SOME NOTES ON THE HABITS OF CERAPACHYS AUGUSTAE.

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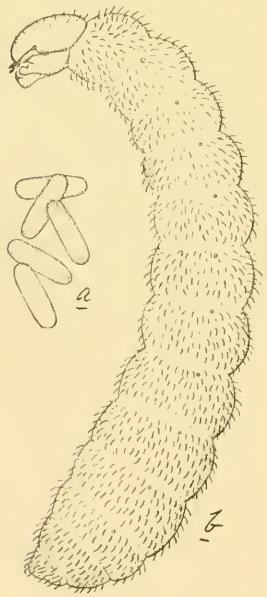
A year ago I described in the Biological bulletin (Vol. 3, No. 5, Oct. 1902, p. 181–191) a singular Texan ant (*Cerapachys* [*Parasyscia*] *augustae*, of all known New World Formicidae the most primitive and generalized. The few specimens that furnished the types of the species were found under circumstances precluding a study of their habits. These, however, must be more thoroughly known before the precise taxonomic affinities of the tribe Cerapachyi to the Dorylinae and Ponerinae can be determined. I was well pleased. therefore, during the past spring to happen on another larger living colony of these extremely rare ants together with their eggs, and to be able to study their behavior for several days in an artificial nest. Unfortunately, these ants, like their allies, the Ponerinae and Dorylinae in general, do not thrive so well in confinement as the more highly specialized and plastic Myrmicinae and Camponotinae. Hence my observations proved to be rather fragmentary, but I have seen fit, nevertheless, to record them because they shed some light on the habits and development of the Cerapachyi and thus bring us a step nearer to a determination of their natural affinities.

The colony of *C. augustae*, on which the following observations were made, was discovered May 6th, 1903, near high water mark in the bottom of Shoal Creek at Austin, Texas. It was inhabiting a simple, straight gallery about 5 cm. long by 7 mm. in diameter, under the very center of a large block of limestone. At one end the gallery dipped down into the soil to a depth of 4 cm. The ants, 29 in number, were all congregated in the surface gallery with their long bodies wrapped about a large packet of eggs. Only workers were found, though careful search was made for the peculiar wingless female described in my former paper. The whole colony, with the possible exception of a few ants that may have been out foraging, was captured and placed in a small Petri dish, the bottom of which had been provided with a thin layer of damp soil partly covered with a glass microscope slide. The ants soon took up their abode under the slide after collecting their scattered eggs. Nymphs of two common Texan termites (*Amitermes tubiformans* and *Eutermes cinereus*) were cut into a few pieces and given them as food. Even when these were placed only a few millimeters from the ants, the latter showed no signs of noticing them till they were actually touched with the antennae. And even then the ants often hesitated before attacking the still struggling heads and thoraces. Eventually the termites were dispatched by the ants curling about them and using both mandibles and sting. The latter produced sudden paralysis. Then the ants eagerly lapped up the juices exuding from the cut ends of the termite fragments,

while remaining very quiet as if absorbed in the delight of feeding. The mandibles seemed to be too feeble to cut or puncture even so thin a chitinous investment as that of the termites.

The antennae are undoubtedly the most important and remarkable organs of *Cerapachys*. This is shown by their great thickness (whence the name of the genus), the differentiation of the glandiform terminal joint of the flagellum, and their singular freedom of movement. This freedom is permitted by the clypeus which is much compressed laterally in the form of a vertical crest, and does not overlap the scapes on the sides. The antennae are, in fact, kept in continual vibration in a plane perpendicular to the head with their elbows uppermost and not directed sidewise as in other ants, while the glandiform joint of the flagellum plays over the surfaces with which it comes in contact. The insects must be guided almost exclusively by the contact-odor sense in these organs since they have no trace of eyes. Pronounced negative heliotaxis, evidently depending on some photodermatic sense, was apparent when the ants were exposed to the sun, though they did not respond very readily to the lower intensities of diffuse day-light. Strangely enough, this negative heliotaxis was not associated with a high degree of positive thigmotaxis, as it is in many other insects, since the animals showed no decided tendency to conceal themselves with their bodies applied to the earth or glass. Often the whole colony would lie exposed for hours on the surface of the soil, merely agglomerated in a mass about their eggs.



