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STUDIES ON ARIZONA ANTS.
2. NEW DATA ON THE ECOLOGY OF
APHAENOGASTER HUACHUCANA
AND A DESCRIPTION OF THE SEXUAL FORMS

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In 1932 the writer presented, in this journal, a description of the worker of *Aphaenogaster (Atto-myrrma) huachucana* (1). The type specimens came from a single nest taken at an elevation of about 7000 feet in Ramsey Canyon in the Huachuca Mountains. I expected that other workers would find additional material of *huachucana* and that this would permit a better evaluation of its status, for *huachucana* is clearly related to *texana*. Since the latter species is also present in the Huachucas, much might be learned from the way in which the two insects behave in that area. In 1950 I synonymized Wheeler's variety *furvescens* with *texana* (2). The variety *furvescens*, which was based on material coming from the Huachucas, had proven to be a color phase that occurs over the entire range of *texana*. The synonymy of this variety raised disturbing possibilities in the case of *huachucana*, for there was a chance that it might also prove to be an inconsequential variation of *texana* when better known. In order to test the significance of the structural features on which *huachucana* was based, more material was urgently needed. This material has now come to hand and with it field data which provide good evidence that *huachucana* is a separate species. In order for this evidence to be appreciated it is necessary

to discuss the range and ecological response of *texana* as well as those of *huachucana*.

It is impossible to give a concise account of the behavior of *texana* in the field. The species has a wide but discontinuous distribution in the southern United States. As far as can be determined all of the range of *texana* lies south of the 38th parallel and the great majority of it lies south of the 36th parallel. At this latitude, and south of it, the range extends from the Atlantic seaboard states to Arizona. This seems simple enough, but a careful examination of the stations in which *texana* has been taken will show that they have remarkably little in common. Thus, *texana* is abundant at sea-level in the neighborhood of Miami, Florida (Wheeler, Smith). It has been reported from damp woods at an elevation 1800 feet in the Great Smoky Mountains of Tennessee (Cole). It occurs in the foot-hills of the Appalachians in South Carolina (Smith) and northern Alabama (Creighton). It has been taken at an elevation of 900 feet on the plains of southern Kansas (Wheeler). It inhabits shady ravines in central Texas (Wheeler). It has been found on Bright Angel Trail below Indian Garden in the Grand Canyon (Wheeler). It is abundant at the 6000 foot level on sunny slopes in the canyons of mountains of southern Arizona (Wheeler, Creighton).¹ All these stations lie south of the 38th parallel, but I fail to see that there is any other feature which they share that could be cited as a reason why they were selected as nest sites by *texana*. Under such circumstances it appears hopeless to attempt a generalization which will cover the behavior of *texana* over its entire range. However the situation is by no means difficult if field observations are limited to a particular part of the range. For it seems that wherever this insect has been found in sufficient numbers to permit an adequate view of its behavior, this behavior has been surprisingly constant for the area involved. Thus, in the Huachuca Mountains the range of *texana* lies in the lower part of the evergreen oak belt which, on the northeastern

¹ *A. texana* also occurs in the northern part of the Sierra Madre Oriental. The writer has recently taken it on Chipingue Mesa (2400'-4200') and near Iturbide (2800') Nuevo Leon, Mexico.

slopes of the mountains, extends from the canyon mouths to an elevation of about 7000 feet.

This evergreen oak area is an interesting one. Shreve calls it a "western xeric evergreen forest in which oaks are dominant" (3). The term "forest" is apt to mislead those who expect a forest to consist of sizeable trees. It is only under especially favorable conditions that this association produces a forest in the popular sense. In certain areas, however, the evergreen oaks form groves in which the trees may be thirty or forty feet high. On the north-eastern slopes of the mountains the best stands of evergreen oaks occur at elevations of about 6500 feet. At higher elevations the groves become increasingly mixed with pines until, at an elevation of about 7000 feet, the pines replace the oaks. As one descends from the 6500 foot level most of the evergreen oaks decrease in size and at the 6000 foot level, and below it, they are usually stunted, bushy little trees not more than ten or twelve feet high and often much smaller. These little oaks frequently form dense thickets, but the thickets are seldom extensive and generally the evergreen oaks at the 6000 foot level are thinly scattered over the slopes which rise from the stream bottom. Along the stream bottom at this level groves are almost always present, but these consist of various deciduous trees and large junipers.

