NEW AND LITTLE-KNOWN SPECIES OF *PHEIDOLE* (HYMENOPTERA: FORMICIDAE) FROM THE SOUTHWESTERN UNITED STATES AND NORTHERN MEXICO

By William S. Creighton* and Robert E. Gregg†

In two papers published in 1908 and 1915, W. M. Wheeler first described a number of species of *Pheidole* coming from the southwestern United States. Forty new forms were recognized in these publications, and twenty-nine of these are considered valid at present. Since these two papers account for almost half of the *Pheidole* fauna of the United States, their importance cannot be minimized. But it may be stated, without belittling the magnitude of Wheeler's contribution, that a number of his descriptions were drawn from inadequate type material. When a species is based on fewer than a dozen specimens taken from a single nest, it is obvious that little can be said as to the constancy of the definitive structural characters or as to the environmental preferences of the species. Any statement about the range of such specimens is, of course, pure surmise. In Wheeler's 1915 publication this unfortunate situation was the rule rather than the exception, and it is not surprising that the status of several of our species of *Pheidole* has been problematical. The writers have attempted to deal with some of these difficult species in this paper, particularly those whose main range lies in northern Mexico. The paucity of records from this region has made it difficult to test the widely accepted belief that specimens coming from Mexico must be at least subspecifically different from those taken in south Texas and southern Arizona. Adequate material from northern Mexico often exposes the fallacy of this view. During 1952 and 1953 the senior author collected many colonies of *Pheidole* in northern Mexico.[1] These specimens have demonstrated the need for revision of certain species, and as the *Pheidole* fauna of northern Mexico becomes better known, it is probable that further revision will be necessary.

Pheidole barbata Wheeler (Fig. 1)

Ph. barbata Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 448 (1908) ♀♀.

This species was originally described from a single major and one minor taken by Wheeler near Needles, California. Wheeler later took other specimens near Yuma, Arizona. During April 1952, the senior author secured eleven colonies of *barbata* in the following localities in California:

* Professor of Biology, The City College, New York, N. Y.

† Associate Professor of Biology, University of Colorado.

[1] Fieldwork done on a Guggenheim Fellowship.

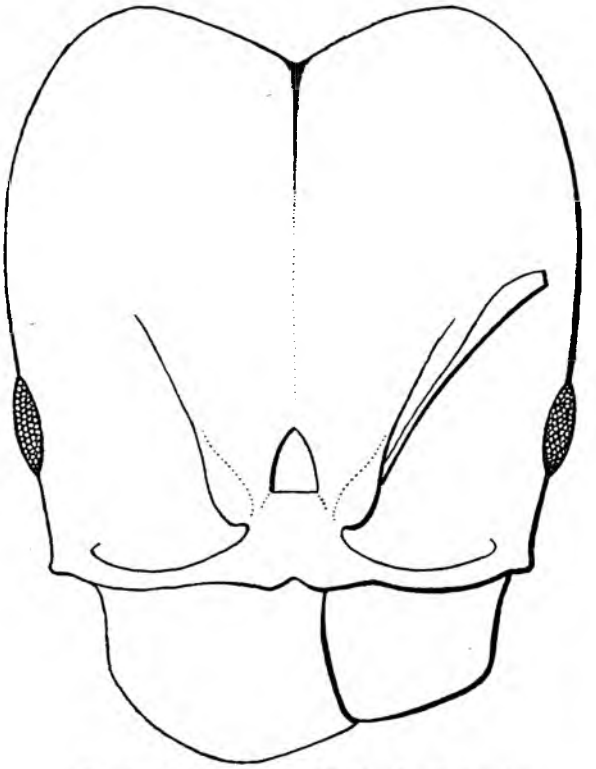

FIG. 1. *Pheidole barbata* Wheeler, head of major

Los Angeles County: Little Rock (2900′) 3 colonies.
Llano (3300′) 3 colonies.
San Bernardino County: Yermo (2200′) 1 colony.
Riverside County: Fried Liver Wash, Joshua Tree Nat. Mon. (1700′) 2 colonies.
San Diego County: Borrego Wells (300′) 2 colonies.

To judge from these colonies *barbata* prefers to nest in light, sandy soil, although it will also nest in coarse, hard-packed sand along the edges of arroyos. But no nest of *barbata* was ever encountered in loose sand. This is an interesting point in view of the fact that the closely related species *psammophila*, described in this paper, will, apparently, nest only in shifting sand.

No female was taken from any nest — a strong indication that no nest was fully excavated. The entire complement of the colony is, therefore, probably larger than the following figures indicate. Most of the nests yielded only three or four majors and two or three dozen minors. The largest nest (Borrego Wells) consisted of eleven ma-

jors and seventy-three minors. The nest of *barbata* is usually surmounted by a low crater from two to four inches in diameter. A chaff ring is sometimes present at the periphery, which shows that *barbata* is a harvester. It should be noted that *barbata* is equally at home in the Mojave Desert and in desert areas of much lower elevation south of the Mojave. Its distribution thus agrees with that of a number of xerophilous ants which occur both in the Mojave Desert and in the deserts around the head of the Gulf of California. As far as ants are concerned, there seems to be little justification for the view which Shreve and others have advanced that the Mojave Desert is a separate biotic area.

The definitive structural characters which mark *barbata* are discussed at the end of the description of the new species *psammophila* (see page 18).

Pheidole cerebrosior Wheeler (Fig. 2)

Ph. vinelandica subsp. *cerebrosior* Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 34, p. 405 (1915) ♀♀.
Ph. cerebrosior Creighton, Bull. Mus. Comp. Zoöl., Vol. 104, p. 175 (1950) ♀♀.

Ph. cerebrosior was described from a series of thirteen majors and ten minors taken by Wheeler near Tucson, Arizona, and was originally treated by him as a subspecies of *vinelandica*. The senior author proposed specific status for *cerebrosior* (Creighton, 1950) and has since seen no reason to change this view, although subsequent events have shown that the best definitive characters for *cerebrosior* are not those which were cited in 1950. At that time the major of *cerebrosior* was separated from that of

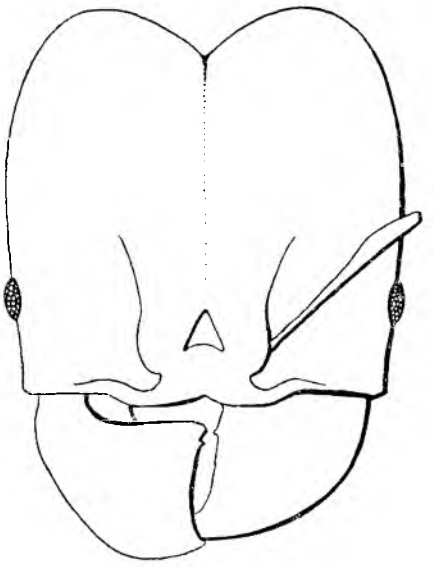

FIG. 2. *Pheidole cerebrosior* Wheeler, head of major

bicarinata, of which *vinelandica* is a subspecies, because of differences in the shape of the postpetiole. In the major of *cerebrosior* the postpetiole is ordinarily more strongly transverse and has much more prominent lateral connules. This distinction is still serviceable in most cases, but with the accumulation of much additional material for both species, it has become apparent that the shape of the postpetiole of the major varies enough in each species to make this character difficult to use for certain colonies. The difficulty does not arise from overlapping or intergradation but simply because extreme conditions in each species approach each other too closely to permit easy separation if the shape of the postpetiole is the only separatory feature employed.

A much better character for distinguishing *cerebrosior* from *bicarinata* is the structure of the clypeus in the major. In the major of *bicarinata* the anterior edge of the median lobe of the clypeus is distinctly notched. The depth of this notch varies, but each side always forms the inner half of the prominent angle which marks the junction of the median lobe with the lateral lobes. Since the lateral lobes of the clypeus recede rather sharply from the angles, the latter set off the median lobe very distinctly. The portion of the clypeus between the notch and the frontal area is free from carinulae except for one or two feeble rugae which run forward from the anterior end of the frontal lobes.

In the major of *cerebrosior* the anterior edge of the median lobe of the clypeus is broadly and feebly concave. This shallow, central concavity passes to the lateral lobes through two low, broad curves which cannot possibly be mistaken for angles. Hence the median lobe of the clypeus is not sharply set off from the lateral lobes, and the outline of the anterior edge of the clypeus is feebly sinuate. The entire upper surface of the median lobe of the clypeus is covered with carinulae, some of which usually swing in toward the midline.

Although these distinctions appear to be the most serviceable, there are other differences which separate the two species. In the major the outline of the promesonotum, seen in profile, is much more gibbous in *cerebrosior* than in *bicarinata*. The node of the petiole has a blunt crest in *bicarinata*, and this crest, when seen from behind, is entire or very broadly and feebly concave; in the major of *cerebrosior* the node of the petiole has a sharp crest, which, when seen from behind, is distinctly notched.

There follow the records for all specimens of *cerebrosior* which the writers have seen. Where no collector's name is given the specimens were taken by the senior author. Unless otherwise noted, a single colony was taken at each station:

ARIZONA: Tucson (type locality, W. M. Wheeler); Nogales (3900′)(L. F. Byars, 3 cols.); Huachuca Mountains, Palmerlee (W. M. Wheeler), Miller Canyon (L. F. Byars); Fry (5000′); Baboquivari Mountains, Forestry Cabin (3500′), Brown Canyon (3600–4200′) 3 cols.; Hasayampa River, 5 miles south of Wickenburg (1800′) 2 cols.

CALIFORNIA: San Diego County, Boulder Oaks (3100′)
BAJA CALIFORNIA: 10 miles east of Tecate (2100′)
CHIHUAHUA: Sierra de en Medio, Nogales Ranch (5000′)
NEW MEXICO: Animas Mountains, San Luis Pass (5400′)

These records show that *cerebrosior* nests more frequently in mountain canyons than on the open desert. It seems to prefer the evergreen oak association. All the colonies of *cerebrosior* which the senior author has examined have been small ones, seldom containing more than a dozen majors. In some nests only three or four majors were present. If the colonies of *cerebrosior* are always small, as seems probable, this fact gives a field difference which distinguishes *cerebrosior* from *bicarinata*, for the fully developed colonies of *bicarinata* are more populous. It also seems clear that the two species have a different elevational range. The lowest elevation for *cerebrosior* recorded to date is 1800 feet, the highest 5800 feet. For the western representatives of *bicarinata* most of the range lies between 3500 feet and 7000 feet, but occasionally colonies have been reported from much higher elevations (Cole, 1953). It seems safe to assume that *cerebrosior* is a harvester but no positive proof of this has been forthcoming.

Pheidole gilvescens Wheeler

Ph. xerophila subsp. *tucsonica* var. *gilvescens* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 448 (1908) ♀; Creighton, Bull. Mus. Comp. Zoöl., Vol. 104, p. 192 (1950).

Several of the reasons for reinstating *gilvescens* and for raising it to specific rank are given in the discussion of *Ph. xerophila* (see page 38) and need not be mentioned here. The writers are aware that the structural differences which separate *gilvescens* from *xerophila* are not large. But in this case the important consideration is the constancy of the differences, not their magnitude. Prior to 1950 there was so little *gilvescens* material available for study that any statement as to its taxonomic status was largely surmise. In the original description of *gilvescens* Wheeler observed that it was difficult to decide whether the variety should be assigned to the typical *xerophila* or to the subspecies *tucsonica*. The intermediate character of the thoracic sculpture of the major was cited in this connection. The senior author accepted Wheeler's views on *gilvescens* in large part in 1950 but proposed that the form be suppressed as a synonym of the typical *xerophila*, since giving names to intergrades is impractical. It is unfortunate that more material of *gilvescens* could not have been examined before that proposal was made, for such material would have exposed the fallacy of considering *gilvescens* an intergrade. As is shown below, the typical *xerophila*, the subspecies *tucsonica*, and the sibling species *gilvescens* each has its own distinctive type of thoracic sculpture in the major, and that of *gilvescens* is not intermediate.

In the major of *xerophila xerophila* all of the transverse rugae on the thorax are

fine, and most of them are limited to the descending anterior face of the pronotum and the part of the neck adjacent to it. The dorsum of the pronotum may have a few delicate, close-set striae just behind the descending anterior face, but most of the dorsum is smooth with the sculpture largely confined to feebly coriaceous areas near the humeri. These coriaceous areas may also have a few short, fine rugae present, but such rugae do not cross the dorsum. The dorsum of the mesonotum usually has some coriaceous sculpture present and in certain specimens it may be largely coriaceous. But none of this sculpture is coarse, and most of the areas where it occurs are moderately shining. These with the more strongly shining unsculptured parts of the thoracic dorsum produce an appearance entirely unlike that of the heavily sculptured and almost opaque thoracic dorsum of *xerophila tucsonica*.

In the major of *tucsonica* not only is the descending anterior face of the pronotum crossed by transverse rugae but there are also coarse, reticulate rugae which cross the dorsum of the pronotum and often that of the mesonotum as well. The areas between these rugae are so heavily coriaceous as to be almost granulose, and the entire surface is opaque or nearly so. The only light reflected is from small, scattered points, and the appearance of the thoracic dorsum is notably rough and dull as compared with that of *xerophila xerophila*.

In the major of *gilvescens* there are transverse rugae on the pronotal dorsum, but these are few in number and not notably reticulate. Both they and the transverse rugae on the descending anterior face are spaced out (close-set on the descending face in the other two forms) with both the rugae and the surfaces between them strongly shining. What little coriaceous sculpture is present does not appreciably dull the surface, except at the lower end of the descending anterior face. It follows that the major of *gilvescens* is the most shining of the three, and while the transverse rugae on the thoracic dorsum of *gilvescens* are more numerous than those of *xerophila xerophila* and less numerous than those of *xerophila tucsonica*, their arrangement is different from those of either of the other two forms.

In addition to the sculptural differences just discussed, the head of the major of *gilvescens* is shorter than that of the typical *xerophila* and that of its subspecies *tucsonica*. Measured from the most anterior point on the clypeal border to the most posterior level of the occipital lobes, the head of the largest major of *gilvescens* is 1.5 mm. in length against 1.7 mm. for the other two forms. Since the head of the *gilvescens* major is almost as broad as that of the other two forms, the cephalic index of *gilvescens* is 98–99 against 90–91 for the typical *xerophila* and its subspecies *tucsonica*. The epinotal spines of the major of *gilvescens* are shorter than those of either *xerophila xerophila* or *xerophila tucsonica* and they are not erect, as are those of the other two forms. The postpetiolar connules of *xerophila tucsonica*, and especially of the typical *xerophila*, are well developed, whereas the postpetiole of *gilvescens* is trapezoidal, and its lateral angles do not form connules.

Similar considerations apply to the minor of *gilvescens* which has a completely smooth and shining pronotal dorsum with the only sculpture on the promesonotum limited to a coriaceous area on the descending anterior face and the neck and another near the meso-epinotal suture which grades into the granulate pleura at either side. This type of sculpture is sometimes found in the minor of *xerophila xerophila*, but in such cases the dark color of the minor of the typical *xerophila* will easily distinguish it from the minor of *gilvescens*. In most minors of the typical *xerophila* there is some coriaceous sculpture on the pronotal dorsum, and in many minors of the subspecies *tucsonica* the entire promesonotum is coriaceous. It seems worth noting that while the epinotal spines of the minor of *gilvescens* are sometimes reduced to tiny denticles, they are not always small and acute, as Wheeler supposed. There are so many minors of *gilvescens* in which the epinotal spines are indistinguishable from those of *xerophila* and *tucsonica* that the length or shape of the epinotal spines in the minor is a feature of scant separatory value.