As the number of eggs visibly increased during the confinement of the colony, it is clear that some of these must have been laid by the workers, as there was no female in the nest. No ants could be more careful of their eggs. They enveloped them with their bodies so that the packet could not be seen except by disturbing the whole colony. When the packet was broken apart the eggs were eagerly sought and deftly brought together again. This brooding over the eggs is quite unlike anything I have seen in other ants except Eciton, the smaller species of which (*E. opacithorax*, *schmitti*, *sumichrasti*, etc.) have a very similar habit. Besides affording protection to the eggs, it may, perhaps, serve to hasten the embryonic development. The eggs are very slender (Figure, *a*), being fully four times as long as broad. They are not kept in several packets with the long axis of the component eggs parallel with one another, as in some

Ponerinae (Leptogenys, Pachycondyla), but without any definite orientation in a single subspherical mass. The first eggs did not hatch till May 14th, showing that the incubation period must exceed eight days. They hatched rather slowly, a few at a time.

The larvae (Figure, *b*) were extremely slender, not twice as broad behind as at the anterior end, with well-marked segmental constrictions. The head is proportionately large, with strong, acute mandibles projecting beyond the clypeal and labial regions. The maxillae are furnished with a pair of prominent sensory papillae and the labium with a well-developed duct to the spinning glands. The dorsal surface of the head as well as the whole surface of the body is covered uniformly with short, slightly curved hairs. There are no traces of tubercles of any description. Attempts to observe the method employed by the ants in feeding their larvae were unsuccessful. Once, on placing a number of eggs and young larvae of *Camponotus festinatus* in the nest, I saw the young Cerapachys larvae feeding on the former after they had been carried under the slide by the workers. It was apparent also that the ants and their older larvae soon began to feed on the unhatched eggs and younger larvae of their own species, for the number of progeny decreased rapidly from day to day. In order to reduce the size of the colony and thus save as many of the young as possible from destruction, I killed and removed twelve of the workers May 17th. I was not successful, however, in stopping the infanticides, so on the following day I removed six more workers. By this time, however, though I had provided the nest daily with fresh termite food (the ants would not eat sweets, larvae of other ants, or miscellaneous insects) the Cerapachys became so demoralized that by May 19th no eggs and only five half-grown larvae remained. These larvae were carried by the ants after the manner of Eciton and Leptogenys, *i. e.* by the neck, with the long slender body extending back between the legs of the worker. The ants were quite as careful of their larvae as of their eggs.

To my intense disappointment, it soon became manifest that I should be unable to rear the few remaining larvae to the pupal stage. I therefore killed the surviving workers and the three larvae still uneaten May 20th. Thus I was unable to settle two important questions: first, the method of feeding the larvae, whether by regurgitation or with pieces of insect food; and, second, the character of the pupa, whether naked or covered with a cocoon. The powerful development of the larval jaws would seem to indicate that the young are fed with pieces of insect food, and from the fact that the larval spinning glands seem to be well developed, one may infer that the pupa is enclosed in a cocoon. Whoever is so fortunate as to happen on a colony of these ants during the middle or latter part of June will probably be able to determine the pupal characters without difficulty, as the pupae should at that time be found in the nests.

What light do these few observations, together with those recorded in my previous paper, shed on the affinities of the Cerapachyi to the Ponerinae on the one hand and the Dorylinae on the other? It is clear that the following traits of *C. augustae* are decidedly Ponerine:—

1. This ant lives in small colonies like the Ponerinae (Stigmatomma, Ponera, etc.) and not in populous colonies like the Dorylinae.

2. Its nest has a very simple structure like that of the Ponerinae.

3. The colonies are stationary like the Ponerinae and not nomadic like the Dorylinae. In confinement, at least, *C. augustae* made no attempts to leave the nest and showed none of the singular restlessness which characterizes confined colonies of Eciton, but behaved like the home-loving species of Ponera, Leptogenys, Pachycondyla, etc.[1]

4. *C. augustae* exhibits the same slow, monotonous, and timid behavior as the Ponerinae (Stigmatomma *e. g.*) in marked contrast to the intrepid, predatory instincts of the Dorylinae.

5. The female of the Texan Cerapachys is not dichthadiiform, *i. e.* shaped like the huge wingless females of Dorylus and Eciton, but resembles the workers in form and stature. Some species of Cerapachys are known to have winged females.

6. The workers are all very nearly of the same size and structure and in these respects resemble the workers of the Ponerinae. There is no tendency to polymorphism as in Dorylus and Eciton.

