

of flowering, or perfecting their seed, after which the minute shoots (seldom an inch in length and very rarely branched) drop off, leaving a persistent cup-shaped base.

The technical characters of this species will be fully developed in Dr. Engelmann's forthcoming monograph of the genus.

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## ON THE WYANDOTTE CAVE AND ITS FAUNA.

BY PROF. E. D. COPE.

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THE Wyandotte Cave traverses the St. Louis Limestone of the carboniferous formation in Crawford County in south western Indiana. I do not know whether its length has ever been accurately determined, but the proprietors say that they have explored its galleries for twenty-two miles, and it is probable that its extent is equal to that of the Mammoth Cave in Kentucky. Numerous galleries which diverge from its known courses in all directions have been left unexplored.

The readers of the *NATURALIST* have freshly in their memories the interesting papers of Messrs. Packard and Putnam on the fauna of the Mammoth Cave and related species. The writer accompanied the excursion so pleasantly described in the *NATURALIST*, and obtained most of the species there enumerated as well as two or three additional ones which will be mentioned at the close of this article. On returning to Indianapolis at the request of Prof. E. T. Cox, state Geologist of Indiana, I made an examination of the Wyandotte Cave, so far as two days' exploration could be called such. Having prepared my report, I present a portion of it, by permission of Prof. Cox, to the *NATURALIST*.

The Wyandotte Cave is as well worthy of popular favor as the Mammoth. It lacks the large bodies of water which diversify the scene in the latter, but is fully equal to it in the beauty of its stalactites and other ornaments of calcite and gypsum. The stalactites and stalagmites are more numerous than in the Mammoth, and the former frequently have a worm or macaroni-like form, which is very peculiar. They twist and wind in masses like

the locks of Medusa, and often extend in slender runners to a remarkable length. The gypsum rosettes occur in the remote regions of the cave and are very beautiful. There are also masses of amorphous gypsum of much purity. The floor in many places is covered with curved branches, and, what is more beautiful, of perfectly transparent acicular crystals, sometimes mingled with imperfect twin-crystals. The loose crystals in one place are in such quantity as to give the name of "Snow Banks" to it. In other places it takes the form of japanning on the roof and wall rock.

In one respect the cave is superior to the Mammoth—in its vast rooms, with step-like domes, and often huge stalagmites on central hills. In these localities the rock has been originally more fractured or fragile than elsewhere, and has given way at times of disturbance, piling masses on the floor. The destruction having reached the thin-bedded strata above, the breaking down has proceeded with greater rapidity, each bed breaking away over a narrower area than that below it. When the heavily-bedded rock has been again reached, the breakage has ceased, and the stratum remains as a heavy coping stone to the hollow dome. Of course the process piles a hill beneath, and the access of water being rendered more easy by the approach to the surface, great stalactites and stalagmites are the result. In one place this product forms a mass extending from floor to ceiling, a distance of thirty or forty feet, with a diameter of twenty-five feet, and a beautifully fluted circumference. The walls of the room are encrusted with cataract-like masses, and stalagmites are numerous. The largest room is stated to be 245 feet high and 350 feet long, and to contain a hill of 175 feet in height. On the summit are three large stalagmites, one of them pure white. When this scene is lit up, it is peculiarly grand to the view of the observer at the foot of the long hill, while it is not less beautiful to those on the summit. There is no room in the Mammoth Cave equal to these two.

I must not omit to mention the kind attention to the wants of his guests constantly displayed by Mr. Conrad, the present proprietor of the hotel, and the equally useful guidance of Mr. Rothrock, the owner of the cave. Visitors will also find on their way thither an American Auerbach's hotel at Leavenworth, near the steamboat landing. This excellent house is not haunted, like its European predecessor at Leipsic, by either a Mephistophiles or a Faust, but by a landlord (Mr. Humphreys), whose charges are

low, and whose wife knows how, in lodgings and table, to satisfy reasonably fastidious persons.

An examination into the life of the cave shows it to have much resemblance to that of the Mammoth. The following is a list of sixteen species of animals which I obtained, and by its side is placed a corresponding list of the species obtained by Mr. Cooke and others at the Mammoth Cave. These number seventeen species. As the Mammoth has been more frequently explored, while two days only were devoted to the Wyandotte, the large number of species obtained in the latter, suggests that it is the richer in life. This I suspect will prove to be the case, as it is situated in a fertile region. Some of the animals were also procured from caves immediately adjoining, which are no doubt connected with the principal one.

Of the out-door fauna which find shelter in the cave, bats are of course most numerous. They are probably followed into their retreat by the eagle and other large owls. The floors of some of the chambers were covered to a considerable depth by the castings of these birds, which consisted of bats' fur and bones. It would be worth while to determine whether any of the owls winter there.

I believe that wild animals betake themselves to caves to die, and that this habit accounts in large part for the great collections of skeletons found in the cave deposits of the world. After much experience in wood craft, I may say that I never found the bones of a wild animal which had not died by the hand of man, lying exposed in the forest. I once thought I had found the place where a turkey vulture (*Cathartes aura*) had closed its career, on the edge of a wood, and it seemed that no accident could have killed it, the bones were so entire as I gathered them up one by one. At last I raised the slender radius; it was broken, and the only injured bone. I tilted each half of the shaft, and from one rolled a single shot! The hand of man had been there. One occasionally finds a mole (*Scalops* or *Condylura*) overcome by the sun on some naked spot, on his midday exploration, but if we seek for animals generally, we must go to the caves. In Virginia I found remains of very many species in a recent state; in a cave adjoining the Wyandotte I found the skeleton of the gray fox *Vulpes Virginianus*. In a cavern in Lancaster Co., Pennsylvania, in an agricultural region, I noticed bones of five or six *Cistudines*, as many rabbits, and a few other wild species, with dog, horse, cattle, sheep, etc., some of which had fallen in.

