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THE TAXONOMY, DISTRIBUTION AND ECOLOGY
OF
CALIFORNIA DESERT ANTS

(Hymenoptera: Formicidae)

by

Roy R. Snelling and Chris D. George

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THE TAXONOMY, DISTRIBUTION AND ECOLOGY OF

CALIFORNIA DESERT ANTS

(Hymenoptera: Formicidae)

by

ROY R. SNELLING¹ and CHRIS D. GEORGE²

Abstract. A total of 99 species of ants, in 26 genera, are recognized to occur within the combined Mojave and Colorado Deserts of California. Keys for subfamilies, genera and species are provided, often for all castes and subcastes. The keys are supplemented by pertinent illustrations.

Two species, Cardiocondyla ectopia and Paratrechina longicornis, are adventive. Of the native species the majority (64%) may be considered true hot desert ants. Most (53%) are clearly of Sonoran affinities, the remainder are related to Great Basin Sagebrush Desert or California Chaparral groups.

Each species is briefly discussed and all verified locality records are shown on maps; specific collection data are given only when the number of records is small. Such general and specific ecological data as have been available are included and discussed. We have attempted to deduce some general ecological patterns relative to the ants of our area.

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INTRODUCTION

We undertook this study in order to determine the composition, distribution and general ecology of the ants of the California desert regions. Since some sort of artificial boundaries had to be established we adhered to those of the California Desert Plan Program, Bureau of Land Management, U. S. Department of the Interior, an area of approximately 256,730 hectares (40,114 square miles). The ant fauna of no comparably large desert area has ever been so surveyed. The increasingly important role of ants as subjects for ecological studies in arid lands renders a study such as this one necessary.

The standard reference work for systematics of ants in the United States is Ants of North America by William S. Creighton (1950). This work, the first modern study of a major ant fauna, is now very much in need of revision. Several large genera with desert representation have been revised, and Creighton's keys are no longer pertinent. Furthermore, the experience of the senior author has been that those keys are very difficult for the nonmyrmecologist.

Of T. W. Cook's The Ants of California (1953) we have little good to say. The work was hopelessly outdated at the time of its publication. Keys, as such, are wholly lacking. The bulk of the text, including the distribution records, is gleaned from previously published works of other authors. Often these earlier records were, as we now know, based on misidentified specimens and therefore Cook merely compounded the difficulties faced by the unwary. The illustrations frequently are erroneous or irrelevant. Throughout the text which follows we have made no further mention of this myrmecological curiosity, except to note the proper synonymic placement for a couple of the forms described as new by Cook.

The only other principal reference work is The Ants of Deep Canyon by George C. and Jeanette Wheeler (1973). Since the Deep Canyon transect utilized by the Wheelers extends from low desert to coniferous forest, it includes many nondesert species. And, since it is a restricted study, its applicability to the desert, as a whole, is limited. Nonetheless, it ranks as a work of major importance, and has been much used by investigators of desert ants. The keys, though based solely on worker castes, are quite workable and are supplemented by pertinent illustrations.

The present study, encompassing as it does, a far more extensive area, naturally deals with more species. Even so, the pertinence of The Ants of Deep Canyon to the entire California desert region is impressive. The Wheelers include 19 genera in the desert part of their study with a total of 52 species. In our much larger area we have 26 genera and 99 species (Appendix 1). Thus, they dealt with 73% of our genera and 53% of our species. When allowance is made for those species which barely enter our area, with only one or two records, their species treatment is about 60% of ours.

ACKNOWLEDGMENTS

A study of this sort naturally cannot be unilateral. It requires the assistance and cooperation of individuals other than the investigators. We wish to express our sincere gratitude to each of the following for their generous assistance toward the success of this study, for without their aid, our results would certainly be the poorer.

For the opportunity to study specimens in their care we thank: F. G. Andrews & M. S. Wasbauer, California Department of Agriculture (CDA); P. H. Arnaud, Jr., California Academy of Sciences (CAS); J. A. Powell, University of California, Berkeley (UCD); R. O. Schuster, University of California, Davis (UCD). A particular note of gratitude must be expressed for the generosity of S. Frommer, University of California, Riverside; the UCR ant material was, through his cooperation, transferred to the LACM on permanent loan.

