PSYCHE

VOL. 58 JUNE, 1951 No. 2

STUDIES ON ARIZONA ANTS. 1. THE HABITS OF *CAMPONOTUS ULCEROSUS* WHEELER AND ITS IDENTITY WITH *C. BRUESI* WHEELER.

BY WM. S. CREIGHTON
Department of Biology
College of the City of New York

During the summer of 1950 the writer enjoyed the privilege of spending three weeks in the Huachuca Mountains of Arizona. This was made possible through the courtesy of Mr. Charles Bogert, Curator of Herpetology at the American Museum of Natural History. Mr. Bogert permitted us to use a four wheel drive jeep and trailer belonging to his department. We met Mr. Bogert and his party in the Huachucas and there we collected reptiles and insects. July 1950 was a very wet month in the Huachucas and the collecting, as far as the ants were concerned, was all that could have been asked. I was able to study the habits of several species which I had previously known only from cabinet specimens. I wish to express my thanks to Mr. Bogert and to the American Museum of Natural History for their part in making these studies possible.

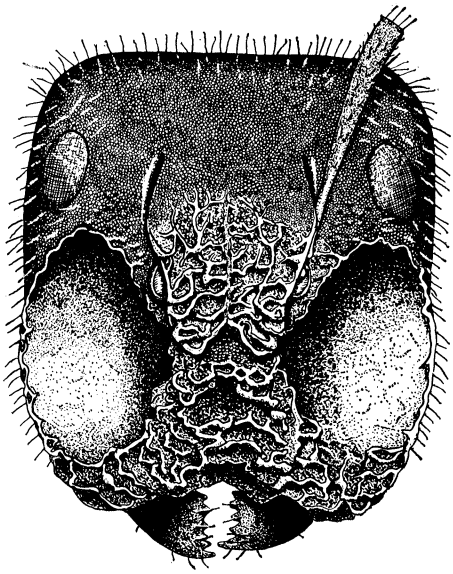
One very surprising result of this work was the discovery that *ulcerosus* and *bruesi* are specifically identical. The insects to which these two names have been applied have hitherto been regarded not only as separate species but as representatives of separate subgenera in the genus *Camponotus*. This unusual situation has resulted from attempts to deal with wholly inadequate material. The error was, therefore, unavoidable for, as I shall show, the structure of

this ant is very peculiar and no amount of logic applied to fragmentary material could have given a correct concept of the species. Before discussing these peculiarities it seems advisable to present an account of the earlier taxonomy of *ulcerosus* and *bruesi*. Several of the proposals carried in this paper depend upon previous studies on this remarkable insect.

The original description of *ulcerosus* and that of *bruesi* were both presented in a paper by W. M. Wheeler which appeared in 1910 (1). At that time the subgenera of *Camponotus* were in a rather fluid state, hence it is not surprising that Wheeler made no attempt to assign either of his species to a particular subgenus. Instead he related *bruesi* to the *novogranadensis* group and left *ulcerosus* in a group of its own. It is instructive to note that Wheeler felt that *ulcerosus* formed a link between *bruesi* and species in the subgenus *Colobopsis*. Although this view is incorrect, it shows that Wheeler was aware of a basic structural similarity in the specimens which he assigned to *bruesi* and to *ulcerosus*. With adequate material for study the importance of this similarity would have been appreciated and subsequent confusion avoided. But the material upon which Wheeler based his original descriptions was far from adequate. There was a single major worker and five or six minors of *bruesi*, all strays taken by Wheeler at Ft. Davis, Texas. In addition to these types Wheeler had six more minor workers coming from two stations in Mexico. The paucity of type material was even more acute in the case of *ulcerosus*. This species was described from a single major worker taken by C. Shaeffer at Palmerlee in the Huachuca Mountains of Arizona.