7. The petiole and post-petiole resemble the corresponding parts of certain Ponerinae (Stigmatomma, etc.).

[1] A fine colony of *Eciton schmitti* which I kept a few years ago, exhibited this restlessness in a striking and ludicrous manner. The colony was at first confined in a tall glass jar on a square board surrounded by a water moat. The ants kept going up and down the inside of the jar in files for many hours. Finally I removed the lid. The file at once advanced over the rim and descended on the outer surface till it reached the circular base of the jar where it turned to the left at a right angle and proceeded completely around the base till it met the column at the turning point. To my surprise it kept right on over the same circumference which was long enough to accommodate the whole colony. The ants continued going round and round the circular base of the jar, following one another like so many sheep, without the slightest inkling that they were perpetually traversing the same path. They behaved exactly as they do on one of their predatory expeditions. They kept up this gyration for 46 hours before the column broke and spread over the board to the water's edge and clustered in the manner so characteristic of this and the allied species (*E. opacithorax*, *sumichrasti*, etc.). I have never seen a more astonishing exhibition of the limitations (*germanice* "Bornirtheit") of instinct. For nearly two whole days these blind creatures, so dependent on the contact-odor sense of their antennae, kept palpitating their uniformly smooth, odoriferous trail and the advancing bodies of the ants immediately preceding them, without perceiving that they were making no progress but only wasting their energy, till the spell was finally broken by some more venturesome members of the colony. Recently I have found a remarkable observation of the same kind recorded by Fabre in the 6th volume of his incomparable "Souvenirs Entomologiques." He describes an army of caterpillars of the "processionnaire du pin" (Cnethocampa pityocampa) going round and round the outside of a large vase 1.35 m. in circumference for seven days! During this period the caterpillars were on the march 84 hours altogether, stopping to rest on their path only when overtaken by the cold, and not actually deviating till the eighth day. Fabre estimated that the caterpillars crawled around the vase 335 times! In this case the insects were not guided by contact-odor like the Ecitons, but by the silken thread spun by each individual over the surface traversed.

8. The eggs are shaped like those of certain Ponerinae (Leptogenys, Pachycondyla).

9. The larva probably spins a cocoon.

On the other hand *C. augustae* exhibits unmistakable Doryline characters: —

1. In the conformation of the head and antennae which closely resemble those of Eciton.

2. In the habit of brooding over the eggs.

The following characters are common to both Dorylinae and Ponerinae: —

1. The method of carrying the larvae is common to forms like Eciton and Leptogenys.

2. The larva is intermediate between that of Eciton and Stigmatomma. It is covered with shorter, less flexuous, and less abundant hairs than the latter and in these particulars resembles the larvae of Eciton.[1]

These facts go to show that *C. augustae* is a generalized form much like the hypothetical ancestor from which both Dorylinae and Ponerinae are supposed to have sprung. At the same time, the majority of the characters are Ponerine and justify us in adopting the views of Forel who places the tribe Cerapachyi with the Ponerinae. Other species of Cerapachys bear out this interpretation. Dr. Hans Brauns writes me from Willowmore, Cape Colony: "Cerapachys ist doch wohl sicher eine Poneride. *C. peringueyi* ist bei Port Elizabeth keineswegs selten, hier einzeln. Ihr ganzes Betragen ist das einer Poneride."

Owing to the close relationship of Cerapachys with both Ponerinae and Dorylinae, the recent discovery by Emery of a form (Aneuretus) intermediate between the Ponerinae and the Dolichoderinae, and the patent relationship between the Ponerinae on the one hand and the Myrmicinae and Camponotinae on the other, it is evident that the Formicidae constitute a very compact group of Hymenoptera. This unitary character of the group is still further emphasized by its comparatively recent geological origin. Hence it should be designated as a family, and its five divisions as subfamilies, in accordance with the views of European myrmecologists like Emery, Forel, Mayr, Wasmann, etc.; and the recent tendency of some Cisatlantic hymenopterists to regard the ants as a superfamily ("Formicoidea"), consisting of the five families Myrmicidae, Poneridae, etc., is not to be commended merely for the sake of making the nomenclature of this group look like that of some of the other divisions of the Hymenoptera.

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[1] I have not seen Emery's description of the larva of the Ponerine Ectatomma, but I have been able to examine the larvae of *E.* (*Holcoponera*) *strigatum* Norton from Guadalajara, Mexico. These larvae are nontuberculate like those of *Stigmatomma pallipes* (Biol. bull., 1900, vol. 2, p. 61, fig. 8) but covered with long, multifurcate, somewhat flexuous hairs. An exhaustive monographic study of ant-larvae would certainly repay the investigator, as they present a bewildering array of interesting characters in the various tubercles, "poils d'accrochage," etc., with which they are provided.