We are especially, and most notably, indebted to George and Jeanette Wheeler (GJW). Theirs is the largest collection of desert ants other than that of the LACM. They not only permitted us to study their material, but we had unlimited access to their field notes. And, several days and many letters of their time in which they shared their knowledge and experience.

A formidable amount of lizard fecal samples was made available by B. F. Turner & P. A. Medica. This material has been fascinating and very informative.

We also must express our gratitude to R. Gustafson, LACM, for identifying many very drab and uninteresting plant samples. His assistance has been invaluable.

Finally, we wish to thank Kristin Berry, Desert Management Program, Bureau of Land Management, U. S. Department of the Interior, whole enthusiastic interest made this project possible.

THE CALIFORNIA DESERTS

The area encompassed by this study includes the California portions of the Mojave and Colorado Deserts as well as a fringe of the Great Basin Sagebrush Desert. It includes the California distribution of the Creosote Bush Scrub, the so-called "hot desert". The Great Basin Sagebrush Desert is "cool desert" in the sense of Wheeler & Wheeler (1973).

Our attention has focused on the "hot desert" portions and we consider the "cool desert" to be marginal, for few of the species present there also occur in the Creosote Bush Scrub. Pinon-juniper Woodlands in the higher desert mountain ranges are generally excluded from this study for they, too, are "cool desert" habitats with few species shared with the "hot desert".

The Colorado Desert

We have persisted in using this term within this report though, as far as ants are concerned, there is little justification for doing so. "Colorado Desert" is a term of convenience only and must be understood as such. The Colorado Desert is the northwestern extension of the Sonoran Desert; it includes the drainage of the lower Colorado River and the Gila River in Arizona, the northwestern lowlands of Sonora and northeastern Baja California. For our purposes, it is bounded on the south by the International Border and on the west by the mountains of the Coast Ranges: the Laguna, Santa Rosa and San Jacinto Mountains. The eastern boundary is the Colorado River, north to Needles. In the northwest the Little San Bernardino, Cottonwood, Eagle and Coxcomb Mountains form a partial boundary; east of these ranges the desert floor gradually rises to an elevation of more than 1100 feet and merges into the Mojave Desert through a gradual ecotone.

Although the Colorado Desert is among the most arid regions in North America, there is a bimodal pattern of precipitation, in contrast to the unimodal pattern of the Mojave Desert. According to Shreve (1925) summer rainfall increases from about 5% of the annual total along the western margin to about 34% at the Colorado River. Annual totals for

black pebble beds ("desert pavement") may occur between arroyos; these are often entirely without perennial vegetation.

Cactus Scrub (Figs. 279, 280), located mostly on south-facing slopes, is our only community dominated by stem-succulents. Although the soil type can usually be called rocky, the soil is fine-textured and rocks are interspersed. Intermediate sized, or gravelly, soil particles are usually absent. Dominant plants here include: Opuntia spp. (incl. O. bigelovii), Echinocactus acanthodes and Echinocereus engelmannii.

On sites, usually in rocky canyons, with a permanent water supply we find Palm Oases, visually dominated by Washingtonia filifera (fig. 278). Soil salinity is low in the root zone but rises toward the surface where salt crust is often present. Other important floral elements may include Sporobolus airoides, Juncus acutus, Pluchea sericea and Haplopappus acradenius. Tamarix spp. and Prosopis glandulosa may also be present.

Once a prominent feature of the Salton Sink, Saltbush Scrub is now largely under cultivation. This is a lowland community of sandy loamy soils with a salinity range of 0.2-0.7 ‰. Dominant perennials in this biome are Atriplex polycarpa, A. canescens, Prosopis glandulosa and Haplopappus acradenius var. eremophylus.

Along the Colorado River and the margins of the Salton Sea are belts of wet, heavy soils with a salinity ranging from 0.5-2‰. Codominant plants here are Allenrolfea occidentalis and Suaeda torreyana, defining the Alkali Sink biome. Other important elements are Tamarix spp., Pluchea sericea, Baccharis glutinosa, Atriplex lentiformis, Prosopis pubescens, Salix goodingii and Populus fremontii.

the desert are, however, essentially meaningless: the total may be the result of a single storm, mostly lost due to high runoff rate; further, rains are often highly localized and any one site may go for years with no rain at all.