In the area just described I have observed several dozen nests of *texana*. The majority of the nests of this ant are situated between the 5500 and 6000 foot levels. The area selected is almost always a sunny, open slope, far enough away from the stream bottom to be out of the shade of the groves which occur there. As a rule the nests are placed so that they avoid even the scant shade furnished by the small evergreen oaks. Since the nests are often less than fifty yards away from areas of heavy shade, it seems clear that the nest-founding female prefers sunny places to shady ones. Above the 6000 foot level the incidence of the colonies decreases as the elevation increases. For practical purposes the upper limit of the range is reached about the 6500 foot level. I have found one nest of *texana* at an elevation of 6700 feet but the incidence of nests above

the 6500 foot level is very small and I feel sure that colonies founded above this level only rarely come to maturity. This rather abrupt termination of the range in the neighborhood of 6500 feet offers a marked contrast to the abundance of *texana* at lower levels. It should be noted that at these lower levels, and on the same slopes where the nests of *texana* occur, there is an extraordinarily rich ant fauna. Conspicuous in it are representatives of genera which are typically Sonoran (*Pogonomyrmex*, *Myrmecocystus*, *Xiphomyrmex*, etc.). It is true that these Sonoran elements are not as abundant in the evergreen oak belt as they are on the plains at the base of the mountains (where *texana* appears to be absent) but they are sufficiently well represented to give the lower part of the evergreen oak association a distinctly Sonoran character. It may, therefore be stated that, in the Huachuca Mountains, *texana* is associated with the Sonoran elements of the biota and shows little tendency to nest outside the area where the Sonoran representatives occur.

The association where *huachucana* is found is a wholly different one. This is Shreve's "northern mesic evergreen forest". This association occurs in various parts of Arizona and because its constituent plants vary somewhat with latitude, it is more difficult to characterize than is the evergreen oak association. In the Huachuca Mountains the northern mesic evergreen forest is predominantly a zone of pines. As noted above the lower edge of this pine belt mingles with the upper edge of the evergreen oak belt. At the 7000 foot level on the northeastern slopes the pines are the dominant element of the flora. At the 8000 foot level the stand of pine is frequently interrupted by aspen groves. These groves continue to the tops of the peaks but do not form a belt. According to Shreve the pines may be replaced by spruce and fir at elevations above 9000 feet. If this is true in the Huachucas the spruces and firs must be limited to a small area at the top of Miller Peak and Carr Peak. The five nests of *huachucana* which were found during the summer of 1950 were all situated between the 7000 and 8000 foot levels. The area in which they occurred lay between the head of Carr Canyon and the

lower slopes of Carr Peak. In this same area were taken representatives of typically northern ant groups (*Polyergus*, *Myrmica*, *Raptiformica*, *Camponotus* sen. str., *Stenam-ma*, etc.). Since the Sonoran elements of the evergreen oak belt are absent at these elevations, the ant fauna above the 7000 foot level has an entirely different character from that of the 6000 foot level. Its affinities are Transitional or Canadian and the presence of *huachucana* in this association offers a good demonstration that this insect belongs with the northern elements of the biota. It may be added that all the nests of *huachucana*, including the type nest, were situated on steep slopes. They were placed in shady aspen groves, in the lighter shade of pine groves or in full sun. Some were built in the soil under a covering stone, others in the soil which had accumulated between the stones in a rock slide. In view of the fact that *texana* is quite fussy about its nest sites, the greater tolerance of *huachucana* in this respect is surprising.