The matter of color has been reserved until last, since this feature is so rarely a satisfactory distinction for ants. It appears, however, that the color of *gilvescens* is one of the few exceptions to the rule. Wheeler was not correct in stating that the subspecies *tucsonica* is invariably darker than the typical *xerophila*, for both ferrugineous and blackish red individuals occur in both races. But he was correct in pointing out that the gaster of the major of *gilvescens* is concolorous with the rest of the insect. Thus, although the deep golden yellow color of the major of *gilvescens* may closely approach that of the ferrugineous individuals found in some nests of *xerophila* and *tucsonica*, the latter always have the gaster partly or completed infuscated and notably darker than the head and thorax. An equally clear color difference marks the minor of *gilvescens*, which is usually light golden yellow throughout, but more rarely has the head lightly infuscated with brown. But this is the closest approach to the deep piceous brown or black color that marks the minor of both the typical *xerophila* and the sub-species tucsonica.

The type specimens of *gilvescens*, which appear to have been strays, came from Phoenix and Tucson. The insect is quite scarce in both stations, its main range lying further west as the following records show:

ARIZONA: Organpipe Cactus National Monument, Headquarters (1600′); Growler Mountains, Abra Wash (1300′); Quitobaquito (900′); 5 miles east of Aguila (2200′).

CALIFORNIA: 21 miles east of Indio (1600′); 9 miles north of Llano (2800′); Bartlett (3700′); Yaqui Well, Anza Desert State Park (1300′); Borrego Wells (300′).

A single colony was taken by the senior author in each of these stations except at Abra Wash in the Growler Mountains, where eight colonies were secured. The nests of *gilvescens* are invariably small, often containing no more than half a dozen majors and two or three dozen minors. The insect shows little tendency to forage in files, and the majors rarely leave the nest. Presumably *gilvescens* harvests seeds, but no positive data on the feeding habits of this species were obtained.

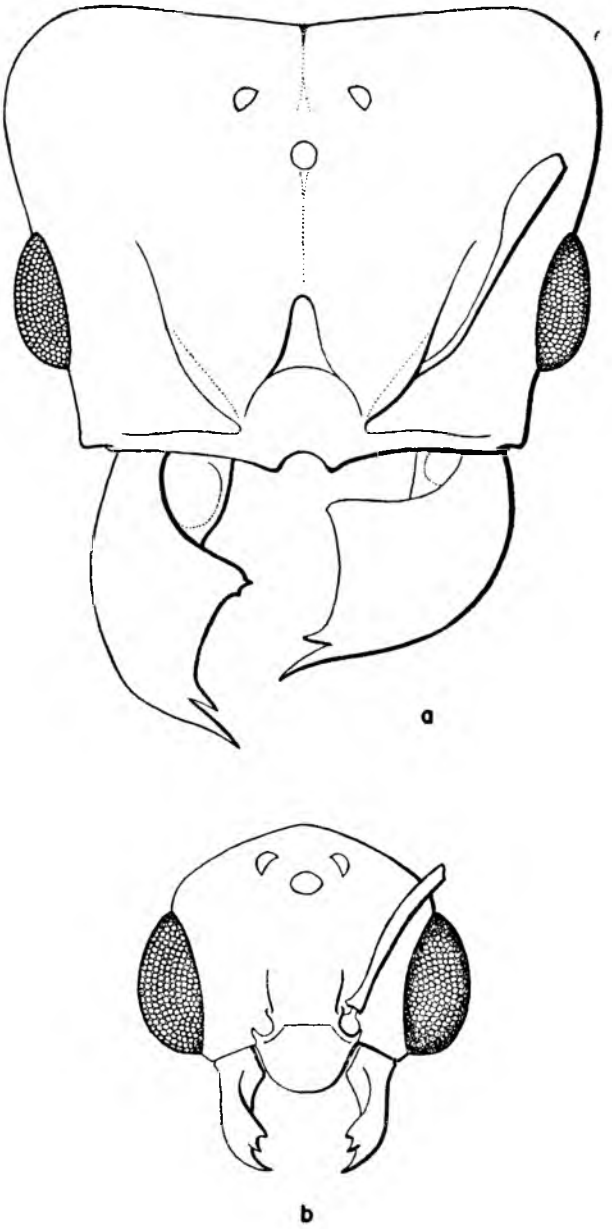

FIG. 3. *Pheidole militicida* Wheeler: a. head of female, b. head of male, (both drawn to the same scale).

Pheidole militicida Wheeler (Fig. 3)

Ph. militicida Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 398 (1915) ♀ ♀.

This species is included to permit the description of the hitherto unknown sexual forms (*vide infra*). It also seems advantageous to review the remarkable hypothesis which Wheeler appended to his original description of *militicida*. The worker types of *militicida* were taken by Wheeler near Hereford and Benson, Arizona, on November 10, 1910. At that time Wheeler found no majors in the nests but observed their remains on the chaff piles. The major types of *militicida* were secured by W. M. Mann in the Benson area a year or so later, during the month of August. Since Mann found majors in the nests during August and Wheeler found only their remains on the chaff piles in November, Wheeler stated that this species kills the majors at the end of the harvesting season! His explanation for this startling view was as follows:

"It appears, therefore, that all the individuals of this caste (the majors) are regularly killed off by the workers on the approach of winter, probably after they have broken open all the hard seeds collected by the workers. Such a slaughter of the members of a large caste during the season when their activities are no longer required, when they would simply be a burden on the colony by consuming stored food and when fresh food cannot be collected, must have great advantages. Although I have never noticed this behavior in other species of *Pheidole*, I believe that a study of the harvesting species with very large-headed soldiers in the deserts of the southwest may bring other similar cases to light."

While we admire the ingenuity of Wheeler's theory, we believe that it is incorrect on every count. The primary objection to Wheeler's postulate is that the harvesting species in the southwestern deserts do not terminate their seed-gathering activities in early November. On the contrary, that month is a very active period of harvesting. But if Wheeler's theory is accepted, it must be believed that his *militicida* colonies brought in the entire winter supply of seeds, hulled them and killed off the majors prior to November 10th. It is possible that *militicida* behaves in this fashion, but such behavior certainly does not apply to most of the harvesters in the southwestern deserts. The senior author has ample evidence that several species of *Pheidole* with large-headed majors (*vaslitti*, *tepicana*, etc.) not only overwinter the majors in the nest but also harvest seeds throughout the winter although, of course, much more sporadically than in the fall.

Since Wheeler was incorrect in his broader generalization, we need only consider the possibility that the behavior of *militicida* constitutes a special case. The writers believe that the "extensive" excavation of the Benson and Hereford colonies of *militicida* failed to reveal the presence of majors because the excavations were not carried far enough. In 1953 Dr. A. C. Cole published data on a number of nests of *militicida* which he studied near Bayard and Deming in southwestern New Mexico,

and in addition has very kindly supplied us with unpublished information on these colonies. Of a total of thirty-seven colonies which he excavated, majors were taken in thirteen; none were secured in the remaining twenty-four colonies, although here again the excavations were said to be "complete". Thus, more than half the colonies appeared to lack majors, but Dr. Cole wisely allowed for the fact that they might have been missed despite the thorough excavation. In our opinion this was certainly the case, for Dr. Cole examined his nests on August 16th, when the harvesting season had barely begun, as was indicated by the presence of thin chaff piles near the nest openings. These chaff piles furnish good evidence that seed-hulling majors were present in the nests, even though they were not found. Finally, it should be remembered that neither Wheeler nor Cole took a female in any colony which they dug out. Hence, it seems safe to assert that no colony was fully excavated by either investigator.

But if the colonies were partially excavated, then the only evidence which Wheeler had to support his theory of the massacre of the majors was the presence of their remains on the chaff piles of the nests. The writers are convinced that a much more plausible explanation for these remains can be supplied. Most of the range of *militicida* lies in a region of light winter and heavy summer rains. In the mountains of southeastern Arizona as much as eighty per cent of the total annual rainfall occurs during the period from July 1st to September 15th. These summer rains produce an astonishing growth of desert grasses during the months of July and August. The seeds of some of these grasses ripen by the end of July, and from that time until the middle of September there is a steady increase in the volume of seeds available. With the cessation of the summer rains in mid-September the desert grasses cease to grow and rapidly turn brown. But the seeds which they have produced in quantity are more readily available to the harvesters at this time than at any other period, for seed-gathering is no longer hampered by rain. As a result, the period from the middle of September to the end of November is the peak of the harvest. Large quantities of seeds are brought into the nests and the chaff piles become very extensive, not only because many hulls are being placed on them but also because they are no longer matted down or dissipated by rain. Even in small colonies the chaff pile may extend several inches from the nest entrance. This fact, coupled with the loose texture of the chaff, insures that anything brought out of the nest and discarded is virtually certain to be retained on the surface of the pile. Under such circumstances it might be expected that the remains of dead members of the colony would accumulate on the chaff pile. It is also likely that the mortality rate in the colony is high during the peak of the harvesting season, as is the case with bees during the period of maximum honey flow. But to cite this accumulation of remains as proof that the majors have been slaughtered by the minors is altogether another matter. Final proof in this case will involve the total excavation of nests of *militicida* during the winter months.

When this is done the writers are confident that majors will be found in them. The descriptions of the sexual castes of *militicida* are as follows:

Female: Length, 10.96–11.50 mm.; head length (excluding mandibles), 1.79–1.92 mm.; head index, 1.28; thorax length, 3.42–3.58 mm.

Head distinctly broader than long (mandibles excluded), with the widest portion posterior to the eyes; occipital corners prominent and slightly angular, posterior margin of the head concave but the resulting depression very shallow and the cephalic furrow or sulcus indistinct. Sides of head decidedly convergent toward the insertions of the mandibles; general dorsal surface and the gula also, convex. Frontal area depressed. Frontal carinae low, widely divergent and only slightly projecting over the antennal insertions. Clypeus almost flat, ecarinate, median lobe projecting and bearing a broad emargination; lateral lobes entire and straight. Compound eyes convex and placed slightly anterior to the middle on the sides of the head. Ocelli large but quite sessile. Antennal scapes curved at the base but not flattened; incrassate distally, and extending almost ⅔ the distance from their insertions to the occipital corners of the head. Funicular clubs well defined, three-segmented. Mandibles stout, evenly curved, and sharply bidentate; apical tooth long and delicately curved outward; second tooth and incisor edge sharp.

Thorax broadest at the insertions of the forewings, only a little narrower than the head. Prothorax vertical. Dorsum of mesonotum slightly convex in profile, the mesoscutum merging with the scutellum in a hardly perceptible curve; the scutellum stands only slightly above the metanotum. Parapsidal furrows distinct. Epinotum broadly convex except for a median groove in which the basal and declivious faces merge through a gradual curve; epinotal spines represented by low but fairly sharp ridges. Petiolar peduncle stout and not distinctly separated from the node; crest and sides of node ending in a rather sharp ridge which is broadly notched dorsally; posterior peduncle poorly defined. Postpetiole fully 1½ times as wide as the petiole; anterior surface convex, sides produced into prominent connules whose posterior surfacee are concave; connular ridges proceed dorsally but give way to a median depression. Gaster oval and of the usual contour. In addition to the large spiracles opening on the epinotum, there are easily visible pairs on the sides of the petiole, the postpetiole, and the first three of the four exposed gastric segments.

Sculpture: Cephalic sculpture dilute; occiput, vertex, gula, and most of the frons smooth and shining, except for large piligerous punctures which do not reduce the gleam. Fine striae are discernible on the posterior faces of the occipital lobes, and fine divergent striations on the lower frons parallel the carinae but disappear before reaching the level of the ocelli. Median lobe of clypeus smooth and shining, lateral lobes crossed by rugulae which continue into the antennal insertions and onto the genae anterior to the eyes; genae smooth behind the eyes. Mandibles smooth and shining, finely punctate. Entire pronotum, mesonotum and mesopleura smooth and shining, metanotum finely and transversely striate, subopaque; dorsum of epinotum striate and granular but still quite shining; pleura and declivious face of epinotum with irregular rugulae and interrugal granules, subopaque. Petiole and postpetiole finely granular, weakly shining to subopaque. Gaster smooth and shining, in part delicately shagreened.

Pilosity: Hairs rather dense, long, pointed, yellowish, and covering almost all surfaces of the body, including the eyes. Hairs longest on the gula, crest of petiole and postpetiole, and the posterior end of the gaster. Pubescence absent except on the funiculi, prothorax, and coxae.

Color: Head ferrugineous, mandibles darker red, antennae yellowish brown; thorax ferrugineous except for posterior mesoscutum and the scutellum which are brown; petiole and postpetiole reddish and gaster reddish brown; wings hyaline, veins and stigma yellowish; one closed discoidal cell.

Gynetype: An alate female collected at Safford, Arizona, at an elevation of 3000 feet, on July 6, 1950, by W. S. Creighton. Fourteen other winged females are included in the series, and also eleven majors, eighteen minors, and thirteen males.

Male: Length, 7.46–8.00 mm.; head length (excluding mandibles), 1.04–1.08 mm.; head index (excluding the eyes), 1.0; thorax length, 2.58–2.67 mm.

Head as wide as long, excluding the compound eyes which are very large, convex, protruding, and cover nearly the entire lateral surfaces of the head; occipital margin entire and evenly convex; ocelli large, prominent, and situated on a broad protuberance of the vertex. Frons with a "T"-shaped crease in the middle below the median ocellus. Frontal area flat. Clypeus convex, lateral lobes much smaller than the median lobe, the latter with a distinct transverse furrow. Frontal carinae rather indistinct and not covering the antennal insertions; antennal articulations not depressed. Scapes long, slightly and evenly curved at the base, equal in length to that of the first five funicular segments; antennae 13-segmented, first funicular article subglobose. Mandibles small and weak, tridentate.

Thorax fully 1½ times as broad as the head. Parapsidal furrows and the anterior limbs of the Mayrian furrows distinct. Mesoscutum large, slightly overarching the pronotum, gradually and evenly convex. Scutellum flat, except that where it and the pre-scutellar plates join the mesoscutum, the surface is depressed; metanotum slightly below the level of the scutellum. Epinotum rounded in all directions, base and declivity confluent without demarcation; spines reduced to low rounded bosses. Petiole and postpetiole very stout; peduncle of the petiole only imperfectly differentiated, the node ridged laterally and the dorsal surface shows a decided concavity; postpetiole 1½ times as wide as the petiole, connules absent, anterior face vertical, and posterior face showing a broad junction with the gaster, as there is no peduncle. Gaster of the usual shape, five segments visible dorsally; cerci minute, hairy; stipes of moderate size, not prominent.

Sculpture: Dorsal surface of head covered with irregular striae and rugulae except for the center of the frons and the median lobe of the clypeus which are rather smooth and shining; most of head subopaque, genae opaque and very dull, gula striate and granular. Prothorax, dorsum of mesothorax and the mesopleura for the most part smooth and shining. Metanotum granular; metapleura, epinotal pleura and dorsum rugulose and granulose, opaque to subopaque. Petiole and postpetiole faintly rugulose and granular. Gaster smooth and shining.

Pilosity: Hairs like those on the other castes, but somewhat sparse and on the whole shorter; present on almost all parts of the body, including legs and antennae; gular hairs relatively long.

Color: Head very dark brown; prothorax and mesoscutum dark brown except for the anterior median border of the latter which is light brown; scutellum, epinotum, petiole, postpetiole, and gaster brown; legs, antennae, mandibles, genitalia and cerci yellow; wings hyaline, stigma yellowish, veins pale yellow; one closed discoidal cell.

Androtype: A male selected from the series of males, females, workers, and soldiers collected at Safford, Arizona, on July 6, 1950, by W. S. Creighton.