In both of Wheeler's species the major worker possessed a striking, oblique truncation at the front of the head. But in the type of *ulcerosus* each cheek bore a large, deep, ulcer-like depression. The outer edge of each depression was bounded by a ridge along the lateral border of the head. Its inner edge lay close to the clypeus and the frontal lobe. These depressions, the clypeus and the frontal lobes were covered with very coarse, uneven, irregular rugae. In contrast, the type of the major worker of *bruesi* showed no depressions on the cheeks. The truncated anterior part of

the head formed an almost flat plane which rounded into the lateral borders of the head through a blunt angle. The cheeks, clypeus and frontal lobes were coarsely but unevenly punctato-rugose (Text-fig. 3). It is not surprising that Wheeler considered these very different insects as distinct species or that Emery should later have placed them in separate subgenera. With nothing more than the structure of the types for a guide, this procedure required no justification. The accumulation of additional material of *ulcerosus* and *bruesi* was slow. Wheeler took two colonies of *ulcerosus*



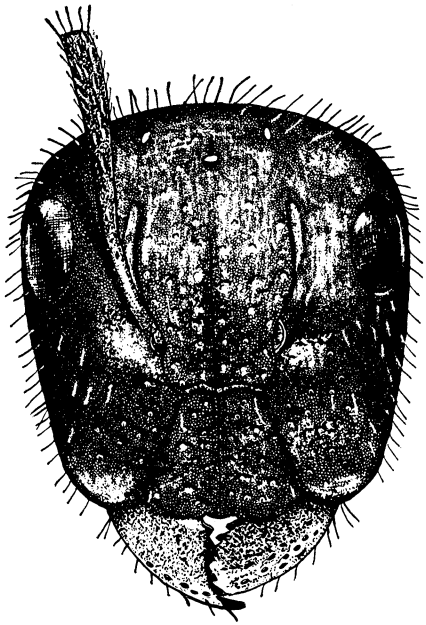
Text-fig. 1. *Camponotus* (*Myrmaphaenus*) *ulcerosus* Wheeler, head of major worker with fully developed ulcers.

containing both major and minor workers in the Huachuca Mountains after he had described that species but before the paper carrying the description was printed. This material, which was referred to in a footnote, seems never to have been mounted for study. I believe that it must have been subsequently lost for I have never seen any of it in the collections which I have examined. It was not until nine

years later that additional material of *ulcerosus* came into Wheeler's hands. In March 1919 he collected, at Oracle, Arizona, a small nest of *ulcerosus* containing both major and minor workers. Two years later Wheeler set up the subgenus *Manniella* (2) but he did not assign *ulcerosus* to it. This transfer was made in 1925 by Emery (3) who placed *bruesi* in the subgenus *Myrmaphaenus* at this same time. Emery's treatment has been followed by students of North American ants to the present, although in my 1950 publication (4) I expressed doubts that *ulcerosus* could properly be included in the subgenus *Manniella*.

A fixed idea often has an extraordinarily tenacious hold. When I collected six colonies of this ant in Garden Canyon in 1950 I still attempted to assign them either to *ulcerosus* or to *bruesi*. I had studied these colonies in the field as carefully as I could. I had examined a considerable proportion of each under a small binocular microscope. I knew that the four females which had been taken with them were all extremely similar and not at all like the major workers with which they had been secured. I knew that in every case the structure of the nest was the same. Yet it was not until I mounted up this material and studied it in detail that I realized that *ulcerosus* and *bruesi* are the same insect. Since others may have equal difficulty in believing that two such dissimilar major workers can belong to the same species, I have presented here the steps by which this conclusion was reached. The altogether unexpected structure of the female may be considered first. Except for very minor details of color, pilosity, and sculpture all four females are identical. Only their cephalic structure need be considered at this point. The front of the head of the female shows nothing comparable to the oblique truncation of the major. The clypeus and the cheeks are, perhaps, a trifle flatter than is usual but, in general, the head of the female shows the customary, convex curvature found in many species of *Camponotus* (Text-fig. 2). The cheeks show no sign whatever of ulceration. The sculpture of the clypeus, frontal lobes and cheeks consists of moderately coarse, oval or rounded punctures which are irregularly spaced. The surface between these punctures is finely and densely granulose.