What is even more surprising is that the range of these two species should be so clearly separated by so small an amount of space. It should be plain from the discussion just presented that there is an elevational gap of some five hundred feet between the lower edge of the range of *huachucana* and the upper edge of the range of *texana*. The distance involved is such a minor one that it could not conceivably be a direct barrier to movement in either direction, particularly to winged females. We must suppose, therefore, that the gap between the ranges exists not because either species is unable to enter it but because, when they have done so, each species finds the area unsuitable as a situation for a successful nest. Both *huachucana* and *texana* (at least that part of its population which occurs in the Huachucas) have developed a degree of environmental restriction which isolates the two species as effectively as though their ranges were separated by hundreds of miles. In view of the actual proximity of the ranges one may inquire how this isolation can be maintained. There is every reason to believe that at the time of nuptial flight, many males and females of each species reach the range of the other species. If the nuptial flight

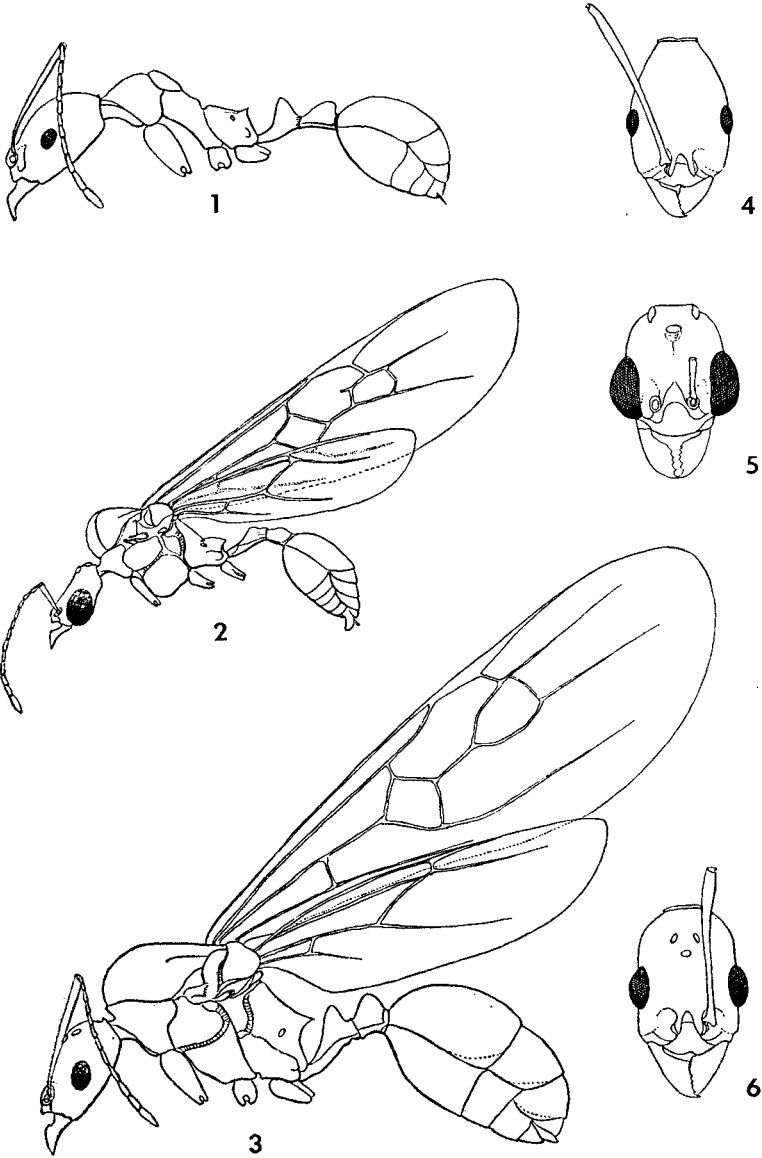
of *texana* coincides with that of *huachucana*, there would be ample opportunity for cross-fertilization and, if this occurred, the two populations would soon merge. The fact that the two populations show no sign of intergradation may be taken as proof that no cross-fertilization is occurring. If it can be shown that the nuptial flights of the two species take place at different times, one need look no further for the mechanism which maintains the two populations as separate entities. The evidence on this point is scanty but it seems significant nonetheless. One nest of *huachucana*, secured on July 24th, contained a few mature males and many mature females. There were no male or female pupae in this nest and only a few callows of the sexual forms. This leads me to believe that the nuptial flight was about to take place. If so, the marriage flight of *huachucana* must occur at the end of July or the first of August. During the month of July (7th-28th) a number of nests of *texana* were examined. No winged sexual forms were found in any of them. Either the nuptial flight had taken place before July 7th or it would be some weeks before the sexual forms matured, in which case the flight would come much later in the summer. In either case the nuptial flight of *texana* would not coincide with that of *huachucana*.