Pheidole pinealis Wheeler

Ph. pinealis Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 24, p. 495, pl. 27, fig. 38 (1908) ♀♀.

It is gratifying to report the discovery of three nests of this species which, since the time of its description in 1908, has been known only from the type material. *Ph. pinealis* was described from eleven majors and one minor which Wheeler found nesting beneath a stone in Limpio Canyon about ten miles west of Ft. Davis, Texas. In 1952 the senior author took a colony of *pinealis* in the Sierra de la Muralla

(4000′), forty miles south of Monclova, Coahuila. Soon afterwards two other nests of *pinealis* were taken in an upland valley (5800′), in the mountains five miles south of Arteaga, Coahuila. The elevation of the type locality cannot have been less than 4800 feet, since the mouth of Limpio Canyon has that elevation, and it seems probable that the vertical range of *pinealis* is comparatively limited. The colonies taken in Coahuila were under stones, and no store of seeds was found. It may be recalled that the type nest of *pinealis* contained many seeds. Their absence in the three colonies cited above may be due to the fact that these nests were excavated in February, a month when there is seldom much foraging activity in harvesting species.

The additional material of *pinealis* permits the clarification of a number of points which were obscure because of the limited amount of type material. The colonies of *pinealis* appear to be small. The nest taken in the Sierra de la Muralla consisted of fifteen majors and thirty-three minors. Those taken near Arteaga consisted of eight majors and twenty-four minors in one nest and twenty-one majors and thirty-six minors in the other. Wheeler described the color of the major of *pinealis* as "ferrugineous brown" with a clearly defined, dark brown or black "saggitate blotch" on the middle of the head. It appears that this blotch shows clearly only in the lighter-colored majors and that their color may vary within the colony from a rich golden yellow to piceous brown. There is also variation in the thoracic sculpture of the major. As Wheeler stated, some have only sharp, transverse rugae crossing the otherwise shining pronotal dorsum, but in other specimens the rugae are diagonal and somewhat obscured by coriaceous sculpture which not only occurs between the rugae but also extends forward onto the neck of the pronotum. The head length of the major of *pinealis* also varies. In the largest major the head (mandibles excluded) is approximately 1.33 mm. in length, while that of the smallest major measures about 1.10 mm. The head of the smallest major is more nearly quadrate; hence the reduction in the length of the head is not accompanied by a comparable reduction in its width. This fact has a bearing on certain points made by Wheeler in the original description of *pinealis*.

Wheeler considered that *pinealis* is closely related to *vinelandica*, a subspecies of *bicarinata*, and anyone who has compared the two insects would certainly concur with this view. But the three points of difference which Wheeler cited as distinguishing the major of *pinealis* from that of *vinelandica* were that in the former species the head is larger, the postpetiole has prominent pointed connules, and there is a black patch on the vertex. Since neither color nor head length will distinguish these two insects, all that is left of Wheeler's distinctions is the shape of the petiole. There are, however, other differences which Wheeler failed to record.

The anterior margin of the clypeus is sinuate in the major of *pinealis* and lacks the angle at either side of the median impression which marks the clypeus of *bicarinata*. Since essentially this same situation occurs in *cerebrosior*, the reader is referred to the

discussion given under that species (see page 4). The frontal lobes of the major of *pinealis* converge much less abruptly than do those of *bicarinata*. In certain majors of *pinealis* the outer margins of the frontal lobes are almost parallel. The sculpture in the region between the eye and the frontal lobe is different in the two species. In both this area is covered by prominent, longitudinal rugae but in the major of *pinealis* the surface between these rugae is very lightly sculptured at best. When present this sculpture consists of a few delicate, scattered rugules which are hard to see and which do not dull the surface appreciably. The cephalic sculpture of the major of *bicarinata* varies considerably, but even in the lightly sculptured individuals there are always enough rugules in the area between the eye and the frontal lobe to dull the surface between the longitudinal rugae. Ordinarily this area bears not only rugules but conspicuous punctures as well, and in such cases it presents a rough, rather dull appearance which is notably different from that of *pinealis*. There is also a difference in the arrangement of the epinotal spines in the major of the two species, but this difference is deceptive because of variation in the epinotal structure of both species. In most majors of *pinealis* the dorsum of the epinotum descends very little from the meso-epinotal suture to its junction with the declivious face. In such cases the line marking the long axis of the epinotal spine makes a right angle with the dorsum of the epinotum. More rarely the epinotal spines are tilted slightly to the rear, and this condition approaches that which is the rule in *bicarinata*. In the major of *bicarinata* the dorsal face of the epinotum usually slopes rather strongly from the meso-epinotal suture to its junction with the declivious face. The epinotal spines are invariably tilted to the rear, sometimes so much that they scarcely rise above the epinotal dorsum. They are also usually shorter than the spines of *pinealis*, but in the event that they are long the axis of the spine forms an obtuse angle with the dorsum of the epinotum.

Wheeler stated that the minor of *pinealis* is less hairy and more uniform in color than that of *vinelandica*. Neither of these distinctions will hold if the entire range of variation in *bicarinata* is considered. Indeed the resemblance of the minor of *pinealis* to that form ordinarily assigned to *bicarinata buccalis* is so close that no satisfactory separation seems possible.

No definite conclusion as to the status of *pinealis* can be reached until more material is available. As things stand at present the insect might be considered either a southern race of *bicarinata* or a sibling species. For *pinealis* ranges well to the south in Coahuila, a state from which *bicarinata* has not yet been reported, and its presence in the northern end of the Sierra Madre Oriental is a strong indication that it may also occur in similar mountain valleys in southern Nuevo Leon and northern San Luis Potosi. This region is very difficult of access at present, but this cannot be said of the northern end of the range of *pinealis*, which lies in an area repeatedly collected by myrmecologists. These collections have produced no additional specimens

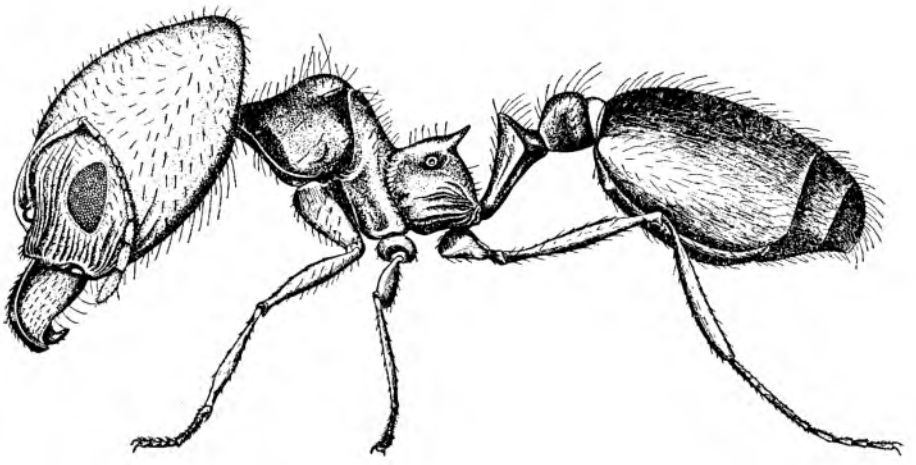

FIG. 4. *Pheidole psammophila* sp. nov., major

of *pinealis* nor any evidence of intergrades between it and *bicarinata*. The probabilities are, therefore, that *pinealis* is a distinct species and not a southern race of *bicarinata*.

Pheidole psammophila sp. nov. (Figs. 4 and 5).

Major: Length, 4.84–5.40 mm.; head length (excluding mandibles), 1.58–1.83 mm.; head index, 0.96; thorax length, 1.33–1.50 mm.

Head, not including the mandibles, practically quadrate, but with pronounced occipital lobes and a deep posterior emargination descending to a well marked, median cephalic furrow, which though becoming faint anteriorly, does extend to the frontal area. Frontal carinae well developed, diverging posteriorly, and disappearing as traces near the middle of the head; carinal lobes distinct and covering the antennal insertions. Frontal area triangular but with anterior margin concave, depressed. Clypeus narrow, the lateral lobes ridgelike, and the anterior border sinuate; median lobe lacks an emargination. Eyes moderate in size, convex, polygonal in shape, fully lateral, and placed anterior to the middle of the head. Head broadest behind the eyes, converging slightly to the mandibular insertions. In profile, the occipital lobes rather pointed, vertex flat, frons and gula convex, antennal fossa pronounced. Antennae 12-segmented; scape extending only ⅔ the distance from the clypeal to the occipital border; base of scape narrow, distinctly curved but not flattened, apex swollen; funicular segments 1–8 longer than broad, especially the first; club well differentiated and composed of three segments. Mandibles heavy, bluntly bidentate apically, evenly curved, incisor edge sharp, condyles conspicuous.

Thorax, through the pronotum, about one half as wide as the head, remainder narrow. Humeral angles prominent and slightly overhanging. Dorsal profile of pronotum concavo-convex, very high; mesonotum straight but descending at a steep angle to the meso-epinotal suture which is decidedly impressed, making the thorax definitely saddle-shaped and constricted; base of epinotum faintly convex, declivious face almost flat and perpendicular, so that the angle between it and the base is 90°; epinotal spines prominent, rather sharp, extending upward and backward. Petiole moderate in length, biconcave laterally, widest through the node, superior border of the

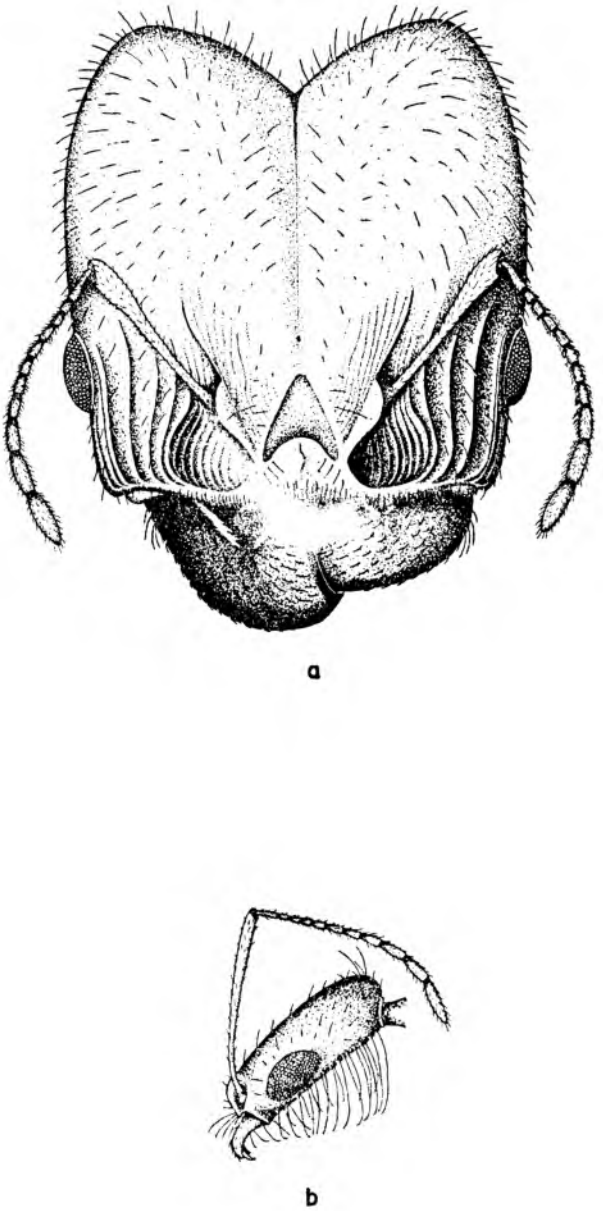

FIG. 5. *Pheidole psammophila* sp. nov.: a. head of major, b. head of minor, (both drawn to the same scale).

node with shallow notch, anterior slope gradual and merging imperceptibly with the peduncle, posterior slope abrupt and convex in its upper half; no ventral spine. Postpetiole subglobose, not quite twice the width of the petiole, broadest toward the rear but lacking any indication of lateral connules. Gaster of the usual myrmicine shape, three segments visible, anterior lateral angles moderate.

Sculpture: Vertex, occiput, and gula very smooth and shining, the sculpture consisting only of piligerous punctures; frons striate, genae rugose-granulate, the rather wide interrugal spaces bearing fine punctures and granules which do not obscure the shining surface; frontal area smooth; clypeus with a weak median carina, median lobe smooth, lateral lobes granulate. Prothorax smooth and shining dorsally and laterally, mesonotum smooth and shining, mesopleura granular and subopaque, basal and declivious faces of epinotum granular, epinotal pleura granulo-rugose, subopaque. Petiole and postpetiole granular and subopaque on all surfaces. Gaster smooth and shining with only piligerous punctures.

Pilosity: Abundant, long, pointed, flexible hairs covering practically all surfaces of the body, including the legs, scapes, and funiculi. Eyes hairless. Mandibular hairs short and curved on the upper surfaces; on the posterior mandibular border and on the gula longer than elsewhere on the head, curved, and forming a "pseudopsammophore". Thoracic hairs notably uneven in length, a few very long on the pronotum.

Color: Bright reddish brown, especially the head; thorax and gaster brown; petiole, postpetiole, and scapes dark brown, funiculi yellowish.

Minor: Length, 2.42–2.92 mm.; head length (excluding mandibles), 0.58–0.67 mm.; head index, 0.87; thorax length, 0.75–0.83 mm.

Head notably longer than broad, excluding the eyes, which are large, very convex, laterally placed, and extend well beyond the sides of the head; occiput flat, posterior angles definite but rounded; frontal area depressed; frontal carinae well developed and straight, extending to the level of the eyes. Clypeus convex, carinate, the anterior border smooth and slightly sinuate laterally. Gula definitely flattened, giving the head a truncated appearance ventrally when viewed in profile. Antennae 12-segmented; scapes slender, curved slightly at the base, and extending beyond the occipital corners by a distance about equal to the length of the first funicular joint; funiculus similar to that of the soldier. Mandibles triangular, bidentate apically, with numerous denticles along the incisor edge.

Thorax narrower than the head, with the usual constriction at the meso-epinotal suture. Promesonotum low, the dorsal contour weakly convex and extending in an unbroken curve to the meso-epinotal suture, which is distinctly impressed and saddle-shaped. Epinotal base convex, declivity concave and sloping posteriorly, and the angle between them obtuse; epinotal spines reduced almost to tubercles. Petiole with slender peduncle, which merges gradually with the rather low and ill-defined node; node rounded and poorly separated from a posterior peduncle. Postpetiole subglobose, widest posteriorly, but only $\frac{1}{5}$ broader than the petiole. Gaster very similar to that of the soldier.

Sculpture: Clypeus, frons, vertex, and gula smooth and shining; entire prothorax smooth and shining, as is also the mesonotum; mesopleura and the whole epinotum granulate and subopaque; petiole and postpetiole smooth and shining dorsally, slightly granulate laterally; gaster very smooth and shining.

Pilosity: Flexuous, pointed hairs on all surfaces like those of the major, noticeably longer on the head and gaster, present on the legs, funiculi and scapes; clypeal hairs very long and curved downward; hairs along the external borders of the mandibles, and the lateral and posterior borders of the gula are long ammochaetae, curved at their tips, and forming a distinct psammophore. This structure is much more developed than that in the major caste.

Color: Head and thorax dark brown, gaster lighter, especially the apex; legs and scapes light brown; funiculi, tarsi, and mandibles yellowish.

Holotype: Major, deposited in the junior author's collection.
Paratypes: 15 majors and 32 minors from the same nest as the holotype.

Colonies of *psammophila* have been taken also by the senior author in the following stations:

CALIFORNIA: Imperial County, Greys Well (150′) TYPE LOCALITY; 5 miles east of Greys Well (150′) 2 colonies.