## LIST OF LIVING SPECIES IN THE TWO CAVES.

## WYANDOTTE.

*Amblyopsis spelæus* DeKay.

*Erebomaster flavescens* Cope.

*Anthrobia*.

*Orconectes inermis* Cope.  
*Cæcidotea microcephala* Cope.  
*Cauloxenus stygius* Cope.

*Anophthalmus tenuis* Horn.  
*Anophthalmus eremita* Horn.  
*Que dius spelæus* Horn.  
*Lesteva* sp. nov. Horn.  
*Raphidophora*.  
*Phora*.  
*Anthomyia*.  
*Machilis*.  
*Campodea* sp.  
*Tipulid*.

*Spirostrephon cavernarum* Cope.

## MAMMOTH.

*Vertebrata*.

*Amblyopsis spelæus* DeKay.  
*Typhlichthys subterraneus* Girard.

*Arachnida*.

*Acanthocheir armata* Tellk.  
*Phrixix longipes* Cope.  
*Anthrobia monmouthia* Tellk.

*Crustacea*.

*Orconectes pellucidus* Tellk.  
*Cæcidotea stygia* Pack.  
*Stygobromus vitreus* Cope.

*Insecta*.

*Anophthalmus Menetriesii* Motsch.  
*Anophthalmus Tellkampffii* Erichs.  
*Adelops hirtus* Tellk.

*Raphidophora subterranea* Scudd.  
*Phora*.  
*Anthomyia*.  
*Machilis*.  
*Campodea Cookei* Pack.

*Myriopoda*.

*Scoterpes Copei* (Pack.).

The blind fish of the Wyandotte Cave is the same as that of the Mammoth, the *Amblyopsis spelæus* DeKay. It must have considerable subterranean distribution, as it has undoubtedly been drawn up from four wells in the neighborhood of the cave. Indeed, it was from one of these, which derives its water from the cave, that we procured our specimens, and I am much indebted to my friend N. Bart. Walker, of Boston, for his aid in enabling me to obtain them. We descended a well to the water, some twenty feet below the surface, and found it to communicate by a side opening, with a long low channel, through which flowed a lively stream of very cool water. Wading up the current in a stooping posture, we soon reached a shallow expansion or pool. Here a blind crawfish was detected crawling round the margin, and was promptly consigned to the alcohol bottle. A little further beyond, deeper water was reached, and an erect position became possible. We drew the seine in a narrow channel, and after an exploration under the bordering rocks secured two fishes. A second haul secured another. Another was seen, but we failed to catch it, and on emerging from the cave I had a fifth securely in my hand, as I thought, but found my fingers too numb to prevent its freeing itself by its active struggles.

If these *Amblyopses* be not alarmed, they come to the surface

to feed, and swim in full sight like white aquatic ghosts. They are then easily taken by the hand or net, if perfect silence is preserved, for they are unconscious of the presence of an enemy except through the medium of hearing. This sense is, however, evidently very acute, for at any noise they turn suddenly downward and hide beneath stones, etc., on the bottom. They must take much of their food near the surface, as the life of the depths is apparently very sparse. This habit is rendered easy by the structure of the fish, for the mouth is directed partly upwards, and the head is very flat above, thus allowing the mouth to be at the surface. It thus takes food with less difficulty than other surface feeders, as the perch, etc., where the mouth is terminal or even inferior; for these require a definite effort to elevate the mouth to the object floating on the surface. This could rarely be done with accuracy by a fish with defective or atrophied visual organs.\* It is therefore probable that fishes of the type of the *Cyprinodontidæ*, the nearest allies of the *Hypsæidæ*, and such *Hypsæidæ* as the eyed *Chologaster*, would possess in the position of the mouth a slight advantage in the struggle for existence.

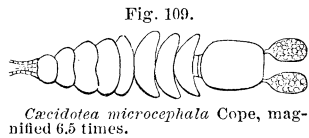
The blind crawfish above mentioned is specifically distinct from that of the Mammoth Cave, though nearly related to it. Its spines are everywhere less developed, and the abdominal margins and cheles have different forms. I call it *Orconectes inermis*, separating it generically from *Cambarus*, or the true crawfishes, on account of the absence of visual organs. The genus *Orconectes*, then, is established to include the blind crawfishes of the Mammoth and Wyandotte Caves. Dr. Hagen, in his monograph of the American Astacidæ, suspects that some will be disposed to separate the *Cambarus pellucidus* as the type of a special genus, but thinks such a course would be the result of erroneous reasoning. Dr. Hagen's view may be the result of the objection which formerly prevailed against distinguishing either species or genera whose characters might be suspected of having been derived from others by modification, or assumed in descent. The prevailing views in favor of evolution will remove this objection; and for myself I have attempted to show † that it is precisely the structural characters which are most obviously, and therefore most lately, assumed

\*Mr. Putnam's objection to my reasoning from the structure of the *Amblyopsis*' mouth was based on a misconception of my meaning. The above explains the point more fully.

† Origin of Genera, p. 41.

on which we have been in the habit of depending for discrimination of genera. The present is a case in point. So far also as the practice of naturalists goes, this course is admissible, for the presence or absence as well as the arrangement of the eyes have long been regarded as generic indications among the Myriopoda and Arachnida. Without such recognition of a truly structural modification our system becomes unintelligible.