Between some of the punctures it is thrown up into a low mound. There are no rugae on the front of the head unless one chooses to regard the mounds just mentioned in this light. As may be seen the head of the female does not resemble that of the major of *bruesi* and still less that of the

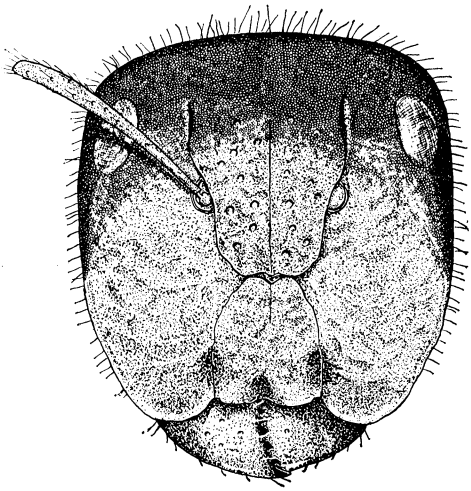


Text-fig. 2. *Camponotus* (*Myrmaphaenus*) *ulcerosus* Wheeler, head of female. Scale as in text-fig. 1.

major of *ulcerosus*. There is, however, a very close resemblance between the head of the female and that of the larger media workers which were taken with them.

We may now consider the structure of the major workers taken with these females. The first female to be secured came from a colony which had been scattered by improper collecting methods. Only two majors were taken in this case. Both are transitional in the degree of development of the ulcers on their cheeks. That is to say, the ulcers are much shallower than those of the type of *ulcerosus* but still

clearly recognizable as ulcers. The second female was taken in association with six major workers. Of these one had moderately prominent ulcers on the cheeks, three had shallow ulcers on the cheeks, one had small and very feeble ulcers and one was non-ulcerate. The two remaining females came from the same colony. In this colony were seven major workers. Three of these have a cephalic structure far more extreme than that of the type of *ulcerosus*. The ulcers on the cheeks of these fantastic insects are so deep that the bottom of the depression must be almost in contact with the



Text-fig. 3. *Camponotus* (*Myrmaphaenus*) *ulcerosus* Wheeler, head of non-ulcerate major worker. The head has been tilted backwards slightly to show the anterior truncation as fully as possible. Scale as in text-fig.1.

gula. Each depression extends clear to the lateral border of the head, where it is bounded on the outside by a thin, vertical sheet of chitin. The sculpture of the depressions, the clypeus and the frontal lobes is extraordinarily rough and uneven, so much so that these parts have a peculiar shrivelled or crumpled appearance (Text-fig. 1). The remaining four majors belonging to this colony closely approximate the condition found in the type of *ulcerosus*. There may be added here the cephalic characteristics of the majors taken

from colonies in which the female was not secured. Only one of these three colonies represented the majority of the nest. In this colony there were ten majors. Three of these majors have no trace of ulcers on the cheeks. Six of them have very shallow ulcers which are, nevertheless, covered with very coarse rugae. These rugae tend to obscure the ulcers but each depression has a low, distinct, lateral ridge which bounds its outer edge. One major worker in the above colony has somewhat deeper ulcers, although they are not as deep as those of the type of *ulcerosus*. Both the remaining colonies were fragments of nests in which the passages were lost during the course of excavation. The first contained two non-ulcerate majors. The second contained two majors with shallow ulcers having rather feeble rugae.

The facts just presented permit the following statements concerning this insect:

1. The female of this species is normal in every respect and there is no correlation between the cephalic structure of the female and that of the major worker.

2. The same type of female may produce widely different sorts of major workers.

3. The range of variation in the head of the major worker extends well beyond the condition found in the type of *ulcerosus*, which stands about midway in the series of transitional forms.

4. The full range of variation in the cephalic structure of the major is seldom, if ever, present in a single nest series. But in every nest series there is sufficient variation in the head of the major to make ulceration useless as a separatory character.

5. The non-ulcerate majors always have low and comparatively obscure rugae on their cheeks. Those with shallow ulcers may have the rugae either feebly developed or coarse and prominent. The majors with very deep ulcers invariably have extremely coarse rugae on the front of the head. Cephalic sculpture, like the ulceration of the cheeks, cannot be used as a separatory character.