ARIZONA: Yuma County, Blaisdell (200′) 3 colonies; Dateland (150′) 1 colony.

SONORA: Cholla Bay, Punta Penasco (sea level) 2 colonies: 7 miles north of Punta Penasca (150′) 1 colony; 10 miles east of San Luis (250′) 2 colonies.

The ecological responses of this ant appear to be unusually constant. All twelve of the colonies cited above came from stations whose elevation was never more than 250 feet above sea level. All the nests were constructed in areas whose dominating characteristic was an abundance of sand. The region of sand dunes, which extends through much of the Gran Desierto in Sonora and into Imperial County in California, appears to be an exceptionally difficult environment for most ants. Even the strongly xerophilous species avoid this area, presumably because the shifting sand is continually covering the nest openings. The presence of *psammophila* in this region indicates that the sand-dwelling habit is highly developed in this species. In areas where the sand was not shifting there were chaff piles around the nest entrances, a clear indication that *psammophila* is a harvester.

Ph. psammophila is closely related to *barbata*. Both species have a characteristic thoracic structure in the major. The promesonotal suture and the meso-epinotal suture are both prominent, especially the latter. Between these sutures the short, high mesonotum descends abruptly, in some specimens almost vertically. The dorsum of the pronotum is flat or nearly so at the level of the prominent humeral angles. Since the sides of the pronotum descend vertically or almost vertically from these angles and since the pronotum is notably wider than the mesonotum, it presents a distinctive cuboidal appearance when viewed from the rear. In such a view the mesonotum appears to be an ovoid shield on the rear face of the pronotum. The meso-epinotal suture is impressed both above and on the sides of the thorax and gives the thorax an unusually distinct waist at the meso-epinotal suture when viewed from above. The major of *psammophila* averages larger than that of *barbata*, but this distinction is difficult to use because of an overlap in the size range of this caste in the two species. A more serviceable difference is furnished by the prominent epinotal spines in the major of *psammophila*. In the major of *barbata* the junction of the basal and declivious faces of the epinotum sometimes bears well-marked angles, but these are never produced into spines. The postpetiole of the major of *psammophila* is narrower than that of *barbata* and often lacks the lateral angles or connules which

are usually present in *barbata*. There is seldom any ventral tooth below the postpetiole in *psammophila*, and even when a small one is present it is never comparable to the conspicuous ventral projection which marks the postpetiole of the major of *barbata*.

The minor of *psammophila* is consistently larger than that of *barbata*, averaging 2.7 mm. against 2.2 for *barbata*. The minor of *psammophila* has longer antennal scapes, larger eyes, and a longer and lower epinotum armed with minute denticles. But its strikingly developed psammophore distinguishes it not only from the minor of *barbata* but also from that of any other North American species of *Pheidole* known to us. In the minor of *barbata* the lower surface of the head is slightly convex and bears scattered, delicate, erect hairs which do not form a psammophore. In the minor of *psammophila* the lower surface of the head is unusually flat, and at either side and along the rear margin there are long, coarse, brownish hairs which curve under the head to form the extensive psammophore.

Pheidole sciophila Wheeler

Ph. sciophila Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 24, p. 443, pl. 26, figs. 18, 19 (1908) ♀ ♀ ♂.
Ph. proserpina Wheeler, Ibid. p. 437 (1908) ♀. NEW SYNONYMY
Ph. sciophila var. *semilaevicephala* M. R. Smith, Ann. Ent. Soc. Amer. Vol. 27, No. 3, p. 385 (1934) ♀. NEW SYNONYMY

A study of twelve colonies of *sciophila* taken at widely separated stations in the southwestern United States and northern Mexico has convinced the writers that *proserpina* and *semilaevicephala* should be treated as synonyms of *sciophila*. The considerations on which this proposal is based are discussed in the following paragraphs.

The type series of *sciophila* includes representatives from several colonies taken by W. M. Wheeler at Austin and New Braunfels, Texas. Whatever may be said about the inadvisability of spreading a type series over specimens coming from different nests and from different stations, it is clear that Wheeler had a fairly substantial amount of material before him when he described *sciophila*. There appear to have been at least 150 specimens in the type series and all castes were represented. The situation is quite different in the case of *proserpina* and *semilaevicephala*. Wheeler described *proserpina* from "several soldiers and workers taken from a single nest under a stone on the banks of the Gila River at Tempe, Arizona". As far as we have been able to determine, there were fewer than a dozen majors and about fifteen minors, ten of which are callows. Some of the latter became so badly distorted on drying that their value is scant. The lack of an adequate type series was even more acute in the case of M. R. Smith's *semilaevicephala*, which was described from six majors, presumably strays, taken by L. C. Murphree at Yuma, Arizona.

It should be clear that of these three forms only *sciophila* is based on satisfactory type material. In both *proserpina* and *semilaevicephala* the separatory criteria were drawn largely or entirely from the major. As is shown below both the major and the minor of *sciophila* exhibit considerable structural variability, but this cannot be appreciated in a limited series of specimens. Thus the recognition of both *proserpina* and *semilaevicephala* resulted from a misplaced faith in the constancy of structural variations noted in a few type specimens. With this in mind we have deliberately chosen to disregard the page precedence of *proserpina*, whose original description appeared in the same paper as that of *sciophila*. By choosing the latter name, we can base this species upon an adequate series of type material, a consideration which seems much more to the point than the technicality of page precedence.

It will simplify matters to describe the structural variation shown by *sciophila* and afterwards to explain how the selection of certain of these variations has been the basis for the recognition of *proserpina* and *semilaevicephala*. The length and the shape of the head of the major of *sciophila* both show considerable variation. At one extreme is the major in which the distance from the mid-clypeal border to the level of the occipital lobes is slightly greater than the width of the head through the eyes. As a rule in such cases the narrowing of the sides of the head toward the occipital lobes begins some distance behind the level of the posterior border of the eyes. At the other extreme is the major in which the distance from the mid-clypeal border to the level of the occipital lobes is equal to the width of the head through the eyes. In such majors the sides of the head usually begin to narrow at, or close to, the level of the posterior border of the eyes. Either type of major may have an extensively sculptured head with the sculpture carried to the occipital margin and the whole upper surface of the head opaque; or the portion of the head behind the eyes may be smooth and shining for the most part, with the sculpture largely limited to scattered patches of shagreening near or in the frontal groove, and small, widely dispersed piligerous punctures elsewhere.

Similar variation is found in the minor worker of *sciophila*. The head may be a little longer than wide, with the portion behind the eyes narrowing toward the occiput, or it may be nearly square with the sides almost parallel. In the first case the scapes ordinarily surpass the occipital margin by an amount at least twice as great as the length of the first funicular joint. In the second case they rarely surpass the occipital margin by much more than the length of the first funicular joint. In either type of minor the head may be smooth and shining or largely covered with sculpture and opaque.

It should be obvious that, if one cared to do so, one could sort out and name a dozen different structural combinations, for there is no correlation between the type of sculpture and the size and shape of the head. It should further be obvious that this is precisely what has happened in the case of *proserpina* and *semilaevicephala*.

For the first "species" is a short-headed, heavily sculptured form with short antennal scapes in the minor, while *semilaevicephala* is a short-headed, smooth form where the shape of the head and its lack of sculpture were made the main taxonomic distinctions. But the futility of such distinctions is demonstrated by colonies which show a wide range of structural variation. The senior author was aware, many years ago, that this variation was true of the type series of *sciophila*, but, since this series was a composite one, assembled from a number of nests, there was no certainty that the variation was present within a single nest series. It is now clear that the structure of a single nest series may vary sufficiently to include the conditions which were described as *proserpina* and *semilaevicephala*. A striking example of this fact is furnished by the colony coming from Arsarca Canyon in the Chinati Mountains of Texas. This colony consisted of thirty-five majors and forty-seven minors. Six of the majors show the characteristics of *semilaevicephala*, nineteen are identical with the less heavily sculptured types of *sciophila*, three closely approximate the conditions found in the types of *proserpina*, and seven are intermediate in character. The forty-seven minors are about evenly divided between long-headed and short-headed forms.

It must not be supposed that every colony of *sciophila* is as morphologically plastic as the one just cited. Many of them show a much greater constancy of structure, particularly the colonies coming from Durango. The majority of the majors in these colonies are of the long-headed, heavily sculptured type, although the shape of the head of the minor varies widely. This might be taken as evidence of the existence of a southern race were it not for the fact that identical conditions were present in the colony taken near Bastrop, Texas, a station which appears to be the present eastern limit of the range. It is possible that with the accumulation of much additional material and the application of statistical methods to it, geographical races in the fluctuating population of *sciophila* might be established. The authors are willing to admit this future possibility but not that either *proserpina* or *semilaevicephala* can be considered a geographical race on the basis of present knowledge. The only remedy for this situation is to treat the two forms as synonyms of *sciophila* and to recognize the inherent morphological instability of that species. The new locality records for *sciophila* are presented below. Except where otherwise noted, the colonies were taken by the senior author.

TEXAS: 8 miles east of Bastrop (700′); Oak Spring, Chisos Mts., Big Bend Nat. Park (4000′); Arsarca Canyon, Chinati Mts. (4800′); 20 miles north of San Antonio (W. S. Ross)

ARIZONA: Carr Canyon, Huachuca Mts. (6000′) (W. M. Wheeler); Ramsey Canyon, Huachuca Mts. (5800′); Brown Canyon, Baboquivari Mts. (4800′); Peña Blanca Springs (3700′) (L. F. Byars); Rillito River, Tucson (2500′) (R. G. Wesson)

SONORA: Puerto Gonzalitos (2500′)

DURANGO: 10 miles west of Durango (7200′) 2 colonies; Arroyo Carretas, Nombre de Dios (6000′)

The most surprising of these records is the last, for it extends the range of *sciophila* to within a few miles of the tropics. It is also interesting that the specimens listed above from Carr Canyon were identified by W. M. Wheeler as *Ph. proserpina* despite the fact that they agree much better with certain specimens in the type series of *sciophila* than with those in the type series of *proserpina*. All the colonies of *sciophila* which Wheeler took came from shady areas near streams. This has been true of some of the colonies taken by the senior author, but this species is capable of utilizing fully exposed nest sites well removed from any source of water. Under such circumstances the ant prefers areas of desert grassland, a fact that casts some doubt on Wheeler's supposition that *sciophila* is carnivorous and not a harvester.

Pheidole spadonia Wheeler (Fig. 6)

Ph. spadonia Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 400 (1915) ♀♀.

This insect was described from six majors and nineteen minors taken by Wheeler from several nests on the banks of the Santa Cruz River near Tucson, Arizona. There appear to be no other published records for the species. The three colonies listed below without collector's name were taken by the senior author during 1951 and 1952.

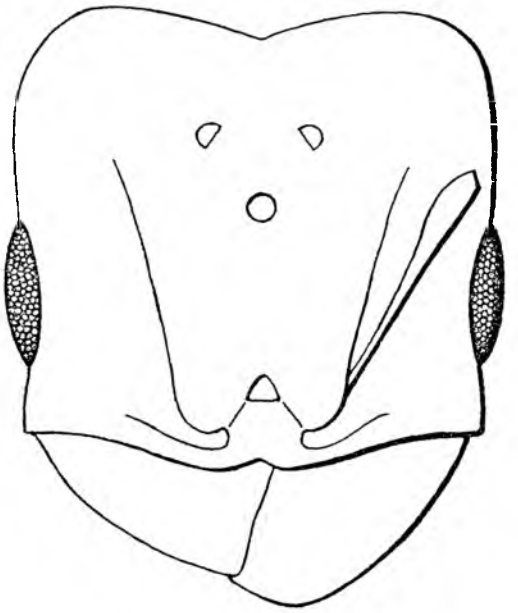

FIG. 6. *Pheidole spadonia* Wheeler, head of female

ARIZONA: Baboquivari Mountains, Forestry Cabin (3500′); Tumacacori (3200′) L. F. Byars

SONORA: 6 miles south of Imuris (3200′); Puerto Gonzalitos (2500′)

According to Wheeler the Tucson colonies were nesting in sand. Those taken by the senior author were nesting in coarse, gravelly soil. The majors of *spadonia* appear to confine themselves to the nest. The minors forage singly. We were unable to determine what this species eats, but it may be said that at least there was no evidence of harvesting activity. All three of these colonies were small, containing three or four majors and not more than a couple of dozen minors. There follows the description of the single, winged female which was taken from the nest in the Baboquivari Mountains:

Female: Length, 6.91 mm.; head length (excluding mandibles), 1.25 mm.; head index, 1.06; thorax length, 1.83 mm.

Head, exclusive of the mandibles, quadrate, only minutely wider than long. Occipital corners well rounded, and posterior cephalic border noticeably impressed leading to a distinct median furrow; sides of head straight, dorsal surface and gula quite convex. Clypeus with a blunt, rounded, median carina that resembles more an elevated prominence; anterior clypeal border sinuate, median emargination weak and shallow. Frontal area very small, depressed. Frontal carinae evident but weak, and gradually diverging from their insertions posteriorly to a point beyond the middle of the head; carinal lobe covering the antennal insertions narrow and indistinct from the remainder of the carina. Compound eyes small and flat, lateral, and occupying about ¼ of the sides of the head; placed anterior to the middle. Ocelli well developed but not prominent. Antennal scapes slender but thickening toward the tips, and basal portions gently curved; scapes extend ⅔ of the distance from their insertions to the occipital corners; funiculi slender, the last three segments forming a rather narrow club. Mandibles fairly stout, with the usual curve and bidentate at the tips.

Thorax, as measured through the mesopleura, only slightly narrower than the head. Dorsal wall of prothorax vertical, mesonotum high and almost flat dorsally, and its anterior margin in profile not sharply angled; parapsidal furrows absent; scutellum feebly convex, its anterior border transversely depressed where it meets the scutum. Metanotum distinctly below the level of the scutellum. Epinotum very low and sloping posteriorly, the basal and declivious faces confluent, as the angle separating them has practically disappeared; epinotal spines reduced to low, pointed, triangular tubercles. Petiolar peduncle short and broad, not sharply differentiated from the node. Crest of the node narrow, transverse, broadly and shallowly emarginate. Postpetiole exactly twice as wide as the petiole, and decidedly expanded into transverse, prominent, and rather sharp connules; anterior border nearly straight, posterior border of connules slightly concave; ventral side of postpetiole bears a distinct transverse ridge. Gaster with parallel sides and markedly truncate anterior margin.

Sculpture: Frons and genae heavily sculptured with longitudinal and gradually diverging rugae, coupled with fine interrugal striations; sculpture thins out on the vertex, and is represented only by the striations on the occipital corners, which are shining; remainder of the dorsal surface weakly shining to subopaque; frontal carinae borders very ill-defined, shallow antennal scrobes lateral to them, but the scrobes are evident chiefly as a result of local reduction of the cephalic sculpture. Median lobe of clypeus smooth and shining, lateral lobes rugose. Gula with fine striations especially near the oral border, weakly shining. Mandibles smooth and shining, interrupted only by hair punctures. Prothorax granular and opaque; mesoscutum, scutellum, and mesopleura

smooth and shining except for coarse striations laterally on the mesoscutum; dorsum of epinotum, petiole and postpetiole granular, subopaque; epinotal pleura rugose, opaque; base of gaster granular and punctate, remainder shagreened, but whole gaster shining.

Pilosity: Short, pointed, yellowish hairs present on almost all surfaces of the body; sparse on the pleurae, notably reclinate on the gaster, somewhat elongated on the clypeus, gula, petiole, postpetiole, scutellum and apex of gaster, short and merging with the pubescence on legs and antennae.