Dr. Packard described in his article already quoted, an interesting genus of Isopoda allied to the marine form *Idotea*, which Mr. Cooke discovered in a pool in the Mammoth Cave. He called it *Cæcidotea*. I obtained a second species, in a cave adjoining the Wyandotte, which differs in several important respects. The head is smaller and more acuminate, and the bases of the antennæ are more closely placed than in *C. stygia* Pack. I call it *Cæcidotea microcephala*. Both species are blind. The new species is pure white. It was quite active, and the females carried a pair of egg pouches full of eggs. The situation in which we found it was peculiar. It was only seen in and near an empty log trough used to collect water from a spring dripping from the roof of one of the chambers.



The Lernæan, *Cauloxenus stygius* Cope, is a remarkable creature.

Fig. 110.



*Cæcidotea microcephala* Cope. The mandible and palpi of right side more enlarged. The outer palpus lies above the lateral plate, and its origin was not seen.

It is a parasite on the blind fish, precisely as numerous species near of kin, attach themselves to various species of marine fishes. The Wyandotte species is not so very unlike some of these. It is attached by a pair of altered fore-limbs, which are plunged into the skin of the host and held securely in that position by the barbed or recurved claws. The position selected by the blind fish Lernæan, was the inner edge of the upper lip, where she hung in a position provocative of attempts at mastication on the part of the fish and reminding one of the picture of the man on the ass' back holding a fork of fodder before the animal's nose, in illustration of the motto that "persuasion is better than force." The little creature had an egg pouch suspended on each side, and was no doubt often brought in contact with the air by her host.

This position would not appear to be a favorable one for long life, as the body of the *Cauloxenus* would be at once caught

between the teeth of the fish, should its direction be reversed or thrown backwards. The powerful jaw-arms, however, maintained like a steel spring a direction at a strong angle with the axis of the body, which was thrown upwards over the upper lip, the apex

Fig. 111.



*Cauloxenus stygius* in position on the lip of *Amblyopsis spelæus*, enlarged.

of the cephalothorax being between the lips of the fish. This position being retained, it becomes a favorable one for the sustenance of the parasite, which is not a sucker or devourer of its host, but must feed on the substances which are caught by the blind fish, and crushed between its teeth. The fragments and juices expressed into the water must suffice for the small wants of this crustacean.

But if the supply of food be precarious, how much more so must be the opportunities for the increase of the family. No parasitic male was observed in the neighborhood of the female, and it is probable that as in the other *Lernæopodidæ*, he is a free swimmer, and extremely small. The difficulty of finding his mate on an active host-fish must be augmented by the total darkness of his abode, and many must be isolated owing to the infrequent and irregular occurrence of the fish, to say nothing of the scarceness of its own species.

Fig. 113.



*Cauloxenus stygius*. Antennal processes and muzzle more enlarged.

The allied genera, *Achtheres* and *Lernæopoda*, present very distinct distributions, the former being fresh water and the latter marine. *Lernæopoda* is found in the most varied types of fishes and in several seas; *Achtheres* has been observed on perch from Asia and Europe, and on a South American *Pimelodus*. It is to the latter that *Cauloxenus* is most nearly allied, and from such a form we may perhaps trace its descent; modification being consequent on its wandering into subterranean streams. The character which distinguishes it from its allies, is one which especially adapts it for maintaining a firm hold on its host, *i. e.* the fusion of its jaw-arms into a single stem.

Fig. 112.



*Cauloxenus stygius*. The animal viewed from below, with an inferolateral view of the cephalothorax.

Whether the present species shared with the *Amblyopsis* its history and changes, or whether it seized upon the fish as a host at some subsequent period, is a curious speculation. Its location

at the mouth of the fish could scarcely be maintained on a species having sight, for if the host did not remove it, other individuals would be apt to.

I may here allude to another blind Crustacean which I took in the Mammoth Cave, and which has been already mentioned in the Annals and Magazine of Natural History as a Gammaroid. Mr. Cooke and myself descended a hole, and found a short distance along a gallery, a clear spring covering, perhaps, an area ten feet across. Here Mr. Cooke was so fortunate as to procure the *Cæcidotæa stygia*, while I took the species just mentioned, and which I name *Stygobromus vitreus*. The genus is new and represents in a measure the *Niphargus* of Schiödte found in the caves of Southern Europe. It resembles, however, the true *Gammarus* more closely, by characters pointed out at the close of this article. This genus has several species in fresh waters, which are of small size, and swim actively, turning on one side or the other.

Of insects I took four species of beetles, all new to science. Two of them of the blind carnivorous genus *Anophthalmus*, and two *Staphylinidæ*, known by their very short wing-cases and long, flexible abdomen. Dr. Geo. H. Horn has kindly determined them for me. One of them, the *Quedius spelæus* Horn, is a half-inch in length, and has rather small eyes.\* It was found not far from the mouth of the cave. Dr. Horn furnishes me with the following list of Coleoptera from the two caves in question :

<i>Anophthalmus</i> Tellkampfli Erichs.	Mammoth Cave.
“ Menetrie-i Motsch. <i>angulatus</i> Lec.	Mammoth Cave.
“ eremita Horn.	Wyandotte Cave.
“ tenuis Horn.	Wyandotte Cave.
“ striatus Motsch.	Mammoth Cave. Unknown to me.
“ ventricosus Motsch.	Mammoth Cave. Unknown to me.
<i>Adelops hirta</i> Tellk.	Mammoth Cave.

These are the only true cave insects at present known in these faunæ. Other species were collected within the mouths of the caves, but which cannot be classed with the preceding, as cave insects proper.