The preeminent vegetation community in the Colorado Desert is Creosote Bush Scrub, with Larrea tridentata and Ambrosia dumosa as codominants. Other important components within this biome include Coldenia palmeri, Croton californicus, Dalea schottii, D. emorvi, Hilaria rigida and Ephedra trifurca. This community is characteristic of the bajadas and is especially well developed in soils of low alkalinity (0.02%) and of coarse, well drained texture. Creosote Bush Scrub is interposed between high, rocky hillsides and Saltbush Scrub in the lowlands.

Where the bajadas are crossed by washes and arroyos a relatively dense growth of trees is formed. This is Wash Woodland (Figs. 289, 290), characterized by Cercidium floridum, Olneya tesota, Dalea spinosa, Lycium andersonii, Prosopis glandulosa var. torreyana, Chilopsis linearis, Condaliopsis lysoides and Baccharis sarothroides. Very flat black pebble beds ("desert pavement") may occur between arroyos; these are often entirely without perennial vegetation.

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The Mojave Desert

Bounded on the west by the Tehachapi and Transverse Ranges, the Mojave Desert extends north through the Owens Valley to about Big Pine and eastward to Eureka Valley; in these areas it is complexly interdigitated with Great Basin Sagebrush Desert. In the east the boundaries are political: the Nevada State Line and the Colorado River. In the south, the San Gabriel, San Bernardino, Little San Bernardino, Cottonwood, Eagle and Coxcomb Mountains form a convenient margin. Beginning at about Needles on the Colorado River, and east of the above ranges, the Mojave merges gradually into the Colorado Desert. Within the Mojave Desert basin elevations range from about 1000 to 3300 feet, but include Death Valley, below sea level. The Chuckwalla Mountains in Riverside County seem also to be Mojavean and may be considered an isolated fragment.

Precipitation in the Mojave Desert is unimodal, winter rains and/or snow. Scattered summer rain may occur in the eastern portions, usually drifting north from the Colorado Desert. Unlike the Colorado Desert, the Mojave does not have as pronounced a rain shadow along the western margins and, in general, total annual precipitation decreases from west to east.

As is true in the Colorado Desert, Creosote Bush Scrub (Figs. 276, 277) is the main vegetational feature, but the diversity of perennials, especially of trees, is much less. Within the Creosote Bush Scrub, which covers some 70% of the Mojave (Shreve, 1942), the codominants are Larrea tridentata and Ambrosia dumosa. Other perennials, in varying combinations, are Yucca schidigera, Stipa speciosa, Ephedra nevadensis, Atriplex spp., Opuntia spp., Lycium andersonii and Gravilla spinosa.

The Shadscale Scrub occurs as a community between Creosote Bush Scrub and Sagebrush Scrub, usually on mountain slopes with dense, rocky soils. Dominants in this association are Atriplex confertifolia, Artemisia spinescens and Sarcobatus baileyi.

One of the most conspicuous biomes in the Mojave Desert is that of the Joshua Tree Woodland (figs. 286, 287), for Joshua Trees are large and often bizarre in appearance. This community is found between Creosote Bush Scrub and Piñon-juniper Woodlands on gentle slopes with fine gravelly-sandy loams. In addition to the Joshua Tree (Yucca brevifolia) there is a well developed understory featuring combinations of Juniperus californicus, Ephedra spp., Eurotia lanata, Haplopappus spp., Hilaria rigida, Salazaria mexicana, Hymenoclea salsola, Opuntia ramosissima, Muhlenbergia porteri and Yucca baccata.

Saltbush Scrub of the Mojave Desert is roughly equivalent to Alkali Sink in the Colorado Desert but trees are usually absent. Dry soils with low salt content are dominated by Atriplex confertifolia, A. hymenolytra and A. polycarpa; these characterize the xerophytic phase of the Saltbush Scrub. This xerophytic phase (Figs. 282, 284) is widespread in basins and valleys and often exists between the halophytic phase and the surrounding biome, usually Creosote Bush Scrub. Soil of high mineral content on playas, sinks and seeps supports the halophytic Saltbush Scrub. Principal components here include Allenrolfea occidentalis, Nitrophila occidentalis, Salicornia subterminalis, Suaeda spp. and Sarcobatus vermiculatus. A variant of the halophytic phase occurs along semipermanent water courses and includes cottonwood and mesquite (Fig. 285).