Color: Entire insect brownish yellow, head a little redder and mesonotum slightly infuscated, legs and antennae lighter than body; wings transparent, pale yellow with a darker stigma; one closed discoidal cell.

Gynetype: A single alate female, collected at the Forestry Cabin, elevation 3500 feet, in the Baboquivari Mountains, Arizona, on July 29, 1951, by W. S. Creighton. Two soldiers and three workers are associated with the female and were collected from the same nest.

Pheidole tepicana Pergande (Fig. 7)

Ph. tepicana Pergande, Proc. Calif. Acad. Sci. (2) Vol. 5, p. 878 (1895) ♀♀
Ph. rugifrons Pergande, Ibid. Vol. 5, p. 880 (1895) ♀
Ph. carbonaria Pergande, Ibid. Vol. 5, p. 881 (1895) ♀♀
Ph. kingi E. André, Bull. Soc. Ent. France p. 244 (1898) ♀♀ NEW SYNONYMY
Ph. townsendi E. André, Ibid. p. 246 (1898) ♀♀ NEW SYNONYMY
Ph. kingi subsp. *instabilis* Emery, Ibid. p. 120 (1901) ♀♀ NEW SYNONYMY; *Ph. kingi* subsp. *instabilis* Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 24, p. 431 (1908) ♀♀♂
Ph. kingi subsp. *torpescens* Wheeler, Ibid. Vol. 34, p. 404 (1915) ♀♀ NEW SYNONYMY

Forms of uncertain taxonomic position which have been incorrectly assigned to *tepicana* or *kingi*:

Ph. kingi subsp. *insipida* Forel, Biol. Centrali-Amer. Hym. Vol. 3, p. 76 (1899) ♀♀
Ph. carbonaria subsp. *calens* Forel, Ann. Soc. Ent. Belg. Vol. 45, p. 130 (1901) ♀♀
Ph. tepicana subsp. *cavigenis* Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 34, p. 403 (1915) ♀♀

The writers regret that this study has shown it is necessary to replace the name *kingi* with the prior name *tepicana*. While we have no doubt that *kingi* is a synonym of *tepicana*, it cannot be supposed that myrmecologists will relish changing a name which has been in use for more than half a century. But there seems to be no way by which this name change can be avoided. In subsequent paragraphs we shall show that Emery was mistaken about most of the criteria which he used to separate *tepicana* and *kingi*. His error appears to have been the result of inadequate material, and it may be added that most of the trouble with the *tepicana-kingi* tangle can be traced to this same cause. Much of the range of *tepicana* lies in a part of Mexico that has received little attention from myrmecologists. The Mexican records have been scattered, and the material on which they were based has often been fragmentary. It is not surprising that the highly polymorphic worker caste of *tepicana* has repeatedly furnished material for new names, nor is it surprising that these names have resisted revision. Until adequate material became available, no critical estimate of them was possible.

We believe that material suitable for such a study is now at hand in the twenty

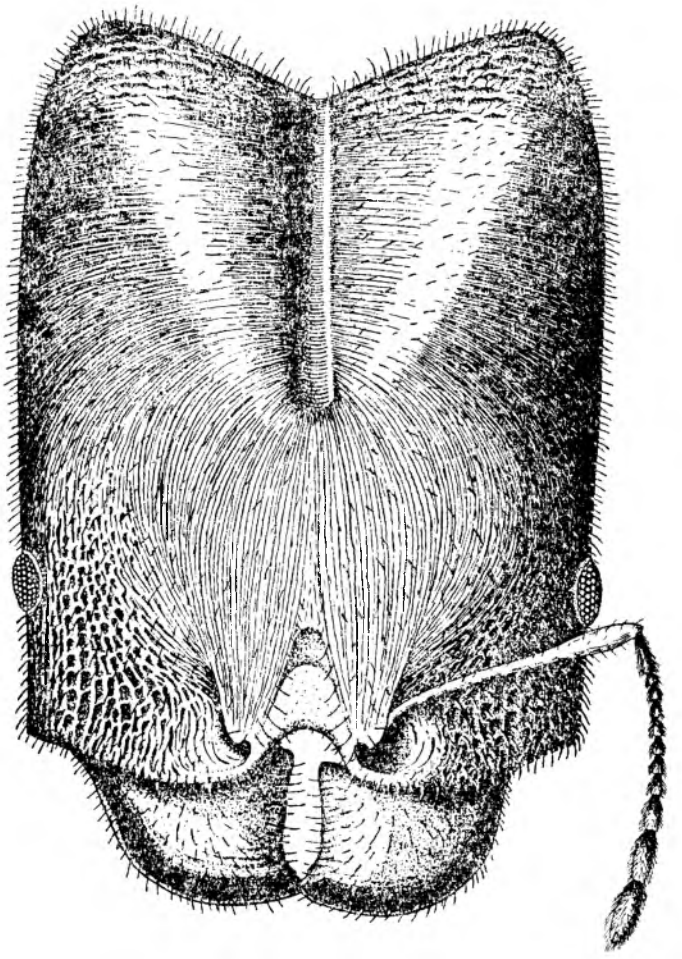

FIG. 7. *Pheidole tepicana* Pergande, head of major, (drawn from a specimen which measured 2.12 mm. in head length, excluding mandibles).

colonies of *tepicana* which the senior author took at fourteen stations in eastern Mexico during the period from 1951 to 1953. These specimens alone would not have permitted all of the synonymy proposed above, but, when the need for additional information on *tepicana* became apparent, Dr. M. R. Smith generously arranged matters so that the senior author had access to a considerable amount of Pergande's material. These types have been invaluable to this study, and we wish to express our sincere thanks to Dr. Smith and to the United States National Museum for their indispensable contribution to this work.

Before considering the reasons for the synonymy proposed above it is necessary to present a clear account of certain variable features in the worker caste of *tepicana*. Both Wheeler and Emery were aware of these features, but neither man ever gave a satisfactory account of them. That they failed to do so is understandable, for the situation is one of extraordinary complexity. Nevertheless, it is correct to state that no sound idea of the *tepicana* problem can be secured unless these variable features are clearly understood. The discussion which follows involves slight differences in the size of the worker. To handle these differences as accurately as possible we have used head length as a gauge of size. The measurement employed is the distance from the most anterior point on the clypeal border to the most posterior point on the occipital border. This measurement has the advantage that it applies directly to the part which is undergoing the most drastic change as the size of the worker increases. All references to head length in the paragraphs which follow are based on this measurement. But it must be understood that, no matter how accurately the head length is measured, it is impossible to assign a fixed set of characters to a specific head length. The size range of the worker caste in fully developed colonies of *tepicana* is not always the same. But, except at the large end of the size range, the sequence of development of a variable character is always the same. In colonies where the size range is reduced, a particular character, or combination of characters, will be shown by a worker with a slightly smaller head than that which would mark a worker having comparable characteristics in a colony which shows the large size range. It is necessary, therefore, to set limits of head length between which certain characteristics appear.

Some of the structural changes which occur as the size of the worker increases need no more than a general characterization. Thus, the convexity of the eyes, which is very pronounced in the smallest workers, gradually decreases as the size of the worker increases. In the largest workers the eyes are almost flat, but it is interesting that their diameter is only about half again as great as it is in the minor. The epinotal spines also show a very gradual change. In the minor these are usually little more than denticulate angles. In the largest workers the epinotal spines, while short, are sharp at the tip and project upward, sometimes almost vertically. In the minor the postpetiole is subcircular in outline and little wider than the node of the petiole. In the maxima the postpetiole is transverse, almost twice as wide as the node of the petiole, with prominent lateral angles which give it a lenticular outline. The length of the antennal scape presents a rather curious problem which was, unfortunately, misunderstood by Wheeler in 1908. Wheeler stated that the length of the antennal scape increases as the size of the worker decreases. Actually the reverse is true. The scape is approximately 0.56 mm. in length in the minor and 0.66 mm. in length in the maxima. Its length thus increases with the size of the worker but at a much slower rate than that which marks the increase in head

length. Therefore, in relation to the length of the head, the scape appears to be much shorter in the maxima than in the minor. In the minor the tip of the scape slightly surpasses the occipital margin; in the maxima the tip of the scape fails to reach half-way from its insertion to the occipital margin.

The writers have had little occasion to use any of these features in this study. On the other hand, constant reference to cephalic sculpture has been necessary. The head length of the minor of *tepicana* varies between 0.53 mm. and 0.55 mm. In workers of this size the head is largely smooth and shining, and its sculpture consists of small, scattered, piligerous punctures, except in the area between the anterior border of the eye and the insertion of the mandibles, where there are feeble, longitudinal rugae. In that part of the size range which lies between a head length of 0.53 mm. and 1.0 mm. the change in sculpture is entirely confined to the front half of the head. As the size increases the longitudinal rugae in front of the eye become slightly coarser and spread inward and to the rear. At first they do not appear on the frontal lobes, but later these are also covered. It may be noted, however, that in the size range given above, no oval foveolae or granulations have appeared, and the surface between the rugae is strongly shining. The transverse occipital rugae begin to appear when the head length is between 1.0 mm. and 1.2 mm. At first these are little more than thin spaces between rows of close-set, shallow punctures, but they rapidly increase in prominence. At this time oval foveolae and granulate sculpture begin to show up along the sides of the head, but most of its upper surface is still smooth and shining. Thereafter the cephalic sculpture develops rapidly. At a head length between 1.5 mm. and 1.7 mm. both the transverse occipital rugae and the anterior longitudinal rugae are becoming heavy. The finer longitudinal rugae on the frontal lobes now spread posteriorly toward the vertex, and some of them turn diagonally outward behind the antennal sockets. There is, however, still a considerable area at the vertex where the surface is shining and where the sculpture consists only of coarse, scattered, circular punctures. Up to this point the progression of sculptural change is quite constant, and this is also true of a part of what follows. The further development of the cephalic rugae appears to be fairly uniform, but this is not true of the granulation, whose development varies widely in this part of the size range. In colonies having the large size range the head length of the maxima may reach 2.1 mm., or more. In colonies having the reduced size range the maxima have a head length of 1.9 mm. In either case the changes discussed below take place when the head length passes 1.7 mm. At this stage delicate transverse rugae appear on the vertex. At first these are so faint that they are difficult to see, but later they become more prominent and eventually may completely cover the vertex. But these rugae themselves do not appreciably dull the shining surface of the vertex, and the coarse punctures can still be seen among them. This represents the final stage of development in the more

lightly sculptured maxima in which the vertex, even though covered with fine rugae, is distinctly shining. In such individuals the frontal lobes are also shining, and the rest of the head is feebly shining to subopaque because of the light granulation between the rugae and foveolae. The fine transverse rugae also appear on the vertex in the heavily sculptured maxima, but they are masked by the presence of a heavy granulate sculpture which completely obliterates the punctures between them and may at times also obliterate the foveolae on the sides of the head. Such heavily sculptured maxima have a completely opaque head except for the frontal lobes, which are feebly shining. These differences in granulation cannot be correlated with head length. A maxima with a head length of 1.9 mm. may show an opaque head, while one with a head length of 2.1 mm. may have a shining, lightly sculptured head. The two types of maxima just described present a striking difference in appearance when compared. This difference has been used in the past as a basis for taxonomic distinction. We believe that it can be shown that such treatment is not justified.

In the hope of simplifying the intricate taxonomy of *tepicana* we have divided the discussion which follows into two parts. The first of these deals with the forms which clearly belong to *tepicana*. The second part is devoted to a consideration of the status of *insipida* Forel, *calens* Forel and *cavigenis* Wheeler. Whatever these last may be it seems certain that they cannot be assigned to *tepicana*. Our reasons for this view have been presented at the end of the discussion which deals with *tepicana*.

In 1901 Emery published a paper, less than three pages in length, entitled *Remarks on a little group of Pheidole of the Sonoran region* — a singularly unfortunate title since there is reason to doubt that any of the forms involved are Sonoran. Regardless of this, it is seldom that such a short paper covers so much ground. The material on which this paper was based consisted of specimens of *tepicana*, *rugifrons*, and *carbonaria* which Pergande had sent to Emery, as well as specimens of *kingi* and *townsendi* which Emery had received from André. But the most important material was a series of specimens from Austin, Texas, which W. M. Wheeler had turned over to Emery for identification. Wheeler was able to assure Emery that the polymorphic workers which composed the several nest series had, in each case, come from a single nest. The polymorphism of *tepicana* had, at last, been clearly established, and as soon as Emery realized this he was quick to appreciate that both Pergande and André had been misled by the belief that all species of *Pheidole* must be dimorphic. As a result of his studies Emery laid down four main propositions:

(1) Pergande's *carbonaria*, the majors of *tepicana* (but not the minors) and *rugifrons* are three size groups in a single polymorphic species which, because of page precedence, should be called *tepicana*. The insect described as the "minor" of *tepicana* does not belong to this species.

(2) André's species *kingi* and *townsendi* are, respectively, the smaller and larger workers of a single polymorphic species which, on the basis of page precedence, should be called *kingi*.

(3) There is enough structural difference between *tepicana* and *kingi* to allow the two to be considered as separate species.

(4) The specimens taken by W. M. Wheeler at Austin, Texas, are sufficiently different from the Tampico types of *kingi* to justify their recognition as a separate race, the subspecies *instabilis*.

The writers agree with the first two propositions; hence there is no reason to discuss them other than to say that the insect which Pergande described as the minor of *tepicana* is some form of *Ph. fallax*, possibly the typical *fallax* itself. We believe, however, that neither of the second two propositions can be accepted.

According to Pergande the type material on which his species were based was as follows:

P. rugifrons 7 majors (the largest 3.8 mm.) no minors

P. tepicana 10 majors (the largest 3.0 mm.) 25 minors

P. carbonaria 4 majors (the largest 2.2 mm.) 7 minors

The twenty-five minors of *tepicana* in this material must be discarded. There are left a total of twenty-eight type specimens — seven majors (*rugifrons*), fourteen media (*tepicana* and *carbonaria*) and seven minors (*carbonaria*) — of which five majors, five media, and four minors have been examined, including two in the collection of the American Museum of Natural History. The study of these specimens has shown that little reliance can be placed on the criteria which Emery cited for the recognition of *tepicana*. Emery's observations are as follows:

"*Ph. tepicana* differs more noticeably; the largest soldier (*Ph. rugifrons*) ought to be close to the maxima form and is much smaller than the maxima form of *instabilis*; the worker (*Ph. carbonaria*) is also much smaller than that of *instabilis*; the mesonotum of the soldier has a rather distinct transverse impression, that of the worker is less arched."