<i>Catops</i> n. sp. ?	Wyandotte Cave.
<i>Quedius spelæus</i> Horn.	Wyandotte Cave.
<i>Le-steva</i> n. sp.	Wyandotte Cave.

And another Alæocharide Staphylinide, allied to *Tachyusa*, also from Wyandotte Cave. No names have as yet been given to

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\*See Proceed. Amer. Entom. Soc., 1871, p. 332.



any of these excepting the second. A monograph of Catops has already appeared containing many species from our fauna, and as the work is inaccessible at present, I have hesitated to do more than indicate the presence of the above species.

The cricket of the Wyandotte Cave is stouter than that of the Mammoth and thus more like the *Raphidophora lapidicola* of the forest. There were three species of flies, one or more species of *Poduridæ* and a *Campodea* not determined.

Centipedes are much more abundant in the Wyandotte than in the Mammoth cave. They especially abounded on the high stalagmites which crown the hill beneath the Mammoth dome, which is three miles from the mouth of the cave. The species is quite distinct from that of the Mammoth Cave and is the one I described some years ago from caves in Virginia and Tennessee. I call it *Spirostrephon cavernarum*, agreeing with Dr. Packard that the genus\* to which it was originally referred is of doubtful validity. The species is furnished with a small triangular patch of eyes, and is without hairs, but the antennæ are quite elongate. Its rings are quite handsomely keeled. The allied form found by Mr. Cooke in the Mammoth Cave has been described by Dr. Packard as *Spirostrephon Copei*. It is eyeless and is, on this account alone, worthy of being distinguished generically from *Spirostrephon*, though the absence of pores asserted by Dr. Packard, would also constitute another character. *Spirostrephon* possesses a series of lateral pores as I have pointed out in accordance with Wood's view.† This genus may be then named *Scoterpes*. I look for the discovery of *S. cavernarum* in the Mammoth Cave.

Two species of Arachnidans were observed, one a true spider, the other related to the "long-legs" of the woods. A species similar to the former is found in the Mammoth Cave, and others in other caves, but in every instance where I have obtained them, they have been lost by the dissolution of their delicate tissues in the impure alcohol. The other forms are more completely chitinized and are easily preserved. They are related to the genus *Gonyleptes* found under stones in various portions of the country. Dr. Wood describes a species from Texas, and I have taken them in Tennessee and Kansas. In the Wyandotte Cave I found a number of individuals of a new species at a place called the screw hole.

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\* *Pseudotremia*.

† *Proceed. Amer. Entom. Soc.* 1870.

This is a narrow passage between masses of rock, which rises from the end of a gallery to the floor of a large room called the senate chamber. Though living at a distance of four or five miles from the mouth of the cave, this species is furnished with eyes. Its limbs are not very long, but its palpi are largely developed, and armed with a double row of long spines pinnately arranged, like its relative of the Mammoth Cave, the *Acanthocheir*. This species is described at the end of the article as *Erebomaster flavescens* Cope. In its relationships it may be said to stand between *Acanthocheir* and *Gonyleptes*.

Besides *Acanthocheir*, another blind Gonyleptid exists in the Mammoth Cave, which I found several miles from the mouth. It is blind like the former, but differs in having many more joints to the tarsi, approaching thus the true *Phalangia*, or long-legs. There are six joints and terminal claws, while *Acanthocheir* is said to have two and *Erebomaster* three joints. It is larger than *A. armata*, and has much longer legs. Its palpi are also longer and their spines terminate in long hairs. I have named it *Phrixix longipes*.

Dr. Packard and Mr. Putnam have already discussed the question of the probability of the origin of these blind cave animals by descent from out-door species having eyes. I have already expressed myself in favor of such view, and deem that in order to prove it, we need only establish two or three propositions. First, that there are eyed genera corresponding closely in other general characters with the blind ones; second, that the condition of the visual organs is in some cave type variable; third, if the abortion of the visual organs can be shown to take place coincidentally with general growth to maturity, an important point is gained in explanation of the *modus operandi* of the process.

First, as to corresponding forms; the *Typhlichthys* of the Mammoth is identical † with *Chologaster*, except in its lack of eyes.

\* Our engraver has not correctly represented the posterior lateral border of the large dorsal scutum. The mandible should also have been represented as terminating in a pair of nippers. — EDS.

† Mr. Putnam shows that the known species of *Chologaster* differ from those of *Typhlichthys* in the lack of the papillary ridges, which is probably another generic character similar to the loss of eyes. The absence in *Chologaster* of minute palatine

Fig. 114.

*Erebomaster flavescens*, magnified 7.6 times.\*

*Erebomaster flavescens*.  
Male organ from below.

*Orconectes* bears the same relation to *Cambarus*; *Stygobromus* bears nearly the same to *Gammarus*, and *Scoterpes* is *Spirostrephon* without eyes, and no pores.

Secondly, as to variability. I have already shown that in *Gronias nigrilabris*, the blind Silurid from the Conestoga in Pennsylvania, that while all of several specimens observed were blind, the degree of atrophy of the visual organs varies materially, not only in different fishes, but on different sides of the same fish. In some the corium is imperforate, in others perforate on one side, in others on both sides, a rudimental cornea being thus present. In some, the ball of the eye is oval and in others collapsed. This fish is related specifically to the *Amiurus nebulosus* of the same waters, more nearly than the latter is to certain other Amiuri of the Susquehanna river basin to which the Conestoga belongs, as for instance the *A. lynx*; it may be supposed to have been enclosed in a subterranean lake for a shorter time than the blind fishes of the Western Caves, not only on account of the less degree of loss of visual organs, but also in view of its very dark colors. A feature on which I partly relied in distinguishing the species, has perhaps a different meaning. The tentacles or beards were described as considerably shorter than those of allied species. On subsequently examining a number of individuals, I was struck with the irregularity in their lengths, and further inspection showed that the extremities were in each case enlarged, as though by a cicatrix. I have imagined that the abbreviation of the tentacles is then due to the attacks of carnivorous fishes which inhabit the subaërial waters into which the *Gronias* strays, from whom its blindness renders it unable to protect itself.