The descriptions of the male and female of *huachucana* which follow deal mainly with details of sculpture, pilosity and color. The general structural features of all three castes of this insect are shown in the figures on Plate 7.

Female: length; head (exclusive of mandibles) 1.6 mm.; thorax 3 mm.; total length 8-9 mm. Mandibles with fine and rather even longitudinal striae which spread slightly as they approach the masticatory margin. Clypeus and frontal area with slightly wavy, longitudinal rugae. Longitudinal rugae on the cheeks and front notably coarser and much more wavy. Longitudinal rugae immediately behind the

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EXPLANATION OF PLATE 7

Aphaenogaster (Attomyrma) huachucana Creighton. Fig. 1. Worker. Fig. 2. Male, wings on left side removed. Fig. 3. Female, wings on left side removed. (Figs. 1-3 to the same scale.) Fig. 4. Head of worker (drawn from type). Fig. 5. Head of male. Fig. 6. Head of female.



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frontal lobes without transverse connectives, not reticulate. Those rugae which are immediately lateral to this central band distinctly reticulate, as are most of those on the cheeks and genae. Rugae on the occiput confined to the area adjacent to the lateral ocelli. These occipital rugae are strongly reticulate, not longitudinal. Behind them is a band which extends to the occipital flange that is not reticulate but covered with piligerous punctures only.

Pronotum with wavy rugae whose direction is roughly parallel to the suture between the pronotum and the scutum. Scutum with very feeble rugae in front which become stronger toward the rear, particularly at the middle third of the scutum. These rugae continue across the paraptera and the anterior half of the scutellum but turn inward and become transverse on the posterior half of the scutellum. Epinotum transversely rugose, the rugae on the concave area above and between the epinotal spines more feeble than elsewhere. Mesothoracic sternite and episternite with feeble rugae, their surface more shining than the other thoracic sclerites. Petiole granulo-rugose, dull; postpetiole with few rugae and with feebler granulation than the petiole, particularly at the crest where it is rather strongly shining. Coxae and gaster strongly shining, the principal sculpture consisting of scattered piligerous punctures. The surface of the gaster also has an extremely delicate reticulate sculpture which is so fine that it can be seen only at high magnifications and in oblique lights. Appendages more heavily punctured and with their surface less shining than the coxae and gaster.

Erect hairs on the head, thorax and gaster golden in color and rather short. Fairly numerous on both the upper and lower surfaces of the head. About equally numerous on the scutum and the scutellum. Sparse on the pronotum and usually absent entirely on the mesothoracic sternite and episternite. Erect hairs on the petiole largely confined to the rear face of the node. Postpetiole with the erect hairs more evenly distributed, most of those on the dorsal surface distinctly longer than those on the ventral surface. Erect hairs evenly spaced over the entire dorsum of the first gastric segment. On succeeding segments the erect hairs are

largely or entirely confined to the rear edge of the segment. Erect hairs on the fore coxae longer than those anywhere else on the body. Femora with short, fine, erect hairs on their flexor surfaces, the hairs appressed on the lateral and extensor surfaces. Tibiae with the hairs appressed. Tarsi with very abundant, fine hairs which are appressed except on the flexor surface, where they are semi-erect. Antennal scapes with very fine appressed hairs. Funiculi with semi-erect hairs which become finer on the last four segments and form pubescence on the terminal segment. The entire insect without pubescence elsewhere.

Head, thorax, gaster and antennae an even, rich, reddish yellow. The legs clear yellow. Wings hyaline with iridescent reflections. The veins clear yellow, the stigma brown. Posterior edge of the wing evenly fringed with short, fine hairs.