It can be shown that Emery was incorrect on each of the points cited. The maxima of *tepicana* is not "much smaller than that of *instabilis*". The head of the largest of the five majors of *tepicana* (*rugifrons*) examined measured 1.5 x 1.9 mm. The head of the largest major of *instabilis* which was found among several hundred specimens measured 1.65 x 2.1 mm. In many colonies of *instabilis* the heads of the maxima measured 1.5 x 1.9 mm., exactly the proportions shown by the head of the largest *tepicana* major. It may be admitted that as far as the types are concerned, *tepicana* exhibits the limited size range which many colonies of this species show. But this is quite a different matter from saying that the maxima of *tepicana* is "much smaller" than that of *instabilis*. It seems probable that Pergande sent Emery one of the smaller majors of *rugifrons*. In the five specimens mentioned above the smallest has a head length of only 1.3 mm. This specimen is certainly

much smaller than the maxima of *instabilis*, but it is equally certain that it is not the maxima of *tepicana*. The same considerations apply to the size of the minor of *tepicana* (*carbonaria*). In type specimens the length of the head of the minor is 0.53 mm. While this length is slightly smaller than that of the minor of *instabilis*, where the head length is 0.55 mm., it is exactly the same as the head length of the minor in colonies in the eastern population which have the limited size range. As to what Emery had in mind when he stated that the thorax of the minor of *tepicana* is less arched than that of *instabilis*, we are unable to say. There is not the slightest difference between the thorax of the minor of *tepicana* and that of *instabilis*. Emery's statement that there is a distinct transverse impression on the mesonotum of the major of *tepicana* needs clarification. At either side of the mesonotum, where it begins its sudden descent to the meso-epinotal suture, there is sometimes a blunt angle. This angle may project upward sufficiently so that it stands slightly above the dorsum of the mesonotum, and, if the thorax is viewed in profile, it might be supposed that the middle of the mesonotum is lower than its rear edge. This is not the case, for the part of the dorsum between the two angles is also depressed. It follows that there is no transverse impression on the dorsum of the mesonotum, and Emery seems to have arrived at his incorrect conclusion by assuming that the two lateral angles are connected by a transverse ridge of equal height. It cannot even be claimed that the angles themselves are any different in *tepicana* and *instabilis*. It is seldom that some of the maximas in a colony of *instabilis* fail to show lateral angles at the rear of the mesonotum. Conversely, only two of the five majors of *tepicana* (*rugifrons*) which we re-examined showed such angles. It seems clear that this feature is a variable one and not significant for taxonomic separation. It follows that the maxima of *tepicana* cannot be distinguished from that of *instabilis* on the basis of thoracic structure. It would appear, therefore, that Emery had nothing but distribution by which to separate *tepicana* and *instabilis*, and, as we shall show later, this distinction will no longer apply.

Emery's treatment of the subspecies *instabilis* is equally unsatisfactory. It should be clearly appreciated that the size range represented by André's types of *kingi* and *townsendi* was incomplete. After Emery had realized that the two are representatives of a single, polymorphic species he stated that there were probably no maximas in the entire type series of *kingi* and *townsendi*, an indirect admission that he had seen none himself. It is evident that Emery must have arrived at the criteria which he used to distinguish *kingi* from *instabilis* by comparing large medias of equal size. According to Emery these differed as follows:

"The typical form of *kingi* differs from the subspecies which I am going to describe by the lighter, yellowish red color of the soldiers and by the stronger and more even sculpture with less extensive smooth spaces at the vertex. The largest examples known (*Ph. townsendi*) are probably not the maxima form."

If the sculptural differences cited by Emery are compared with the sequence of sculpture discussed in preceding paragraphs, it will be clear that they are exactly the differences which separate a large media from one of slightly smaller size. To make the matter more complex, these same sculptural differences can be observed in two medias of identical size if one specimen comes from a nest series showing the full size range and the other from a nest series having the reduced size range. Under such circumstances it is impossible to attach any significance to the sculptural differences used by Emery to separate *kingi* and *instabilis*. If sculpture is eliminated the only difference left is the lighter color which Emery noted in the major of the typical *kingi*. We have shown elsewhere that there is no geographical significance to color differences in *tepicana*.

Since what follows involves a zoögeographical consideration of *tepicana*, we present below a list of the localities in which this insect has been taken. This list is based on published records and specimens seen by the writers. The records made by the Argentine Ant Survey were published by Dr. M. R. Smith in 1936. Records carrying no collector's name are those of the senior author.

TEXAS: Austin (A. E. Emerson); Del Rio (W. M. Wheeler); Barksdale (Brown); Cisco, Lockhart, San Marcos, Nixon, Mineral Wells, Mathis (Argentine Ant Survey); San Antonio, Somerset (W. S. Ross); Carrizo Springs; 10 miles west of Sullivan City (W. S. Creighton). All these records came from stations where the elevation is less than 1000 feet.

TAMAULIPAS: Canyon de El Abra (1100′); 6 miles east of Nuevo Morelos (1900′); Galeana (1100′); 40 miles south of Ciudad Victoria (1100′)

NUEVO LEON: El Pastor, west of Montemorelos (2200′); Iturbide Canyon, west of Linares (2300–3700′); 18 miles north of Linares (2000′)

VERA CRUZ: Tampico (sea level) (Townsend)

SAN LUIS POTOSI: 22 miles east of Ciudad del Maize (3300′); Puerto del Lobos (4400′); El Salto (1400′); Rio Amahac near Tamazunchale (300′); Tamazunchale (600–800′)

HIDALGO: Chapulhuacan (2600′); 4 miles west of Rancho Viejo (5200′)

MORELOS: Cuernavaca (5058′) (W. M. Wheeler)

JALISCO: Guadalajara (5090′) (McClendon)

NYARIT: Tepic (3123′) (Vaslitt and Eisen)

ARIZONA: Tucson (2500′) (W. M. Wheeler); Nogales (3900′) (L. F. Byars).

Of these records only the last two are out of line, and we believe that both should be regarded with caution for the following reasons:

Each was based on fragmentary material. Wheeler's Tucson record (the type series of the subspecies *torpescens*) rests on one major, two media, and several workers. Byars' Nogales record appears to have been based on media only. In addition, each of the above localities is more than six hundred miles removed from the

next nearest station. Each came from localities where the elevation is well above what would be expected for the latitude involved. If, as seems to be the case, the upper elevational limit in the main range of *tepicana* does not exceed 2500 feet north of Latitude 26°, it is curious that the insect should occur at 3900 feet at Latitude 32° in southern Arizona. There is the possibility that continued collecting along the western slope of the Sierra Madre Occidental in Mexico might provide records that would tend to fill the gap between the type locality at Tepic, in the state of Nyarit, and the Nogales record. However, many months of collecting in southern Arizona by the senior author failed to produce any evidence of *tepicana* in that area, and since the same situation is true of northern Chihuahua and Sonora, it can scarcely be claimed that the Arizona stations are northern fringes of a species whose main range lies immediately south in Mexico. Whatever the significance of the Arizona records may be, they should not divert attention from the beautifully regular geographical pattern that *tepicana* exhibits elsewhere.

Beginning at the latitude of Ft. Worth, Texas, the range of *tepicana* runs south through Austin and San Antonio and thence across southern Texas into eastern Nuevo Leon and Tamaulipas. It proceeds southward through the eastern tip of San Luis Potosi to Hidalgo, where it turns west into Morelos. It then runs westward through central Jalisco to southern Nyarit. It is probable that *tepicana* is present over much of the northern half of the state of Vera Cruz, although the only specimens from that state so far are Townsend's types of *kingi*. It should be noted that as the range of *tepicana* passes to the south the elevational spread increases rapidly. The upper elevational limit is less than 1000′ in Texas. This limit rises to 2500′ in central Nuevo Leon, 4000′ in San Luis Potosi, and 5000′ in Hidalgo. This response to elevation seems to determine the boundary of the range of *tepicana*. There are no records of *tepicana* from the Edwards Plateau or from the part of Texas west of the Pecos River. As far as could be determined this ant is not present in the highlands of northern Coahuila nor anywhere on the Mexican Plateau. It also seems to be absent on the eastern slopes of the Sierra Madre Occidental. Since the senior author collected at many stations in the areas just cited and took many colonies of various species of *Pheidole* while doing so, it is safe to say that if *tepicana* occurs on the Mexican Plateau or in the areas which bound this region, its incidence there must be extraordinarily low. It should also be noted that little of the range of *tepicana* lies in arid regions, and much of it runs through areas that are decidedly humid. While *tepicana* can undoubtedly tolerate conditions of considerable aridity, its distribution negates the idea that this ant is a strict xerophile.

Since the colonies from eastern Mexico had closed much of the gap which previously separated the Texas colonies from those coming from central Mexico, the writers believed that it might be possible to authenticate some of the previously described subspecies as geographical races in this population. Efforts to do so were

uniformly discouraging. It soon became apparent that Wheeler's *torpescens* is nothing but a nest variety which occurs over most of the range of *tepicana*. Maximas having the head wider behind than in front (the criterion for the recognition of *torpescens*) have often been taken from nests where the other maximas have heads of the more common type. Color was equally unsatisfactory, for light- and dark-colored colonies occur over the entire range of *tepicana*, and these differences in color seem to be due to the situation of the nest. A fully exposed nest will usually contain light-colored workers. The sculpture of the head of the maxima appears to be the only feature in which there is the slightest correlation with distribution, and this relationship is so intricate that it may be doubted that the most ardent proponent of geographical races would care to employ it. As far as we have been able to determine, lightly sculptured and heavily sculptured maximas occur over the entire range of *tepicana*. But at the northern end of the range the lightly sculptured maximas are more frequently encountered than are the heavily sculptured maximas. The two sorts of maximas are about equally abundant in San Luis Potosi and Hidalgo, but where the range swings west the heavily sculptured maxima predominates. It might be possible, therefore, to set up two geographical races each based upon the proportion of lightly sculptured to heavily sculptured maximas in the population. That such a plan would have the slightest taxonomic value seems out of the question. We believe that *tepicana* is best treated as a single, somewhat variable population in which the variation cannot be used as the basis for the recognition of geographical races.

In conclusion we wish to present the reasons why Forel's *insipida* and *calens* and Wheeler's *cavigenis* should be dissociated from *tepicana*. The original material of *insipida* consisted of two series of specimens, one taken by Sallé at an unspecified station in Mexico, the other secured by H. H. Smith at Xucumanatlan in the state of Guerrero. On the basis of André's description, Forel made *insipida* a subspecies of *kingi*, since he had no material referable to *kingi* at that time. When he described *insipida* in 1899 Forel was not aware that *kingi* is polymorphic. In the original description of *insipida* the major is said to be 3.3 mm. in length. Its occipital lobes lack punctures and are very smooth and shining. The antennal scape reaches the posterior quarter of the head, and there is a deep transverse incision at the middle of the mesonotum. We have shown elsewhere that the thorax of *tepicana* does not have a transverse impression on the mesonotum, and if Forel's measurement of length was reliable it would be easy to point out that a media of *tepicana* with an over-all length of 3.3 mm. would have distinct transverse rugae on the occiput and antennal scapes which barely surpass the middle of the head. But to allow for possible error in Forel's measurement we must deal with this situation in a more roundabout way. As already noted, the transverse occipital rugae do not appear in the media of *tepicana* until a head length of 1.0 mm. has been reached. At this time

the antennal scapes extend approximately to the rear third of the head. It should be clear, therefore, that if *insipida* is a media of *tepicana* it must have a head length of less than 1.0 mm., for only in such a size would the occiput be smooth and shining and the scapes reach the posterior quarter of the head. But the average over-all length of a media of *tepicana* having such characteristics is about 2.5 mm. to 2.7 mm., depending on the position of the head, and by no amount of stretching can its length be made to reach 3.3 mm. We do not know what Forel's *insipida* is, but it seems reasonably clear that it is not related to *tepicana*.

The case of the insect which Forel described as *Ph. carbonaria* subsp. *calens* is similar. This subspecies was based upon specimens taken by W. M. Wheeler in Aguas Calientes when he visited Mexico in 1900. The state of Aguas Calientes lies near the southern end of the Mexican Plateau. As there is no part of the state where the elevation is less than 6000 feet, it is very unlikely that *calens* could belong to *tepicana*, for *tepicana* does not occur at this elevation in any part of its range. It can be shown that Forel had no notion as to the real character of *carbonaria* when he assigned *calens* to it. By the time that Forel described *calens* in 1901 he not only knew that *kingi* was polymorphic but he also had a good idea of the characteristics of this species. For Wheeler had sent Forel specimens from Cuernavaca which Forel knew were the same as Emery's still unpublished subspecies *instabilis*. Forel's 1901 publication carried the record for the Cuernavaca specimens as "*Ph. kingi* var. *instabilis* Emery *in litt.*" But it is clear that Forel did not know the full extent of Emery's revisionary work, as he would otherwise have assigned *calens* to *tepicana* rather than to *carbonaria*. It is equally clear that Forel not only misunderstood the nature of *carbonaria* but also failed to acquaint himself properly with Pergande's description of it. Forel gave the length of the major of *calens* as 3.4 mm. and stated that its occipital lobes are smooth and shining with large, distinct, scattered piligerous punctures "much stronger than the punctuation in the typical *carbonaria*". Yet Pergande expressly states in his description of *carbonaria* that the major has faint, transverse striae on the occipital lobes. In short, there was no reason why Forel should have assigned *calens* to *carbonaria*, and that he was mistaken in doing so is evident. For the major of *calens* is even larger than that of *insipida*; yet it still shows no trace of transverse rugae on the occipital lobes. What was said for *insipida* may be repeated for *calens*. We do not know what *calens* is but it is certainly not related to *tepicana*.

The insect which W. M. Wheeler described in 1915 as *Ph. tepicana* subsp. *cavigenis* is the worst enigma of the three. This subspecies was based on three majors, one of them a callow, which Wheeler took at an elevation of 5600 feet in Miller Canyon in the Huachuca Mountains of Arizona. The latitude of Miller Canyon is about 31°, 30′. At this latitude the main range of *tepicana* has an upper elevational limit of less than 1000 feet. Hence the record for *cavigenis* comes from a station

whose elevation is at least 4600 feet too high. There are other serious inconsistencies in Wheeler's treatment of *cavigenis*. At least two of the criteria which Wheeler used to distinguish *cavigenis* are based on an erroneous concept of the typical *tepicana*. Wheeler claimed that in the major of the typical *tepicana* the sides of the head are feebly convex and the node of the petiole is entire. Neither of these statements is correct as far as the types of *tepicana* are concerned. In the maxima of *tepicana* the sides of the head are parallel over most of their length, and the node of the petiole is slightly but distinctly excised at the summit. Strangely enough Wheeler missed the principal difference which distinguishes *tepicana* from *cavigenis*. In *tepicana* the anterior border of the clypeus bears a deep, almost semicircular median impression which extends inward in the maxima almost to the level of the frontal lobes. No such structure is found in *cavigenis*, where the median border of the clypeus is feebly excised. The senior author realized this fact many years ago when the key to *Pheidole* which appeared in 1950 was being prepared. As a result *cavigenis* was placed with other species (*sitarches*, *pilifera*, etc.) which have a feebly incised clypeal border. But at that time there were no majors of *tepicana* available for examination, and, since the senior author was not sure what kind of clypeus *tepicana* had, no attempt was made to separate *cavigenis* from it. It should be clear that this must now be done. It now seems more probable that *cavigenis* is related to *sitarches*. The two are similar not only in the structure of the clypeus but also in the shape and sculpture of the head and the character of the eyes in the maxima, which are rather large and prominent. It may further be pointed out that *sitarches* occurs widely in southwestern New Mexico, Chihuahua, and Durango, where it nests in stations whose elevation is often in excess of 6000 feet. It may be added that *sitarches* is a highly variable species which is also in need of revision. It would not be surprising if further work shows that *cavigenis* is a synonym of *sitarches*.

Pheidole titanis Wheeler

Ph. titanis Wheeler, Psyche, Vol. 10, p. 95, fig. 3 (1903) ♀ ♎.

In choosing the name *titanis* for this species Wheeler emphasized the large size of the type specimens. There is no doubt that the type series of *titanis* contains major workers of unusual size, but it cannot be said that this is always true of the species. In preparing the key to *Pheidole* which appeared in 1950, the senior author examined not only the types of *titanis* but also a series of specimens taken by Wheeler in Post Canyon in the Pinaleño Mountains (more often called the Graham Mountains) of eastern Arizona. While these specimens were notably smaller than the types, they were otherwise identical and this seems to be generally true. Except for size differences between colonies the structural features of *titanis* are remarkably constant, and there is little difficulty in recognizing the smaller representatives of *titanis* despite the discrepancy in size. In recent years the senior author has taken

three colonies of *titanis* in southern Arizona. Two of these were secured in the Baboquivari Mountains, one near the Forestry Cabin in Baboquivari Canyon (3500′), the other in Perkins Ranch in Brown Canyon (4000′). In both these nests the size of the major was closely comparable to that of the majors which Wheeler took in the Pinaleño Mountains. The over-all length of the majors averaged about 5.5–6.0 mm. against 7.25–8.0 mm. in the types. But the majors in the third colony, which was taken at Sweetwater in the Santa Rita Mountains (6000′), were notably smaller, measuring only 4.5–5.0 mm. in over-all length.