Thirdly, it is asserted that the young *Orconectes* possess eyes, and that perhaps those of the *Typhlichthys* do also. If these statements be accurate, we have here an example of what is known to occur elsewhere, for instance, in the whalebone whales. In a foetal stage these animals possess rudimental teeth like other Cetecea, which are subsequently absorbed. This disappearance of the eyes is regarded with reason by Prof. Wyman as evidence of the descent of the blind forms from those with visual organs. I would suggest that the process of reduction illustrates the law of "retardation," accompanied by another phenomenon. Where characters

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teeth, and the presence of an additional pair of pyloric cæca, which he mentions, will be apt to prove only specific.

which appear latest in embryonic history are lost, we have simple retardation, that is, the animal in successive generations fails to grow up to the highest point, falling farther and farther back, thus presenting an increasingly slower growth in this special respect. Where, as in the presence of eyes, we have a character early assumed in embryonic life, the retardation presents a somewhat different phase. Each successive generation, it is true, fails to come up to the completeness of its predecessor at maturity, and thus exhibits "retardation," but this process of reduction of rate of growth is followed by its termination in the part, long before growth has ceased in other organs. This is an exaggeration of retardation. Thus the eyes in the *Orconectes* probably once exhibited at maturity the incomplete characters now found in the young, for a long time a retarded growth continuing to adult age before its termination was gradually withdrawn to earlier stages. Growth ceasing entirely, the phase of atrophy succeeded, the organ become stationary at an early period of general growth, being removed, and its contents transferred to the use of other parts by the activity of "growth force." Thus for the loss of late assumed organs we have "retardation," but for that of early assumed ones, "retardation and atrophy."

In comparing the list of animals from the Wyandotte with that of the Mammoth Cave, it will be observed that the representatives in the former, of two of the blind genera of the latter, are furnished with eyes. These are the *Erebomaster* and *Spirostrephon*, which correspond with the *Acanthocheir* and *Scoterpes* respectively. In the outer part of a branch of the Wyandotte I took two eyed beetles the *Quedius spelæus* and a *Platynus*.

The out-door relatives of the blind forms are various. Those having congeners outside are the *Spirostrephon*, *Campodea*, *Machilis*, *Phora*, *Raphidophora*. Those with near but few allies, the *Scoterpes*, *Amblyopsis* and the three *Gonyleptidæ*. Species of the latter are much more rare in this country than those of *Phalangidæ*, which are not known from the caves. The *Orconectes* is mostly fresh water in kindred, while Packard shows that those of the *Cecidotea* are marine. Those of the *Cauloxenus* are partly marine, and those of the *Stygobromus* fresh water and marine.

The mutual relations of this cave life form an interesting subject. In the first place, two of the beetles, the crickets, the centipede, the small crustaceans (food of the blind fish) are more

or less herbivorous. They furnish food for the spiders, craw-fish, *Anophthalmus*, and the fish. The vegetable food supporting them is in the first place fungi, which in various small forms, grow in damp places in the cave, and they can always be found attached to excrementitious matter dropped by the bats, rats and other animals which extend their range to the outer air. Fungi also grow on the dead bodies of the animals which die in the caves, and are found abundantly on fragments of wood and boards brought in by human agency. The rats also have brought into fissures and cavities communicating with the cave, seeds, nuts and other vegetable matters, from time immemorial, which have furnished food for insects. Thus rats and bats have, no doubt, had much to do with the continuance of land life in the cave, and the mammals of the post-pliocene or earlier period, which first wandered and dwelt in its shades were introducers of a permanent land life.

As to the small crustaceans, little food is necessary to support their small economy, but even that little might be thought to be wanting, as we observe the clearness and limpidity of the water in which they dwell. Nevertheless the fact that some cave waters communicate with outside streams is a sufficient indication of the presence of vegetable life and vegetable débris in variable quantities at different times. Minute fresh water algæ no doubt occur there, the spores being brought in by external communication, while remains of larger forms, as confervæ, etc., would occur plentifully after floods. In the Wyandotte Cave no such connection is known to exist. Access by water is against the current of small streams which discharge from it. On this basis rests an animal life which is limited in extent and must be subject to many vicissitudes. Yet a fuller examination will probably add to the number of species and of these, no doubt, a greater or less number of parasites on those already known. The discovery of the little Lernæan shows that this strange form of life has resisted all the vicissitudes to which its host has been subjected. That it has outlived all the physiological struggles which a change of light and temperature must have produced, and that it still preys on the food of its host as its ancestors did, there is no doubt. The blindness of the fish has favored it in the "struggle for existence," and enabled it to maintain a position nearer the commissariat, with less danger to itself than did its forefathers.