There is but one conclusion to be drawn from the above data: *ulcerosus* and *bruesi* are the same insect. The most immediate effect resulting from the recognition of this fact

involves the choice of the valid name. Either name is available since both appeared in the same publication. It has been the practice of myrmecologists to use page precedence in deciding cases of this sort. In this instance the name *bruesi* has page precedence but I have selected *ulcerosus* as the valid name for two reasons. In the first place the fully ulcerate major worker of this ant is a most extraordinary insect and it seems well to retain a name which refers to this striking peculiarity even though it is not shown by all the major workers. In the second place the type locality of *ulcerosus* is in the Huachuca Mountains of Arizona. Since this ant appears to be much more abundant in the Huachucas than at Ft. Davis, Texas (the type locality of *bruesi*) it is advantageous to have the Huachuca Mountains as the type locality.

It would be gratifying if the subgeneric affinities of this insect could be as easily handled as can the choice of its specific name. Since *bruesi* was assigned to *Myrmaphaenus* and *ulcerosus* to *Manniella*, the inconsistency of a species split between two subgenera cannot be allowed to stand. The problem is to rectify this inconsistency with the least damage to the subgenera involved. In a previous publication (4) I have shown that the constitution of *Myrmaphaenus* is unusually heterogeneous. This is entirely due to Emery who, without giving any valid reason for the change, reversed his earlier views in 1925 and combined in one group species which he had formerly assigned to three subgenera. This circumstance makes it impossible to select a clearly definitive character by which all the species belonging to *Myrmaphaenus* may be recognized. But it may be stated that there are some species in *Myrmaphaenus* that have a major worker in which the front of the head is obliquely truncated. There are some species in which the worker caste is polymorphic. There are some species known to have a normal female. If, therefore, we are dealing with a species which combines these three features, its inclusion in *Myrmaphaenus* causes no increase in heterogeneity on any of the above counts. As to whether this species shows the 'subgeneric characteristic' of *Myrmaphaenus* is not the question for, as things stand at present, there is no uniformly appli-

cable characteristic which will define the members of this ill-conceived and conglomerate subgenus.

The situation in the subgenus *Manniella* is simpler, but this is mainly because it contains a much smaller number of species than *Myrmaphaenus*. For this subgenus is also cursed with heterogeneity. When *Manniella* was first set up by Wheeler in 1921 it contained only the Cuban species *sphaericus* and its subspecies *sphaeralis*. This species had previously been assigned to *Colobopsis* by some workers and to the subgenus *Myrmeurynota* by others. Wheeler's move was a sound one, for it recognized the peculiar structural features which mark the major worker of this species. The major worker of *sphaericus* possesses ulcerate cheeks and peculiarly modified frontal lobes. Each frontal lobe is large, laterally expanded and with its anterior half distinctly concave. The two concavities are separated by a prominent median septum where the lobes join. While this configuration of the frontal lobes may be nothing more than the specific characteristic of *sphaericus* it seems to have no close counterpart in any other species in the genus *Camponotus*. Hence the subgenus *Manniella* can if necessary, be based upon the unique structure of the frontal lobes of *sphaericus* as long as the subgenus is limited to that species. With this auspicious start it is most unfortunate that Emery and Wheeler should have subsequently added to *Manniella* species which do not agree in the characteristics just mentioned. In 1925 Emery transferred *ulcerosus* to *Manniella* and in 1934 Wheeler placed *linnaei* and *championi* in this subgenus (5). Each of the species transferred to *Manniella* has a major worker with ulcerate cheeks but none of them has frontal lobes comparable to those of *sphaericus*. Emery was clearly aware of this discrepancy, for he commented on it when he transferred *ulcerosus* to *Manniella*. No doubt Wheeler was also, but by 1934 the structure of the frontal lobes had been subordinated to the presence of ulcers on the cheeks as the definitive characteristic of the subgenus *Manniella*. It is instructive to note that both Emery and Wheeler tried to bolster this character with others which would give a better definition to *Manniella*. Thus Emery postulated that the worker caste in *Manniella* is strictly

dimorphic and Wheeler later added the concept that there is no normal, winged female in this subgenus, her place being taken by a fertile major worker. The point in these distinctions is that they give a certain degree of separation from *Myrmaphaenus*, where at least some of the species are known to possess a polymorphic worker caste and a normal winged female.