Scattered throughout the western Mojave Desert, above the Creosote Bush Scrub, there exists a vegetation of low, dark shrubs, often in combination with Joshua Tree Woodland, designated the Blackbush Scrub. The characteristic plant is usually blackbush (Coleogyne ramosissima). However, Blackbush Scrub has been extended to include communities with this characteristic appearance even when Coleogyne is absent. Eriogonum fasciculatum is an important member of this community which includes a wide and varied assemblage of such species as Salazaria mexicana, Ephedra spp., Opuntia spp., Artemisia spinescens, Eurotia lanata, Atriplex spp.,

 

Haplopappus cooperi and Juniperus californicus. It often has the appearance of Joshua Tree Woodland without the Joshua trees.

Most of the above information is, of course, synthesized from other sources. Data for the Colorado Desert is largely from Burk (1977). For the Mojave Desert we drew principally from Vasek and Barbour (1977). Other important sources included Munz (1970) and Johnson (1968).

METHODS AND GENERAL NOTES

The taxonomic portion of this study followed the usual procedures. Initially, we surveyed the existing literature for references to California desert ants. Except for those describing new California forms, these records are often based on misidentifications. When we were unable to verify the identification or locality, we did not accept the record.

Based on this literature survey and the collections of the Natural History Museum of Los Angeles County (LACM) we assembled a list of 25 genera and 81 species for our area. Of these, three genera were ultimately eliminated (one, however, through transfer of its sole representative to another genus, already included) as were five species. We, therefore, had records for 88% of the genera and 77% of the species in our area.

Our next phase was a survey of existing collections. We visited and examined collections in a number of institutions. Here, we identified all pertinent ant specimens that we could locate and recorded the data. In general, the results were disappointing (See COLLECTION ASSESSMENT below).

Several field trips were made to selected areas which, on the basis of data then available to us, required attention. We faced a problem that we could not have anticipated and it severely curtailed the effectiveness of our activities. As a result of Proposition 13 all travel by employees of Los Angeles County was effectively eliminated during the spring and summer months. The senior author utilized such vacation time as he had available, but this was not enough to entirely offset the damage of the travel ban.

The time-honored field method for the myrmecologist is to wander about, locating ant nests, digging into them and collecting samples. This was, and remains, the primary method. The berlese funnel technique is of very limited effectiveness in desert habitats because there is so

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little litter suitable to this method. Berlese samples contributed fewer than 20 specimens to this study.

Ethylene glycol pit traps have also been utilized. These can be effective but unless placed with care can also be a waste of time and energy as a survey method. They are probably a good technique for use by the nonmyrmecologist, however. Pitfall traps did not yield any species not already collected by conventional methods by an experienced myrmecologist. In some instances they are not as effective, for some small ants either do not enter them or are able to walk out without falling into the ethylene glycol.

Baits were also used. Our most frequently used baits were wheat germ, honey-water and tuna fish. Other food items, such as peanut butter, fruits and fruit juices, bits of meat, were also utilized on an opportunistic basis. Baits are effective for sampling an area, especially for those species which forage on the surface of the soil and seems particularly good for crepuscular and nocturnal species.

While in the field we photographed habitats and nest tumuli. Some ants construct quite characteristic tumuli. Excellent examples are those of Veromessor pergandei (Fig. 301), Acromyrmex versicolor (Fig. 307) and Myrmecocystus mexicanus (Fig. 318). However, the usual tumulus is a simple crater of excavated soil and the ultimate appearance is dependent upon the type of soils available, vegetation, weathering and slope. Another factor is the age of the colony. Thus, mature colonies of V. pergandei construct rather large, low rings of soil surrounded or covered by a ring of chaff; the tumulus of a new colony is a simple crater indistinguishable from that of many other ants. Furthermore, in the same area one nest of any given species may be surmounted by a normal crater and another a few meters away may not have any tumulus.

Our conclusion on tumuli as a means of identification is: don't attempt it. We found that, in general, they are not dependable except for a few species. In the field, as experienced observers of ants, we were wrong as often as right, once the obvious species, such as those listed above, were discounted. We fared better at the generic level than at the specific.