*Descriptions of Species from the Wyandotte Cave.*

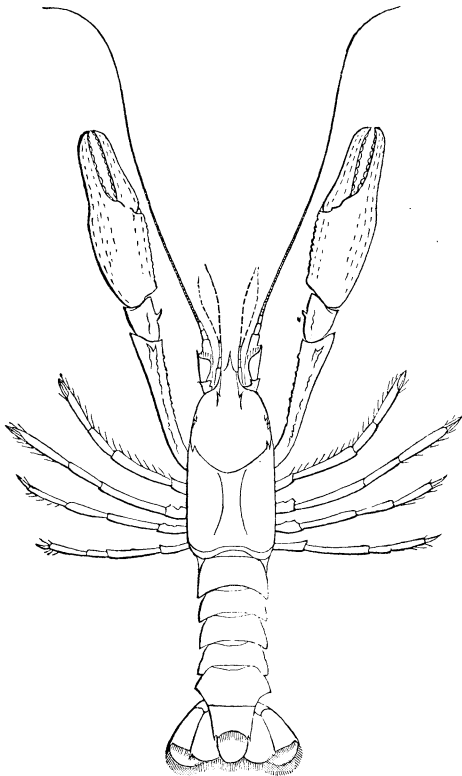
## ORCONECTES Cope.

Genus novum. Similar to *Cambarus*, but with the eyes rudimental with the cornea small and not faceted. The present genus embraces two species, the *O. inermis* of the Wyandotte and the *O. pellucidus* of the Mammoth Cave.

*O. INERMIS* Cope, sp. nov. This species is near the *O. pellucidus*, and differs as follows. Its proportions are generally less slender, and the spines less developed. The frontal process is considerably shorter, the terminal spine not extending beyond the apex of the antennal lamellæ and very little beyond the point of bifurcation of the first antennæ. In *O. pellucidus* the spine extends much beyond these points. The lateral points mark the middle of the length and support very rudimental spines; they are elongate in *O. pellucidus*. The basal lateral ridges are marked and convergent; basal spines short. The antennal lamellæ are much enlarged at the middle and contracted below, and are furnished with a fringe of long hairs. At the base of the second antennæ the margin of the thorax has a projecting convexity moderately developed. On the side of the thorax there is a small patch of weak prickles, and there are two on the anterior lateral suture of the abdomen. In *O. pellucidus* these spines are larger and much more numerous. The lateral outlines of the postabdominal segments are those of one extremity of an ellipse with a slight angulation at the extremity; in *O. pellucidus* these are rectangular, with the hinder margin straight distally.

The chela are slender, but less so than in *O. pellucidus*, the opposed processes are flat and not ridged along the middle as in that species, and the general surface is smooth or nearly so, without the tubercular roughness of *O. pellucidus*. The chela of the second and third legs partake of the broader form of the first. The third femora of the third and fourth legs with short hooks. The spines of the basal segments of the first legs are much as in the old species. The shell of the specimen taken early in September was very soft on the abdominal segment, but well calcified elsewhere. Color white. Total length, head and body, m.051 (= 2½ in.). Length of spine from thorax margin, .0055. Length cheliform segment of first legs, .024; width do., .0075; length movable (last) segment of do., .0123.

The single specimen of this species has been compared with four of the *O. pellucidus* in the Museum of the Academy Natural Sciences, one of which is young; the characters above alluded to are constant. They are also exhibited by Dr. Hagen's figure,\* except the slenderness of the chela, which is less than in our specimens. This figure is copied by Dr. Packard.



*Orconectes inermis* Cope, nat. size.

## CÆCIDOTEA Packard.

*C. MICROCEPHALA* Cope, sp. nov. "Unknown crustacean with external egg-pouches." Cope. Ann. Magaz. Nat. Hist., 1871, November.

\* Catalogue of the Museum Comparative Zoology. Monograph of the *Astacidae* of North America.

Abdominal segments confluent into a single one; thoracic segments seven, well distinguished. Inner antennæ close together, situated between the larger outer ones; both issuing from below the margin of the dorsal plate of the cephalic segment. The specimens are in bad condition, having lost their limbs, egg-pouches and the distal portions of their antennæ. The head is small, narrower and scarcely longer than the first thoracic segment. The segments are all smooth and without hairs or sculpture. The abdominal segment is quadrate-oval, truncate posteriorly, without projection or mucro, above regularly, but slightly convex. Egg-pouches well separated, oval in form, moderate in size. The limbs are given off from the free extremities of the segments. Branchial laminae extending to the extremity of the abdominal segment, in contact throughout on the median line. Color pure white. Length with egg-pouches, but with only four basal joints of antennæ, 5-16th of an inch (m.0077).

This species is near the *Cæcidotea stygia* of Dr. Packard (American Naturalist, 1871, pp. 751-2) and, as such, of much interest. It has a much smaller and more acuminate head than the *Cæcidotea stygia* Pack., though in general the species are not very different in other respects, and are of about the same size. In the *C. microcephala* the abdomen is truncate, in the longer known species, angulate.

This species may then be regarded as the representative of the *C. stygia* in the Wyandotte Cave.

#### CAULOXENUS Cope.

Fam. *Lernæopodidæ* Gerst. The adult female stout, sack-like, not articulated. Cephalothorax not elongate, large, separated from the abdomen by a strong constriction. Anchor or jaw-feet elongate, arm-like, closely united throughout their length, originating at or behind the middle of the cephalothorax. Cephalothorax undivided, abdomen rounded, sack-shaped, not segmented. Egg-pouches short, wide.

This genus differs from its allies, *Achtheres* and *Lernæopoda* in the fusion of the jaw-limbs, between which a faint dividing depression only may be distinguished, when they are viewed from below. The form of the abdomen is much as in *Achtheres*, but segmentation is not distinguishable. The short, wide egg-sacks are as in other genera of this family; they are well separated and are filled with large, globular eggs.