It should be clear that the data presented in this paper destroys the subgenus *Manniella* as defined by Emery in 1925 and emended by Wheeler in 1934. For, if *ulcerosus* is retained in *Manniella*, as is quite possible since some of its major workers are far more heavily ulcerated than those of any other species in the subgenus, then it follows that *Manniella* must be expanded to include a species with a polymorphic worker caste and a normal female. Conversely if *ulcerosus* is transferred to *Myrmaphaenus*, where it fits on every count except the ulcerate major, then this same ulcerate major breaks down the one certain distinction between the two subgenera. It may be argued that the transitional character of *ulcerosus* defeats any attempt to separate *Myrmaphaenus* and *Manniella* and this is true as long as the separation is based on the presence or absence of ulcers on the cheeks of the major worker. But, as I have already pointed out, the separation need not be made on this basis. If the definitive subgeneric characteristic of *Manniella* is made the configuration of the frontal lobes of the major and not the ulceration of its cheeks, then a good separation can be secured. It is true that this procedure limits the representation in *Manniella* to the species *sphaericus* and that *ulcerosus*, *linnaei* and *championi* must be shifted to *Myrmaphaenus* as a result. But this transfer can do no damage to a subgenus whose constitution is already a monument of heterogeneity. Moreover, this method seems to be the only one which will preserve *Manniella*. I believe that there is a distinct advantage in maintaining *Manniella*, for *sphaericus* is a very singular species and if *Manniella* is fused with *Myrmaphaenus* there is every reason to expect that it will have to be resuscitated at a later date. I also feel fairly sure that it will be necessary in the future to set up a new subgenus to receive *ulcerosus*. I have not

done so at present because of the possibility that *ulcerosus* may fit into one of the subgenera which Emery fused to make *Myrmaphaenus*. Since it is clear that *Myrmaphaenus* will have to be drastically revised if its constituent species are to be put on a sound taxonomic basis, any piecemeal attempt in this direction would be premature. One may earnestly hope that the next revisionary effort applied to *Myrmaphaenus* will be thorough enough to give us a workable version of this highly unsatisfactory group. In the meantime the plan which causes the least disarrangement is to transfer to *Myrmaphaenus* the species *ulcerosus*, *linnaei* and *championi* and to restrict the subgenus *Manniella* to *sphaericus* and its subspecies *sphaeralis*. I propose to follow this plan and trust that other myrmecologists will see the matter in the same light.

I wish to present here certain descriptive details to augment the figures of *ulcerosus* included in this paper. These will be restricted to the minor and media workers and the female. Both the ulcerate and the non-ulcerate phases of the major worker of this insect have been described elsewhere and need no further description here.

Worker minor: head (exclusive of the mandibles) 1.25 mm. long; thorax and petiole 2 mm. long; total length 5.5-6.5 mm. Erect hairs long, thin, white and usually with sharp tips; abundant on the rear of the head, the entire thorax and the abdomen. Hairs on the mandibles, clypeus, cheeks and gula for the most part notably shorter than those on the rear of the head. Femora with short erect hairs on their lateral and flexor surfaces. Those on the extensor surface mostly appressed and often largely limited to the outer half of the femur. Tibiae with abundant erect hairs. Those of the tarsi and antennal funiculi finer, shorter and semierect. Antennal scapes covered with very fine, appressed, yellow pubescence and with a few short, yellow, semierect hairs usually present on the outer half of each segment. Head and thorax finely and densely granulose (under high magnification this granulation may be seen to consist of close-packed, circular craters). Coxae and petiole with a delicate, even, reticulate sculpture. Gaster finely shagreened, somewhat more shining than the coxae and the

petiole. Mandibles with elongate, oval punctures. A few feeble, coarse punctures are present on the clypeus and the cheeks. In some specimens these are so shallow that they can only be seen in oblique lights. Color black, the mandibles, antennae and tarsal joints light brown. The anterior edge of the clypeus and the area immediately behind the insertion of the mandibles often marked with brown. In many specimens the abdomen, and to a lesser extent the thorax, will show bluish reflections.

Worker media: head (mandibles excluded) 1.75 mm. long; thorax and petiole 2.5 mm. long; total length 6-7 mm. Pilosity as in the minor worker. Sculpture of the thorax and abdomen as in the minor worker. The head is a little more strongly granulose and less shining with numerous, conspicuous, oval punctures on the clypeus and cheeks and a few feebler punctures on the frontal lobes. Most of the clypeus, the anterior portion of the cheeks and the anterior half of the frontal lobes light brown. The color otherwise as in the minor worker.

