæa*.

The second crustacean discovered swimming about in the subterranean stream, was a species of Amphipod belonging to the genus *Crangonyx*, and which may be called *Crangonyx antennatum* Packard.¹ It is a large purplish species with very long antennæ, and distinct, well developed black eyes. This genus occurs in caves and subterranean wells in Europe and this country.

The form of most decided interest, however, is the blind crawl-

¹ It is a larger and purplish species; the first antennæ very long; the flagellum with 20-24 joints; the entire antenna being over one-half, and nearly two-thirds as long as the body; the last joint of the peduncle being slightly more than half as long as the penultimate joint. Compared with *C. gracilis* Smith, from Lake Superior, it differs in the form of the eyes, the longer and stouter first antennæ, the flagellum having a greater number of joints, and in the different proportions of the joints of the peduncle; the second joint of the latter being much longer than in *C. gracilis*, while the first joint of the scape is much longer, and the second and third joints one-third longer in proportion than in *C. gracilis*. The fourth pair of epimera are unusually large and nearly square. The telson, together with the caudal stylets is much as in *C. gracilis*, but the rami are slightly stouter and more polished, and the spinules a little stouter. It probably is a little larger species than *C. gracilis*, the specimens being 6-7 mm. in length; the eyes are not so distinct and are only one-fourth as large as in *C. gracilis*. It is very different from *C. vitreus* Cope, of Mammoth cave, and from *C. packardii* Smith, differing in its distinct eyes, and larger, more numerous jointed antennæ.

PLATE VII.



THE FAUNA OF NICKAJACK CAVE

fish (*Orconectes hamulatus* Cope¹). It is quite different from *O. pellucidus* of Mammoth and Wyandotte caves, in the rostrum, the slender hands, the much broader antennal scale, and in the form of the gonopods, while the whole creature is slightly slenderer than *O. pellucidus*, though the rudimentary eyes are of the same proportion to the neighboring parts as in the other species.

It is obvious that the form from which *O. hamulatus* has been derived, is quite different from that which has given origin to the blind crawfish of the Kentucky and Indiana caves. The most common species in Northern Georgia is *Cambarus latimanus*, it having been found at Athens and Milledgeville, Georgia, and probably being abundant in the northern limestone region of Alabama. At any rate it is perhaps to *Cambarus latimanus* that

¹In this species the teeth of the mandibles are usually much sharper than in the other blind species, there being three well marked sharp posterior teeth in *O. hamulatus*, which in *O. pellucidus* are represented by low, obtuse, nearly obsolete teeth; though in different specimens the obtuseness of the teeth vary. The epistoma is much as that of *C. bartonii*, but shorter and broader; while the median terminal tooth is less marked than in *C. latimanus*, and the sides fall away rapidly from the front margin. It is entirely different in shape from that of *O. pellucidus*. The antennal lamina is shorter, broader and much more rounded on the inner edge than in *O. pellucidus*, and in this respect differs from *C. latimanus*. The rostrum is narrower than in *O. pellucidus*, while the first pair of (large) claws are much slenderer, and the telson narrower than in *O. pellucidus*. The most obvious difference is seen in the modified first and second pairs of abdominal feet of the male, to which we may apply the term *gonopod*, for it is not properly an intromittent organ. The first and second pair of gonopods differ decidedly from those of *O. pellucidus*, and closely resemble those of Form II of *Cambarus latimanus* (from Athens, Georgia, figured by Hagen), those of the first pair being shorter, thicker and the last joint being much bent, hook or sickle-shaped, whence the specific name *hamulatus*. The first gonopods differ in the proportion of parts from those of *C. latimanus*, but the joint is much more acute than in *C. latimanus*.

The first pair of gonopods, compared with the *latimanus* form of *obesus* from Maryland, given me by Mr. Uhler, are much like it in general form, but the sinuous branch is longer and straighter, while the hook is much slenderer. In the second pair of accessory gonopods the knob is proportionately smaller. In other more important characters *O. hamulatus* is quite unlike the *latimanus* form of *C. obesus*, the scale of the second antennæ being very different and the chelæ one-half as wide, and the antennæ much longer, while the rostrum is much longer and more pointed. Length of the largest male, 5 centimeters.