The structure of the mouth organs is not readily determinable in my single specimen, owing to the intervention of the very stout jaw-feet. They are only visible in profile (see fig. 112). A pair of perhaps first antennal segments projects from the head, is curved upwards and is without terminal bristle or hook; a short process at the base may represent a tactile appendage. The inferior antennæ are well marked and equally without appendage. There are some bodies between them, perhaps on the middle line, whose nature is not determinable. There is no trace of eyes. The chitinous stem of the common jaw-feet is rather long, and expands discoidally at the extremity.

*C. STYGIUS* Cope. Proceed. Acad. Nat. Sci., Phila., 1871, p. 297. Cephalothorax nearly as long as abdomen, oval, subcompressed; abdomen subround, subdepressed, separated by a rather long constriction. Egg-sacks rounded, shorter than abdomen, on very short pedicels. Jaw-limbs nearly as wide as the abdomen, and not quite so long, much constricted distally at the point of origin of the anchoring stem, which is nearly as long as the arm proper. No dermal appendages of any kind. Rostral region projecting above the arms, subconical. Color uniform whitish. Length (without anchor-claws) m.003.

#### EREBOMASTER Cope.

Genus novum, familiæ *Gonyleptidarum*. Cephalothoracic shield extending over a considerable part of the abdomen, which has seven segments. Tarsus with three joints and a terminal claw. Palpi with five joints and a claw, the fourth and fifth with a series of strong spines on each side. Mandibles chelate. Cephalothorax with a median conical eminence, which has an ocellus on each side of its base. Posterior trochanters like the others.

This genus is related to the *Acanthocheir* of Lucas, which has been recently figured in the NATURALIST. According to Wood that genus is eyeless. Dr. Packard's figure presents many peculiarities. Thus the abdomen is not represented as segmented, and there is no distinct cephalothoracic shield; the tarsi are represented as only two-jointed. From this and other facts, I suspect that *Acanthocheir* should be placed near *Erebomaster* among the *Gonyleptidæ*.

*E. FLAVESCENS* Cope, sp. nov. "Opilio-like Spider." Cope, Ann. Magaz. Nat. Hist., November, 1871. Body smooth, limbs very minutely hairy. Two spines at the extremity of the penultimate tibia. Three or four spines at the base of the third segment of the palpi, not longer than those of the third, which has four on the outer side. Spines of last joint longest. The longest limbs are about twice as long as the total length of the body. Maxillæ rather long. Color a light brownish yellow. Length of head and body m.0025.

In one specimen the male organ is protruded and extends to the mandibular chelæ; it is not chitinized and appears to be twice segmented. It terminates in a short point with mucro, which is flanked on either side by a point with two divergent bristles.

#### ANOPHTHALMUS Sturm.

*A. TENUIS* Horn. Pale rufo-testaceous, shining. Head slightly darker in color, oval and arcuately biimpressed. Thorax broader than the head, slightly longer than broad,

and sinuately narrowing to hind angles, which are exactly rectangular; median line distinctly impressed in its entire length, basal impression deep; base of thorax truncate. Elytra elongate oval, feebly convex, at base slightly flattened; two-thirds longer than broad, humeri obtusely rounded; surface with feeble traces of striæ and three dorsal setigerous punctures on each elytron, in or nearest to the position of the third stria. Body beneath similar in color to the upper surface, legs somewhat paler. Length .18-.24 inch; 4.5-6 mm.

Three specimens of this species were collected. This species is closely allied to *A. Menetriesi* Motsch. (*angulatus* LeC.), but differs by its more elongate and less robust form and less convex surface. The elytra are smoother and with very feeble traces of striæ. The two species differ especially in the form of the hinder thoracic angles and base of thorax. In *Menetriesi*, the angles are acute, slightly prominent externally and the base of the thorax slightly prolonged, while in the present species the angles are strictly rectangular and the base truncate. This species must be placed near the one just cited in my table of our species (Trans. Ent. Soc., Phil., 1868, p. 126).

The new species above described is the most slender in form of any in our cabinets.

**A. EREMITA** Horn. — Pale, rufo-testaceous, feebly shining. Head oval, arcuately biimpressed, impressions moderately deep, intervening space feebly convex. Thorax wider at widest portion than long, sides moderately rounded in front, gradually narrowed to base, hind angles rectangular, base truncate and as wide as length of thorax; disc feebly convex, median line distinctly impressed, basal transverse impression moderate. Elytra oval, less shining than thorax and sparsely clothed with very short, erect pubescence; striæ obsolete; three dorsal punctures on the line of the third stria. Length .20 inch; 5 mm.

One specimen of this species was collected with preceding in Wyandotte Cave. The only species with which it might be confounded is that previously described by me under the name *A. pusio*, and although differing very notably on comparison in their general aspect, the points of difference are not easily made plain in a description. The present species is in all respects broader and less depressed, without being convex as in *Menetriesi*: the thorax is broader, less narrowed behind, and the sides more rounded. The elytra are less shining and the pubescence more distinct, although in both species the pubescence can only be observed by holding the specimen between the eye and the light and then only with a good power. In the three species at the head of my analytical table, no signs whatever of pubescence can be observed. The elytral striæ are here also obliterated, faint traces are discernible only at the base. The basal margin is not prolonged.