Female: head (mandible excluded) 2 mm. long; thorax and petiole 4 mm. long; total length 9-10 mm. Erect hairs on the thorax sparser and a little shorter than those of the worker castes. Erect hairs elsewhere very similar to those of the worker. Sculpture of the head similar to that of the media worker but with the punctures more pronounced, particularly on the frontal lobes where they extend rearward to the level of the median ocellus. Scutum densely and evenly granulose, feebly shining with scattered, irregular punctures from which the erect hairs arise. The remainder of the thorax more strongly shining, particularly the lateral portions of the pronotum, the metanotum, the basal face of the epinotum and the mesothoracic sternite and episternite. On the above areas the granulation is reduced to a delicate and minute reticulate sculpture. Gastric sculpture heavier than in the media, particularly on the dorsum of the first gastric segment where the sculpture consists of a minute pattern of reticulations. Front of the head usually marked with brown as in the media but sometimes the entire head, except the mandibles and antennae, is black. The four fe-

males examined showed no bluish reflections on the gaster or thorax.

The above descriptions, as well as the figures were based upon material taken in Garden Canyon in the Huachuca Mountains of Arizonia. Garden Canyon, therefore, becomes the type locality for the female and media worker. In this connection it seems well to note that there is no good agreement as to the exact situation of Palmerlee, the type locality of the major of *ulcerosus*. I regret that this name was incorrectly spelled as "Parmerlee" in my 1950 publication on North American ants, for this adds further confusion to an already confusing situation. Mr. L. F. Byars, who is much interested in Arizona ants, writes me that the former postoffice of Palmerlee was situated on the Palmer Ranch at the mouth of Miller Canyon. But Will C. Barnes in his entertaining publication *Arizona Place Names*, (6) states that Palmerlee was at the Reef Mine on Miller Creek and that J. L. Palmerlee, on whose land the postoffice was established in 1904, was its first postmaster. Mr. Barnes secured his data from the records of the United States Post Office, hence the date and the postmastership appear beyond dispute. But it is very unlikely that the postoffice was at the Reef Mine. For the Reef Mine is now situated, and apparently has always been situated, at an elevation of 6700 feet near the head of Carr Canyon. This area is well above the ordinary vertical range of *ulcerosus*. The contradictions just discussed need occasion no difficulty if one is content to cite the Huachuca Mountains as the type locality for *ulcerosus*.

Since virtually nothing has been published on the habits of *ulcerosus*. I wish to present certain data which were secured last summer. The observations which follow were made in an area near the picnic grounds in Garden Canyon. At this level the canyon is divided by a low ridge into two roughly parallel valleys. The road to the picnic grounds runs through the larger valley which lies to the southeast of the ridge. This valley is clearly the better watered of the two, for it contains big sycamores and junipers along the stream bed. These are absent in the smaller valley which lies on the northwestern side of the ridge. The di-

viding ridge has many shrubby live oaks on its southeastern slope. These are very abundant at the base of the ridge but thin out toward its crest. A few oaks cross the crest of the ridge into the smaller valley but most of this valley, particularly its slope which faces southeast, is dominated by numerous plants of *Agave palmeri.* As the agave plants are much less abundant in the larger valley, the two sides of the ridge present a very different appearance. Despite this striking vegetational difference the two areas are part of the same plant association. Shreve has pointed out (7) that in the southern Arizona mountains the evergreen oak forest is an open community with many other plants present, among them *Agave palmeri.* Shreve's view is fully supported as far as the ants in this area are concerned, for the same ants occur in the dense oak thickets and on the open slopes where the agave plants grow. In both these areas the soil is very stony, with many of the stones partly projecting above the surface. The nests of *ulcerosus* are usually situated under such partially buried stones.