Note on the function of the Gonopods.—As stated by Milne Edwards and others, the gonopods of the crawfish are not intromittent, but simply rude gutters for the passage of the fertilizing fluid to the eggs. It is obvious that in the lobster the gonopods form simply a rude tube or gutter to conduct the seminal fluid to the eggs as they pass backward from the oviducts to the swimming feet of the female. During the process of fertilization of the eggs, the male, without doubt, as in the crawfish, holds the female by the claws, she resting on her back. The term *gonopod* is applied for convenience in descriptive carcinology to the external reproductive organs of the crustacea, since they are only modified limbs.—(A. S. PACKARD, JR.)

we are to look for the ancestors of *Orconectes hamulatus*. On the other hand, in the form of the body, of the scale and rostrum, as well as of the upper lip and the chelæ (though not of the gonopods), *Orconectes hamulatus* approaches *Cambarus affinis*. Now of all our North American crawfishes, it would appear, as Mr. Uhler has told the writer, and as seems evident to us upon an examination of several types and the excellent figures of Dr. Hagen, that *C. affinis* is the more generalized form, and this is tantamount to saying that it is the ancestral form of our North American crawfishes. So while our Nickajack blind crawfish may have been an immediate derivative of *C. latimanus* of the Gulf States, it probably ultimately originated from *C. affinis*, a more wide-spread species.

It is also of interest to note that *O. hamulatus* presents the same generic characters as *O. pellucidus*, the eyes being rudimentary, functionless, the body long and the appendages slender; we thus feel justified in separating the genus from *Cambarus*.

Of the two crickets found in Nickajack cave, there were three small specimens of *Hadenæcus subterraneus* Scudder, which only differed from Mammoth cave individuals in having rather shorter, thicker maxillary palpi; but this is not even a varietal difference, as the antennæ and legs have the same proportions. The other cricket is a new species of *Ceuthophilus*, and may be called *Ceuthophilus ensifer* Packard.¹ It is very nearly allied to *C. stygius* of Mammoth cave, but may be distinguished by the characters given below.

EXPLANATION OF PLATE VII.

- FIG. 1.—*Orconectes hamulatus* Cope, twice nat. size. 1 *a*, antennal scale, enlarged; 1 *b*, first gonopod.
 FIG. 2.—*Crangonyx antennatus* Packard. 2 *a*, end of abdomen and appendages; 2 *b*, head with base of upper, and entire lower antenna and eyes; 2 *c*, claws; all enlarged.
 FIG. 3.—*Cecidotæa nickajackensis* Packard (only one pair of antennæ drawn). 3 *a*, upper or smaller antennæ; 3 *b*, end of telson with the caudal appendages; all enlarged.
 FIG. 4.—*Ceuthophilus ensifer* Packard, nat. size. 4 *a*, end of abdomen, with the outer rhabdite or blade of the ovipositor bent up to show the shape of the toothed ovipositor, the six teeth are not well shown by the artist; 4 *b*, the end of the body with the ovipositor. J. S. Kingsley, del.

¹ This species differs from *C. stygius* Scudder, of Mammoth cave, by the much more pointed sabre-shaped ovipositor, its tip being long, slender and acutely curved, with six smaller teeth, there being but five in large individuals of *C. stygius*, in which the ovipositor is blunt, and the tip obliquely truncate, while the hind femora are a little longer. The eyes are as well developed as in *C. stygius*. The color and marking are much the same in the two species, both being thickly spotted with black-brown; *C. ensifer* has darker colors and more distinct spots than *C. stygius*, though the latter grows to a larger size. Length of whole body, not including the ovipositor, 22 mm.; length of ovipositor, 8 mm.; of hind femur, 20 mm.; of hind tibia, 20 mm. It differs from *C. lateus* Scudder and *C. sloanii* Packard in the longer legs, and can only be confounded with *C. stygius*.