Male: length; head (exclusive of the mandibles) 1 mm.; thorax 2.25 mm.; total length 5.5-6 mm.

Mandibles smooth, moderately shining, with numerous fine punctures. Clypeus and frontal lobes a little less shining than the mandibles, the punctures less distinct and tending to form longitudinal rows. Front and occiput feebly shining with a fine but dense reticulate sculpture over most of the surface except between the two lateral ocelli, where prominent transverse rugae are present. Entire thorax smooth and shining, largely without sculpture. Posterior half of the scutellum and the entire metanotum with a delicate, reticulate sculpture which dulls the surface to some extent. Posterior half of the epinotum rugose and coriaceous both on the basal face and on the sides. The suture separating the mesothoracic sternite from the episternite and that lying between the epinotum and the metathoracic epimeron crossed by coarse, widely separated rugae. A few of these rugae run out onto the surface of the adjacent segments. Petiole feebly shining, the upper surface evenly covered with fine punctures, the posterior face of the node and the ventral surface with three or four feeble longitudinal rugae. Postpetiole and gaster more strongly shining than the petiole, the surface covered with extremely delicate

and shallow punctures which are visible only at high magnifications.

Erect hairs yellow or whitish yellow, present on the clypeus, the gula, the space between the occipital angles and the posterior border of the eye and the ocellar triangle. Hairs on the mandibles much finer than those on the rest of the head. Erect hairs very sparse or absent over most of the thorax. Those on the scutum very short. A cluster of somewhat longer hairs is present on the scutellum. Petiole without erect hairs. Postpetiole with about six long hairs on its posterior dorsal surface and a few shorter ones on the ventral surface. Erect hairs evenly spaced over the entire gaster. Hairs on the legs for the most part very fine and completely appressed. A few erect hairs on the fore coxae and fore femora. Antennal scapes and the first eight funicular segments evenly covered with fine, semi-erect hairs which grade into pubescence on the last four segments.

Mandibles clear yellow; clypeus, antennae and legs yellow, infuscated very lightly and somewhat unevenly with brown. Head, except for the appendages, blackish brown. Thorax brownish yellow except for the scutum which is clear brown. Petiole, postpetiole and gaster brownish yellow. Wings as in the female.

The additional material of *huachucana* has brought up some points which should be mentioned here. The peculiar, narrowed rear of the head which is very apparent in the worker types (Plate 7, fig. 4) is not a uniform character. A number of workers of *huachucana* show a greater degree of convexity in the part of the head which lies between the occipital flange and the rear of the eye. Such workers approach *texana* closely in head shape. There is also considerable variation in the shape of the epinotal spines, although these spines in *huachucana* are never as thin and delicate as they are in *texana*. On the other hand, all the workers of *huachucana* which the writer has seen differ from those of *texana* in their larger size, their heavier and more rugose sculpture, in the more abruptly elevated rear edge of the mesonotum and in the prominent, triangular lobe at the base of the scape. These features seem to be thoroughly

reliable as separatory characters for the worker. Three of them will apply to the female as well. The female of *huachucana* is larger than that of *texana* (8-9 mm. in *huachucana*). It is also more heavily sculptured and possesses the same triangular lobe at the base of the antennal scape which marks the worker. In this connection it should be noted that the length given for the female of *texana* in Wheeler's 1915 publication (4) evidently included the wings. Wheeler gave the length of the female of *texana* as 11-11.5 mm. On the same page he gave the length of the dealated female of *furvescens* as 7.5 mm. Needless to say the second figure is the correct one for *texana* if, as is usually the case, the body length is what is being measured. The male of *huachucana* is larger than that of *texana* (4-5 mm. in *texana*, 5.5-6 mm. in *huachucana*). The scutum in the male of *huachucana* does not project so strongly above the pronotum. The basal face of the epinotum in the male of *huachucana* consists of descending anterior portion and a feebly convex posterior portion which form a distinct angle in profile (Plate 7, fig. 2). This face of the epinotum forms a single descending plane in *texana*.

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