Considering the abundance of the foraging workers, the nests of *ulcerosus* are extraordinarily difficult to find. Mr. Luther Little, who was camping with us, first called my attention to the workers of *ulcerosus* on the agave leaves. So many of the plants were visited by foraging workers that I thought that there would be little trouble in tracing them to their nests. Most ants readily accept termites offered to them and carry them at once to their nests. I repeatedly offered termites to the workers of *ulcerosus* which they accepted readily enough. But, instead of taking them home, they usually sucked the juices from the termite and remained on the agave leaf. In a few instances a worker would start home with the termite, but nothing came of this for the ant would soon drop the termite and return to the agave leaf. Although the slope of the canyon was covered with agave plants in all stages of development, the ants chose only those plants which had recently bloomed. Young plants were never visited, nor were the shrivelled remains of plants which had bloomed in previous seasons. The heavy panicle of fruit, towering ten to twelve feet above the leaves seemed the part most likely to attract the for-

agers. But the ants rarely ascended the fruit stalk. Instead they confined themselves largely to the upper surface of the leaves. The areas around the bases of the lateral spines and particularly the area at the base of the long terminal spine seemed especially attractive. A worker would often stand for many minutes at the base of the terminal spine, apparently licking some substance from the surface of the leaf. The explanation which best fits this behavior is the assumption that, during the fruiting period, the leaves of the agave give off a sugary substance which attracts the ants. This secretion cannot be produced by the younger plants as otherwise they would also be visited by the *ulcerosus* workers.

Since feeding methods had failed to reveal a nest, it seemed advisable to examine the soil in the immediate vicinity of the agave plants in the hope of finding colonies there. The difficulty was to get at the soil immediately beneath the plant. Any one who attempts to uproot a full-grown plant of *Agave palmeri* will soon have a healthy respect for the needle-sharp terminal spines. To get close to the roots of the plant it was necessary to 'dehorn' all the leaves on one side with a pocket knife. The plant could then be wrenched out of the ground with a pick. But the violence of this operation defeated the purpose for which it was intended. Tearing the roots out of the ground disturbed a considerable area of soil and badly displaced the stones in it. The result was to obliterate any nest passages present. The one fragment of an *ulcerosus* colony which was exposed in this fashion was so badly scattered through the soil that, for reasons already explained, I doubted that the female was that of *ulcerosus*. It then occurred to me, as should have been obvious sooner, that if this species customarily nests under agave plants, the nest should be present for at least a while after the plant has died. There were many dozens of dead agave plants on the side of the canyon. These consisted of a rosette of dried and shrivelled leaves with a central hole where the fruit stalk had been. The whole thing was comparatively light and easily handled. With a little care it could be lifted entire and tossed to one side without disturbing the ground beneath. I removed a

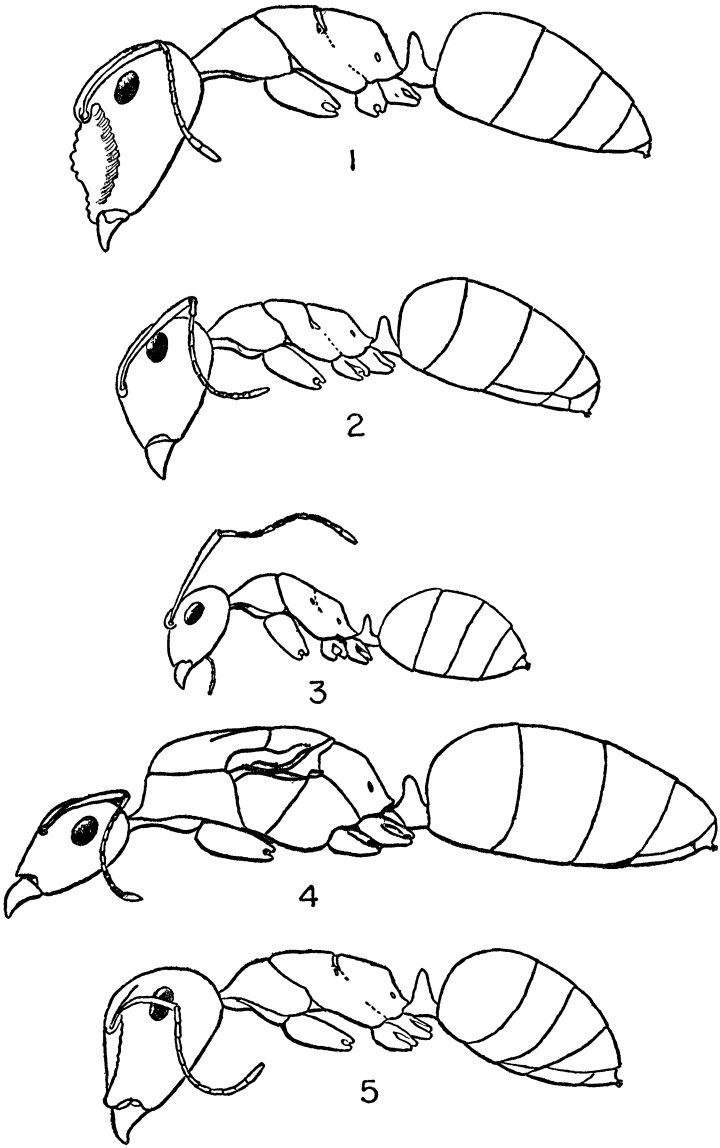
considerable number of these old plants and examined the soil beneath them. In no case did I find a nest of *ulcerosus*. But in fully half the cases the plant surmounted a flourishing colony of *Pheidole vaslitti arizonica*.