It is possible that the smaller specimens coming from Arizona represent a western race of *titanis*, but we do not consider this likely. If the reduced size of the major were correlated with a distribution running from east to west, it would be expected that the smallest representatives would occur at the western limit of the range. This is clearly not the case since the specimens from the Santa Rita Mountains, the smallest taken so far, are one hundred miles inside the known western limit of the range, and at that limit (Baboquivari Canyon) the specimens are of intermediate size.

When the over-all size of the major of *titanis* does not exceed five millimeters, the specimens cannot be handled in the key mentioned above. The heads of such majors (mandibles excluded) measure approximately 1.6 mm. in length, and they thus fall between the limits used to separate the two size groups in Couplet 44. In such cases it is easiest to contrast the major of *titanis* with the larger majors of *hyatti*. The major of *titanis* differs in its much shorter antennal scapes and heavier and more extensive cephalic rugae. Further, the scapes of *hyatti* are very flat and abruptly curved at the base. The minor of *titanis* differs from that of *hyatti* in its notably shorter and more quadrate head. Otherwise the two are very similar.

In his original description of *titanis* Wheeler observed that it prefers to nest under large boulders or where the soil is full of good-sized stones. It also seems to prefer nest sites near streams in canyons. The nest is usually placed near the top of the bank ten feet or more above the stream bottom. In the three nests which were excavated there was no evidence that the insects had been collecting seeds. But there is ample evidence that *titanis* eats termites. The colony taken at Sweetwater did so avidly; indeed, they would snatch their victims from between the tips of the tweezers by which the termites were presented to them. The colony taken in Brown Canyon was discovered when a column of majors and minors, most of them with termites in their jaws, was returning to the nest. In this connection it is interesting to note that the Sweetwater colony refused the larvae of *Pseudomyrmex apache*. When a number of these larvae were placed at the nest entrance the *titanis* workers carried them well away from the nest and discarded them. It would thus appear that the carnivorous diet of *titanis* may be a specialized rather than a generalized trait. In this connection, it is interesting to note that the mandibles of the major are more slender and the teeth more pointed than on the mandibles of granivorous

species of *Pheidole*. If its diet is restricted to termites, as seems likely, this can scarcely be regarded, however, as a primitive type of feeding response.

Pheidole xerophila Wheeler

Ph. xerophila Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 24, p. 446, Pl. 27, fig. 37 (1908) ♀ ♀♂.

As a result of a study of sixty-two colonies coming from forty-two stations, it is apparent that the treatment of *xerophila* presented by the senior author in 1950 is unsatisfactory in several respects. It may be recalled that in 1950 *xerophila tucsonica* was treated as a western race of *xerophila xerophila*, and Wheeler's variety *gilvescens* was suppressed as a synonym of the latter form. At that time the typical *xerophila* was known only from Texas and the subspecies *tucsonica* only from southern Arizona and California. Since Wheeler had considered *gilvescens* as intermediate between the two forms, it seemed logical to conclude that *gilvescens* was an intergrade which occurred at the point where the eastern and western races overlapped in southern Arizona. What follows should show the futility of attempting to deal with geographical races in the absence of adequate material. As the present study progressed, the need for material from certain critical areas became clear. As one of these areas was southern New Mexico, we requested Dr. A. C. Cole's permission to examine the *xerophila* material which he took there in 1951 and 1952. Dr. Cole generously sent on not only the material from New Mexico but also specimens which he had taken in Texas. These specimens proved highly significant to this study, and we wish to thank him for his important aid to this work.

The Texas specimens which Dr. Cole secured were taken at Putnam and Ft. Worth. This record represents a very considerable eastward extension of the range of *xerophila*, for the former eastern limit had been the Davis Mountains, where *xerophila xerophila* occurs in abundance. But this was by no means the most startling fact about these specimens. When examined they proved to be identical with *xerophila tucsonica*, not with the typical *xerophila* as might have been expected. It follows that *xerophila tucsonica* is not a western race, limited to Arizona and California, but a form whose range is far greater than that o any other member of the *xerophila* complex. For this range extends from Ft. Worth, Texas, westward through southern New Mexico and southern Arizona to the mountains of southern California and south into Sonora as far as the latitude of Guaymas. When this fact was appreciated it became necessary to reconsider the status of *xerophila xerophila*. With the range of *xerophila tucsonica* extending beyond that of *xerophila xerophila* both in the east and in the west, it seemed doubtful that the two forms could be considered as races of a single species. After studying Dr. Cole's material from New Mexico we believe, however, that this is the case. The range of the typical *xerophila* runs northward from the Chinati Mountains in the Big Bend through the Davis Mountains and into southeastern New Mexico. As far as the senior author has been

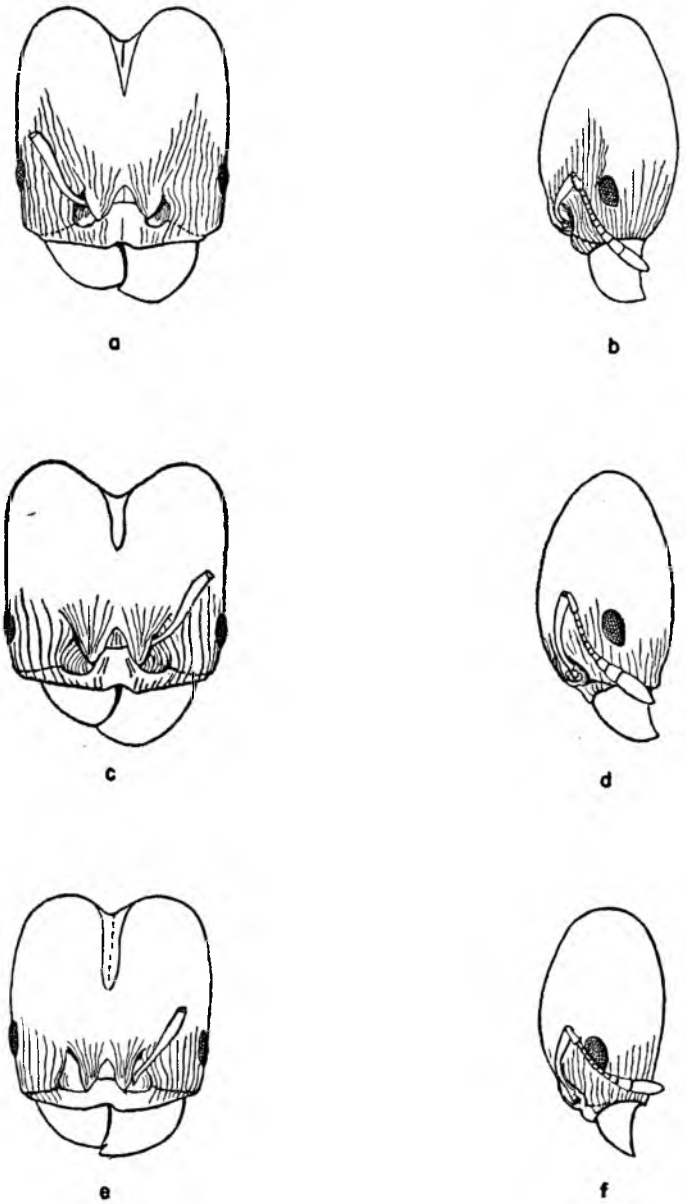

FIG. 8. Members of the *Pheidole xerophila* complex: a. head of major of *Pheidole xerophila xerophila* Wheeler in full face (drawn from type); b. head of same in profile; c. head of major of *Pheidole gilvescens* Wheeler in full face; d. same in profile; e. head of major of *Pheidole yaqui* sp. nov. in full face; f. same in profile, (all drawn to the same scale).

able to discover it is the only form present in these mountains. This condition seems to be true of several of the stations in New Mexico. But the material which Dr. Cole took in the vicinity of Las Cruces consists of some nests having the characteristics of *xerophila tucsonica* and others intermediate between that form and *xerophila xerophila*. In the collection of the junior author is one colony from the Sandia Mountains near Albuquerque, New Mexico, consisting of three majors and numerous minors, which also show an intergradation of characters. The postpetiolar connules of the majors are rather blunt and similar to those of *xerophila tucsonica*, while in each the pronotum approaches very closely the condition found in the typical *xerophila*. It would appear, therefore, that the two forms are geographical races and that they intergrade in central to southcentral New Mexico. This probability does not explain the presence of *xerophila tucsonica* in Putnam and Ft. Worth; and to do so it must be assumed that in the Staked Plains region the range of *xerophila tucsonica* lies to the north of that of *xerophila xerophila*. It is clear enough, however, that as far as spatial relationship is concerned, the typical *xerophila* is a southern race rather than an eastern race as was formerly supposed.

A much more drastic readjustment is necessary in the case of *gilvescens*. From what has already been said it should be clear that *gilvescens* cannot possibly be an intergrade between the typical *xerophila* and *tucsonica*, for the range of *xerophila xerophila* does not enter Arizona, nor does the range of *gilvescens* extend east of Tucson. There is thus a gap of approximately two hundred miles between the western boundary of the range of *xerophila xerophila* and the eastern boundary of that of *gilvescens*. We have been able to examine sixteen colonies of *gilvescens* coming from nine stations, which extend from south central Arizona to the eastern slope of the Sierras in California. In several of the stations *xerophila tucsonica* was also present. Occasionally the two insects would nest within a few feet of each other, but no evidence of intergradation was observed. It is apparent that *gilvescens* is not an intergrade but a sibling species which is sympatric with *xerophila tucsonica* in southwestern Arizona and southern California. It should be added that there are constant structural differences which permit the separation of *gilvescens* from the typical *xerophila* and from its subspecies *tucsonica*.

The fourth member of the *xerophila* complex is a hitherto unrecognized species described in this paper as *Ph. yaqui* (see page 43). The range of *yaqui* is restricted to southern California and northern Baja California. It sometimes occurs in the same stations as *gilvescens*, but in such cases the two show no tendency to intergrade. The four members of the *xerophila* complex may be distinguished as follows (see Fig. 8).

1. Head of the major with a flattened area extending rearward from the antennal fossa toward the occipital lobe; the occipital lobes compressed dorsoventrally; the rear third of the head seen in profile with the upper and lower surfaces converging notably toward the crest of the

lobe; occipital margin of the minor flat or feebly concave; promesonotum of the minor in part or entirely covered with coriaceous sculpture, the sculptured portions dull 2

Head of the major without a flattened area extending rearward from the antennal fossa; the occipital lobes not compressed dorsoventrally, thick and evenly rounded when seen in profile and not sharply set off from the anterior part of the head; occipital margin of the minor with a broad concave impression; promesonotum of the minor, except the mesopleura, entirely free from sculpture, the surface smooth and shining . . . . . *yaqui*

2. Major with the dorsum of the pronotum covered with numerous, coarse, reticulate rugae in addition to the more nearly parallel transverse rugae on the anterior face and on the neck; the surface between the rugae heavily coriaceous, opaque or nearly so . . . *xerophila tucsonica*

Major with the dorsum of the pronotum with few or no rugae present, the rugae mainly confined to the anterior face and neck of the pronotum; the rugae not notably reticulate, the surface between them smooth to slightly coriaceous, moderately to strongly shining . . . 3

3. Postpetiole of the major trapezoidal, the lateral connules short and obtuse; color golden yellow to dull yellow, the head of the minor sometimes infuscated with brown . . *gilvescens*

Postpetiole of the major strongly transverse and with long lateral connules; color ferrugineous red to blackish red, the minor piceous brown . . . . . *xerophila xerophila*

Since a considerable part of the previous discussion has dealt with the distribution of the *xerophila* complex, it seems advisable to present a full list of the stations in which *xerophila xerophila* and *xerophila tucsonica* have been taken. Where no collector's name is given the specimens were secured by the senior author.

Ph. xerophila xerophila Wheeler

TEXAS: Davis Mountains, Ft. Davis, W. M. Wheeler, W. S. Creighton; 10 miles west of Ft. Davis (4800′); Chinati Mountains, Arsarca Canyon (4000′)

NEW MEXICO: Sandia Mountains, Albuquerque (5400′) C. C. Hoff (intergrades); the records which follow are those of A. C. Cole; 30 miles east of Carlsbad (3200′); 18 miles southeast of Bayard (6000′); 7 miles west of Deming (4500′); 11 miles north of Las Cruces (4400′) (intergrades)

Ph. xerophila tucsonica Wheeler

TEXAS: Putnam, A. C. Cole; Ft. Worth (650′) A. C. Cole

NEW MEXICO: Las Cruces (4400′) A. C. Cole

ARIZONA: Tucson (2500′) W. M. Wheeler, A. C. Cole, W. S. Creighton; Florence (1300′) W. M. Wheeler; Hereford (4200′) W. M. Wheeler; Douglas (4000′) A. C. Cole; Phoenix (1100′) A. C. Cole; Naco (4700′) L. F. Byars; Nogales (3900′) L. F. Byars; Tucson Mountain Park (2400′); Safford (3000′); 20 miles east of Safford (3200′); Wilcox (4100′); 8 miles north of Casa Grande (1300′); Pinaleño Mountains, Post Canyon (5000′) W. M. Wheeler; Baboquivari Mountains, Forestry Cabin (3500′), Brown Canyon (4000′); Organpipe Cactus National Monument, Growler Mountains, Abra Wash (1300′), Ajo Mountains, Alamo Canyon (2200′ and 2300′), Quitobaquito (900′)

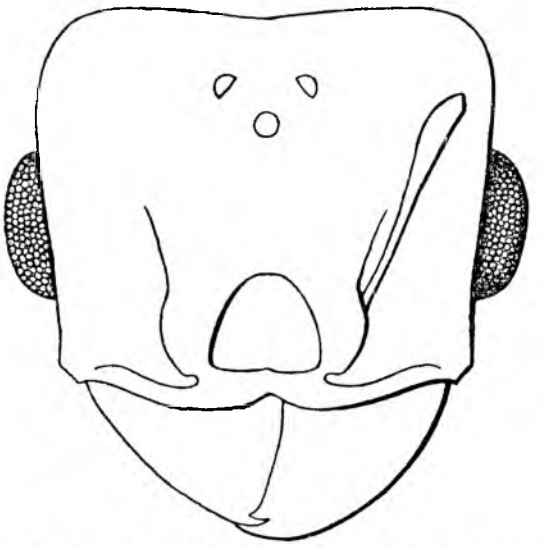

FIG. 9. *Pheidole xerophila tucsonica* Wheeler, head of female

CALIFORNIA: Jacumba (2600′) W. M. Wheeler, W. S. Creighton; Banner (2500′); Inkopah Gorge (2300′); 5 miles east of Desert Center (750′); 3 miles east of White Tank (3000′); Joshua Tree (3000′)

BAJA CALIFORNIA: 20 miles north of San Felipe (200′)

SONORA: El Boludo, L. F. Byars; 2, 10 and 22 miles south of Sonoyta (1400–800′); Arroyo el Apache (2200′); Puerto Gonzalitos (2000′); 10 miles south of Hermosillo (700′); 10 and 15 miles north of Guaymas (100–150′)

There seems to be no significant difference in the habits of *xerophila xerophila* and those of the subspecies *tucsonica*. A fully developed colony may consist of thirty or forty majors and as many as two or three hundred workers, although many colonies do not reach this size. Both races sometimes construct a small, low crater, but this is not a constant feature of the nest. During much of the year the only external evidence of the nest is its small, circular entrance which is usually about 2 mm. in diameter. Chaff piles are rarely produced. The senior author has encountered well-developed chaff piles in only one station (15 miles north of Guaymas, Sonora). The infrequent presence of a chaff pile may be due to its dispersal by wind or rain (as is true of the crater) or it may be due to a tendency of the ants to carry seed hulls well away from the nest before dropping them. Both majors and minors forage and usually form files when doing so. In southern Arizona the marriage flight occurs in July. There follows the description of the female of *Pheidole xerophila tucsonica* Wheeler (Fig. 9):

Female: Length, 6.88–7.20 mm.; head length (excluding mandibles), 1.12–1.20 mm.; head index, 1.18; thorax length, 2.17–2.25 mm.