#### QUEDIUS Leach.

**Q. SPELÆUS** Horn. — Pale, rufo-testaceous, shining. Head broadly oval, smooth, shining, slightly impressed between the eyes in front; two punctures bearing short setæ in front of the eyes, another at the side of vertex, two at the side of head behind, hind angle of head slightly pubescent. Eyes not large, nearly round and prominent. Antennæ moderately stout, one-half longer than the head, first joint nearly as long as the second and third together, the third one-half longer than the second; joints 4-10, gradually but feebly stout, cylindrical and scarcely longer than wide, joint 11, longer than preceding and subacute at tip. Thorax slightly broader than the elytra, sides distinctly explanate, broader than long, emarginate in front, anterior angles subacute, sides and base broadly rounded, forming nearly a circle, less the emargination in front; surface smooth, shining and with punctures arranged as follows: a dorsal series of two punctures moderately distant from the anterior margin, a lateral oblique series of three or four punctures, one puncture being within the line of the lateral but not belonging to the dorsal series; a marginal row of moderately large punctures close to the lateral margin extending along the base, the punctures being more distant in the latter region. Prosternal process behind the coxæ corneous. Scutellum smooth, shining. Elytra slightly longer than the thorax, rather densely and moderately coarsely punctured and sparsely clothed with yellowish pubescence. Abdomen moderately elongate, longer than the head, thorax and elytra together, slightly narrowed to apex, moderately punctured but less densely than the elytra, above and beneath sparsely clothed with brownish hairs. Body beneath and legs similar in color to the upper surface. Length .46-.50 inch; 11.5-12.5 mm. Abundantly distinct from all our species by the color and thoracic punctures. The sides of thorax are more explanate than any of our species except *Q. explanatus* LeC.

Two specimens were collected a short distance within the mouth of Wyandotte Cave.

#### *Descriptions of species from the Mammoth Cave.*

##### PHRIXIS Cope.

Genus novum *Gonyleptidarum*. Cephalothoracic shield covering dorsum of abdomen, which is posteriorly segmented. Eyes none. Tarsi multiarticulate, clawed. Palpi spiniferous, maxillæ chelate.

This genus is near *Erebomaster*, differing in the multiarticulate tarsi, and absence of eyes. It is nearer to *Acanthocheir*, being like it eyeless, but the latter according to Dr.



Packard's figure (in *AMERICAN NATURALIST*, l. c.) has tarsi as in the first named genus, one or two jointed. In *Phrixis* they are much as in *Phalungium*, which the species also resembles in its long limbs.

*PHRIXIS LONGIPES* Cope, sp. nov. Legs eight times as long as the body, tarsus of the shorter with five, those of the longer with six joints, those of the longest not counted. The first and second segments are very long; tibiae shorter than femora; coxæ subglobose. Legs with scattered, rather short hairs. Last tarsal joint with one claw and an opposing bristle, in two limbs as long as femora, exceeding total of body, with two claws. Palpi five jointed, the third, fourth and fifth with large spines on each side, the second, or vertical, with four near the base directed forwards and two near the upper end directed inwards. Mandibles pubescent. Five narrow, and one terminal, segments of the abdomen, the penultimate wider than the others. Body pubescent. Color very pale, with a straw-colored shade. Length of body 1.17 lines, or m.00225; longest leg m.02.

This species, though small, considerably exceeds the *Acanthocheir armatus* in dimensions.

#### STYGOBROMUS Cope.

Gen. nov. *Gammaridarum*. Near *Gammarus*. The first antennæ with flagellum, and much shorter than the second. Two pairs of limbs chelate by the inflexion of the last claw-like segment; other limbs clawed. Terminal abdominal segment very short, spiniferous; the penultimate segment with a stout limb with two equal styles, the antepenultimate short, two-jointed and undivided. Eyes none.

This genus is nearer to the true *Gammarus* than the allied genus described from the Austrian Caves, the *Niphargus* of Schiöde.\* In the latter the first antennæ are the larger, and the body terminates in a very long style; the last abdominal limb is undivided like that which precedes it. In *Stygobromus* the penultimate limb is like that represented by Schiöde for *Niphargus*, though I am not certain whether it is homologically identical. The last limb is about equally divided, but the simple basis is long and stout.

It is just possible that the antepenultimate limb represents the basis and one style only, for in that of one side a slight process appears at the extremity of the basal segment, though it is not visible on that of the other. The terminal limbs are recurved and appressed to the last abdominal segment, forming a fulcrum or prop. The animals of this genus are aquatic, and swim much as the common *Gammarus*. The absence of eyes is another example of the adaptation to darkness.

*STYGOBROMUS VITREUS* Cope. "Gammaroid Crustacean" Cope, *Ann. Mag. Nat. Hist.*, Nov., 1871. Two last pairs of limbs appressed to last abdominal bristles and of nearly equal length, forming a brush. Last segment of abdomen with two terminal bristles. Last segment of the limbs from the third to the seventh, with a long, straight claw directed forwards. Fringed limbs behind this point very small. Outer or second antennæ half as long as the first, which embrace eleven segments, and are about as long as the last five abdominal segments. Total length of head and body 2.1 lines or .0045 m.

There are few conspicuous hairs, the most so are those which stand at the extremity of the last joint of the limbs, rising from the base of the claw. Color translucent.

## REVIEWS AND BOOK NOTICES.

VEGETABLE PARASITES AS CAUSES OF DISEASE. †—The first of these two papers gives the recent ideas, as seen by an able and advanced observer, in regard to those forms of cryptogamic vegetation whose growth is believed to be the cause of Ringworm, Favus, and a few similar affections. Dr. White discusses the

\* *Proc. Entom. Soc.*, London, 1851, p. 150.

† *Vegetable Parasites, and the diseases caused by their growth upon man.* By James C. White, M.D., Prof. of Dermatology in Harvard University. 8vo pamphlet. Boston. 1872.

On the development of Vegetable Organisms within the Thorax of Living Birds. By Dr. James Murie, F.L.S., etc.; Lecturer on Comp. Anat., Middlesex Hospital. Read before the Royal Microscopical Society, Jan. 3, 1872.