By this time I was convinced that *ulcerosus* does not usually found its nests beneath agave plants but as to where to look for them I had no idea. Then, largely through luck, I stumbled on five colonies. Three of these were situated in open areas on the agave slope but at some distance from the nearest agave plant. The other two were placed at the edge of oak thickets on the opposite side of the ridge. In every case the nest was situated on a slope that faced southeast . I was able to excavate three of these nests completely. I might have done so with the other two had I not lost contact with the passages through over-hasty excavation. Each nest consisted of a rather obscure entrance between stones which were embedded in the soil. In two cases there was a thin disc of excavated soil spread around the entrance but this was not present in the other nests. From the entrance a single, tortuous passage twisted through the soil between and under stones at a depth which was seldom more than six inches below the surface. At intervals, usually beneath the lower surface of a stone, the passage widened into a small, irregular chamber. In each of these were major, media and minor workers and some brood. The queen was usually taken in the last chamber at the inner end of the nest. As there was no telling which direction the passage would take, the soil had to be removed a bit at a time to avoid losing the passage altogether. However, the absence of any lateral passages considerably simplified matters. Because the excavation had to be made slowly, there was ample opportunity to secure foraging workers as they returned to the nest. I believe, therefore, that the figures for the three colonies given below represent most of the population in each case. In the first colony there were one hun-

---

EXPLANATION OF PLATE 5

Camponotus (*Myrmaphaenus*) *ulcerosus* Wheeler, Fig. 1. Ulcerate major worker. Fig. 2. Media worker. Fig. 3. Minor worker. Fig. 4. Female. Fig. 5. Non-ulcerate major worker. All figures to the same scale.



CREIGHTON — ARIZONA ANTS

dred and sixty-five minors and medias, six majors and one female. In the second colony there were sixty-four minors and medias, seven majors and two females. In the third colony there were one hundred and thirty-four minors and medias and ten majors. Unfortunately the female of this nest escaped capture. From the above it would appear that the colonies of *ulcerosus* are small, even when more than one female is present. It is also worth noting that all the brood taken in the three nests was in a fairly young condition. No pupae were found and, since the last nest was taken on July 27th, it seems safe to conclude that the marriage flight of *ulcerosus* must occur at the end of the summer or in the early fall.

LITERATURE CITED

1. WHEELER, W. M.
Ann. N. Y. Acad. Sci. Vol. 20, pp. 349-351, 1910.
2. WHEELER, W. M.
Psyche, Vol. 28, No. 1, 1921.
3. EMERY, CARLO
Genera Insectorum, Fasc. 183. 1925.
4. CREIGHTON, W. S.
Bull. Mus. Comp. Zool. Vol. 104, 1950.
5. WHEELER,W. M.
Bull. Mus. Comp. Zool. Vol. 77, No. 5, 1934.
6. BARNES, W. C.
Univ. Ariz. Bull. Vol. 6, No. 1 (Gen. Bull. No. 2) 1935.
7. SHREVE, F.
in Kearney & Peebles, U.S.D.A. Misc. Pub. No. 423, 1942.