Head, not including the mandibles, noticeably wider than long, occipital border almost straight except for a slight indentation at the center, occipital corners rounded but distinct, sides of head converging slightly to the insertions of the mandibles, at which point they flare minutely before joining the clypeus; widest point of the head posterior to the compound eyes. Eyes large, completely lateral, occupying over ⅓ of the sides of the head. Ocelli large and moderately convex, but not tuberculated. Median cephalic sulcus present but shallow. Frontal area only slightly depressed. Frontal carinae short, divergent, and extending posteriorly about ½ the length of the head. Clypeus flat except for a low carina in the middle, and its anterior border gently curved save for a shallow emargination in the median lobe. Antennal scape straight with only a moderate curve at the base, distal portion somewhat swollen, and reaching to a point about ¾ the distance from its insertion to the posterior angle or occipital corner of the head; funiculus with a well-developed, three-segmented club. Mandibles triangular, having the usual moderately curved border and the incisor edge entire except for a bidentate apex.

Thorax through the mesopleura, as wide as the head. Prothorax rises vertically. Anterior edge of the scutum, in profile, vertical, dorsal surface flat and the mesonotum continuing in the same plane through the pre-scutellar plates and the scutellum; the latter stands distinctly above the metanotum. Parapsidal furrows distinct. Basal face of epinotum concave, slopes posteriorly and imperceptibly joins the declivity; spines reduced to broad, triangular tubercles. Petiole with distinct anterior peduncle; node high, compressed antero-posteriorly, carinate laterally, with narrow, slightly emarginate, superior border. Postpetiole 1½ times as wide as the petiole, with broad, blunt, lateral connules, and the dorsal surface rather flattened. Gaster of the shape typical for the genus.

Sculpture: Occiput and vertex smooth and shining except for conspicuous piligerous punctures; frons and genae punctate and longitudinally rugose with some fine interrugal striations which do not obscure the shining surface; clypeus finely striate but shining; gula heavily punctate but shining; mandibles with moderate punctures, smooth and shining. Prothorax coarsely striate, subopaque; mesonotum (scutum, scutellum, and pre-scutellum) and mesopleurae with widely spaced, coarse punctures, but otherwise smooth and shining; metanotum granular, subopaque; metapleura coarsely striate and opaque; basal and declivious faces of epinotum transversely rugulose, and epinotal pleura irregularly rugulose, opaque. Anterior face of petiolar node and the peduncle smooth, sides granular; posterior face of node rugulose, opaque; postpetiole smooth and shining except connules which are finelo granular under high magnification. Gaster smooth and shining.

Pilosity: Abundant, erect, pointed, yellowish hairs cover all surfaces of the body except the dorsum of the epinotum and peduncle, and extend to the legs, scapes, and funiculi; they are especially long on the clypeus, frons, gula, and gaster.

Color: Head and mandibles ferrugineous, prothorax and mesopleura light brown; mesonotum dark brown except for an anterior and two lateral spots, and the pre-scutellar plates which are lighter; scutellum dark brown, epinotum, petiole, postpetiole and gaster reddish brown, lighter dorsally; legs and antennae yellowish brown. Wings transparent, pale yellow, stigma pale brown; one closed discoidal cell.

Gynetype: Winged female (♯999) collected at Wilcox, Arizona, at an elevation of 4100 feet, by W. S. Creighton, on July 6, 1950. Eight other winged females and one deälate female are present in the series from which the type was selected, together with eleven soldiers and twelve workers.

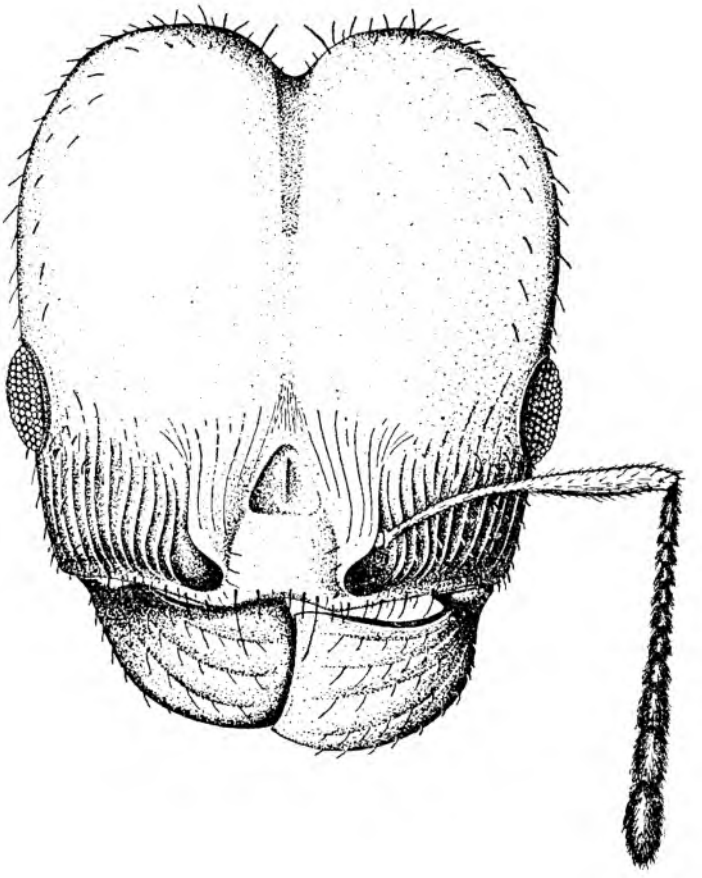

FIG. 10. *Pheidole yaqui* sp. nov., head of major

Pheidole yaqui sp. nov (Fig. 10)

Major: Length, 3.42–4.42 mm.; head length (excluding mandibles), 1.08–1.33 mm.; head index, 1.0; thorax length, 0.83–0.92 mm.

Head, not including the mandibles, fully quadrate; evenly convex from anterior to posterior border and from side to side; prominent but well-rounded occipital lobes, and a strongly developed median cephalic furrow, extending as far forward as the frontal area where it is extremely shallow; lateral borders of the head convex though slightly flattened. Frontal carinae low and small, and slightly divergent, disappearing at the anterior level of the eyes. Frontal area impressed and crossed by a median carinula. Anterior clypeal border straight except for a very shallow median impression; median lobe flat, lateral lobes descending rapidly to rather deep antennal pits. Eyes moderate in size, containing about 60 to 65 facets, oval and truncated anteriorly, somewhat convex, laterally placed, and situated anterior to the middle of the head. Eyes conform to the general

contour of the head which converges from them to the mandibular insertions. Antenae 12-segmented; scape narrow and curved at the base, the distal portion somewhat incrassated, and extending ½ the distance from its insertion to the margin of the occipital lobe; funicular segments 1–8 longer than broad, antennal club distinct and composed of three segments. Mandibles stout, evenly curved and armed with two apical teeth. Gula almost flat.

Thorax through the pronotum slightly less than ½ as wide as the head; humeral angles pronounced and rather sharp, sides of the pronotum slightly concave and rising to a noticeable but blunt median ridge; pro-mesonotal profile continuous, the mesonotum flat and sloping posteriorly to a sharp angle where it descends abruptly and vertically to the meso-epinotal suture, which is impressed; epinotum higher than long, the basal face forming an obtuse angle with the declivity; spines stout, fairly sharp, and divergent. Petiole of normal proportions, anterior peduncle biconcave from above and rising through a gradual curve to the node, the latter truncate dorsally and with a weak, superior emargination; no ventral spine; posterior peduncle very short. Postpetiole subglobose from the side, higher than long; from above twice as wide as the petiole, wider than long, trapezoidal, and with short, blunt, lateral connules. Gaster of the usual shape, except that the anterior border is markedly truncate.

Sculpture: Lateral lobes of clypeus, frons, and genae as far as the eyes, traversed with fine, subparallel rugae, having very little interrugal sculpture with consequent shining surfaces; median lobe of clypeus, frontal area, vertex, and occipital lobes very smooth and shining, except for conspicuous piligerous punctures that are only slightly greater in diameter than the hairs which arise from them. Mandibles rugose but shining. Gula smooth and shining. Dorsum of pronotum and mesonotum almost entirely smooth and shining, only the humeri presenting a few short rugules, while a small area on the neck of the pronotum is coriaceous. Propleura, mesopleura, and epinotal pleura rugo-granulose, in part subopaque; epinotal base and declivity granulose, with several transverse rugae, subopaque. Petiole and postpetiole granular except the dorsum of each which is mostly smooth and shining. Gaster smooth and shining but with piligerous punctures.

Pilosity: Erect, flexible, yellowish hairs of varying length cover all surfaces of the head, mandibles, thorax, legs, gaster, and the dorsum of the petiole and postpetiole, longest on the two latter regions, and on the clypeus, gula, and the pro-mesonotum; antennal scapes and funiculi pubescent to pilose. Eyes hairless.

Color: Body, including legs and antennae, golden yellow, except sutures, articulations, and anterior clypeal margin, which are a little darker; borders and cutting edges of mandibles black.

Minor: Length 1.75–2.0 mm.; head length (excluding mandibles), 0.50–0.58 mm.; head index, 1.0; thorax length, 0.50–0.58 mm.

Head, without the mandibles, and excluding the eyes, as broad as long. Eyes oval, lateral in position, rather convex and protruding considerably from the head; composed of about 60 facets. Occipital border broadly and shallowly impressed at the median sulcus which extends forward faintly on the vertex; lateral margins of the head convex. Frontal carinae well developed, straight, and extending as far as the anterior edges of the eyes. Frontal area depressed and without a median carina. Median lobe of clypeus convex, lateral lobes narrow and ridge-like, anterior margin evenly curved and slightly sinuate toward the lateral corners. Antennae 12-segmented, with club similar to that of the major; scapes surpassing the occipital corners by an amount equal to ⅓ the length of the first funicular joint; insertions deep. Mandibles triangular, evenly curved, bidentate at the apex, with denticulate incisor edge.

Thorax almost ⅔ as wide as the head; pro-mesonotal profile low, convex, but flattened on the mesonotum; meso-epinotal suture impressed but rather shallow; basal and declivious faces of the epinotum equal in length and meeting at an obtuse angle; epinotal spines narrow, sharp, and projecting almost vertically. Petiolar peduncle short, joining the node through a gradual curve; node distinct but rounded from all aspects; posterior peduncle almost obsolete. Postpetiole subglobose,

much lower than the petiolar node, only very slightly wider (1/4) than the petiole; lateral connules lacking. Gaster similar to that of the major but proportionately narrower.

Sculpture: All surfaces of the head smooth and shining except for fine striations on the frontal carinae and the genae below the eyes. Mandibles striate. Entire prothorax and mesonotum smooth and shining; mesopleura and all surfaces of the epinotum granulose, with several rugae on the ventro-lateral border of the epinotum. Petiole and postpetiole smooth and shining, except for a few faint granules on the sides of the former. Gaster smooth and shining.

Pilosity: Hair pattern similar to that of the major, but hairs not as dense.

Color: Golden yellow and very similar to that of the major, except that the vertex and the center of the occiput are golden brown, and the mandibular teeth also brown.

Holotype: Major, deposited in the junior author's collection.

Paratypes: 19 majors and 53 minors from the same nest as the holotype.

The type colony of *Ph. yaqui*, which is one of two nests taken at Yaqui Well (1300′) in the Anza Desert State Park in California, consisted of twenty majors and fifty-three minors. Seven additional nests of *yaqui* were secured at the following stations:

CALIFORNIA: Borrego Wells, San Diego County (300′) 1 colony; The Narrows, Vallecito Mts., Anza Desert State Park (1200′) 1 colony; Palm Canyon Camp Ground, Anza Desert State Park (800′) 1 colony

BAJA CALIFORNIA: Melings Ranch, Sierra San Pedro Martir (1800′) 3 colonies; 5 miles north of San Felipe (sea level) 1 colony

The total material examined in the case of this species consists of 108 majors and 245 minors and exhibits a very satisfactory constancy in the structural features which distinguish *yaqui* from the other members of the *xerophila* complex. The major of *yaqui* is smaller than that of any other member of the complex. Since the size of the major in this group is correlated with the age of the nest, it is necessary to remember that the figures given below apply to the large majors which occur in fully developed colonies. The head length of such majors (mandibles excluded) is as follows: *Ph. yaqui* 1.3 mm.; *gilvescens* 1.5 mm.; *xerophila xerophila* and *xerophila tucsonica* 1.7 mm.

The shape of the head in the major of *yaqui* is different from that of the major of the other three forms. It lacks the dorsoventral compression which gives the characteristic shape to the head of the major in *xerophila*, *tucsonica*, and *gilvescens*. In *yaqui* the upper surface of the head is evenly convex (except for the occipital groove) both from front to back and from side to side. In the other three forms the dorso-ventral flattening has greatly modified the convexity of the upper surface of the head. There are two flattened areas — one which extends rearward from the antennal fossa toward the occipital lobe, the other which parallels the frontal and occipital groove and slopes from the frons to the occipital border. These two flattened areas meet in a blunted and very obtuse angle which runs diagonally from the frons to the top of the occipital lobe. These flattened areas not only modify the convexity of the upper surface of the head but also notably reduce the thickness of the occipital lobes. Viewed in profile the occipital lobes have the appearance of

truncated cones with only the top of the cone rounded. Their profile outline is, therefore, very different from that of the thick and evenly convex occipital lobes of *yaqui*.

The major of *Ph. yaqui* shows several distinct sculptural features not met with in the other members of the complex. The piligerous punctures on the rear half of the head are small and obscure. Their diameter is only a little greater than that of the hairs which rise from them. In the other three forms the piligerous punctures on the head are coarse and conspicuous and notably greater in diameter than the hairs which rise from them. The thoracic sculpture of the major of *yaqui* is even more distinct. The transverse rugae on the pronotum are confined to several short, delicate ridges on the humeri, none of which cross the pronotum. The remainder of the pronotum and the entire dorsum of the mesonotum are very smooth and shining and completely free from coriaceous sculpture except for a narrow band at the anterior margin of the neck. In the other three members of this complex the transverse rugae cross the thorax, and even in the smoothest representatives there is always some coriaceous sculpture on the dorsum of the pronotum. The characteristics which distinguish the minor of *yaqui* have been given in the key (see page 40).

The nests of *yaqui* are always small. They usually consist of twelve to fifteen majors and about three or four times that number of minors. The majors forage with the minors occasionally but much less often than in *xerophila*, where it is the rule for both majors and minors to forage. *Ph. yaqui* prefers very arid nest sites, and in this particular it agrees more closely with *gilvescens* than with *xerophila*. The senior author was unable to get any evidence of the food preference of *yaqui*. No chaff piles were encountered and no seeds were found in the nests. If the ant is a harvester it is certainly not a conspicuous one.

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