While collecting in the field we observed ant behavior: when they were foraging, temperatures at which they were and were not surface active, how far they foraged, forage items and interactions with ants

and other organisms. Forage items were collected for identification. We also collected samples of nest debris which, of course, included remains of forage items discarded once they had been cleaned of any food.

Such debris samples can be very informative. In several instances we were able to recover remains of ant species which we had not located at a specific site. These debris samples can be utilized as an adjunct to normal survey methods, for ants are very effective scavengers. In another instance a debris sample yielded hundreds of termite head capsules. Since all were those of the soldier caste, it seems safe to infer that the ants had gained access to the nest of the termites.

Remains of other ants were a conspicuously large part of these debris samples. At first, it was assumed that these were remains of prey items. This interpretation is surely only partly correct. For all the time we've spent in the field over the last fifteen years, we have witnessed very few aggressive encounters between ants, certainly not enough to explain the relatively large number of fragments in the debris. Another explanation now seems more plausible. In collecting samples from returning foragers we found that remnants of other ants were certainly well represented. Generally these were quite dry, and obviously did not represent a fresh "kill". Rather, they were scavenged items from debris piles of neighboring community members (George, in preparation).

Workers of such well-known scavengers as Solenopsis, Forelius, Conomyrma and Myrmecocystus are often seen on and around the mounds of other ants. Usually, their presence is ignored by the resident species and direct confrontation is rare. The "visitor" rummages through the debris and eventually finds something to carry off. Rarely, the "visitor" indulges in brigandage and actually snatches an item from a returning forager of the resident. Species of Conomyrma are especially noted for such behavior.

All data gathered in the field were recorded on data cards and were also recorded in notebooks. These are part of the data file on ants maintained by RRS at the LACM. Specimens are provided with field numbers which correspond to file card numbers.

Preparation of keys and illustrations was conventional. Our only departure from convention is that we have separate keys for workers, females and males in many cases. In some cases, keys for the sexual

forms were not feasible because these are still too poorly known. Spot maps represent every verified locality for each species. The taxonomic portion was the work of RRS and he assumes sole responsibility for all taxonomic decisions, whether good or bad. So, too, with the figures and maps.

In citing geographic data we have continued to use the English system. Thus, miles instead of kilometers, feet instead of meters for elevations. Currently, all topographic and general maps are based on this system and until new maps with metric coordinates are available, this seems the only sensible approach. Otherwise, all measurements are metric. Temperatures are in °C; air temperature is abbreviated AT, surface temperature, ST.

A few new species were encountered. No names are provided for these in order to avoid possible premature publication of manuscript names. These species will be formally named and described in a future paper by RRS.

COLLECTION ASSESSMENT

Normally, authors do not make comment on the collections studied. We choose to be exceptional. Ecologists are increasingly aware of the importance of ants within arid ecosystems. This means that, increasingly, these organisms will be subjected to study. Inevitably, ecologists will find it necessary to refer to systematic collections and taxonomists to provide identifications for their subjects.

Groups popular to collectors are usually well represented in several collections. Not so for ants. Ants are mostly medium-sized or smaller, usually unobtrusive and not very spectacular to look at. As a rule, ants are collected only in passing or not at all.

Historically, it has been difficult to get identifications on miscellaneous ant material, for ant taxonomy is formidable to the uninitiated and specialists not much prone to look at a lot of ordinary, casually collected material. Further collecting tends to be discouraged. Consequently, there is not a great deal of ant material in the more important western collections. We have found, in general, that most collections had either very little in the way of ants or that they had more exotic than native ants. The collections of the California Academy of Sciences (CAS), University of California at Berkeley (UCB) and at Davis (UCD) must be ranked as minor, as far as their holdings of

southwestern ants are concerned. We do not disparage these collections, for they have important material. And, such collections can only reflect the interests of their curators, past and present.

One of the largest collections, not surprisingly, is that of the California Department of Agriculture (CDA). Since ants often are considered to be pests, any collection emphasizing pests would accumulate many ants. The material is adequately prepared, but mostly unidentified.

The very large collection amassed by George and Jeanette Wheeler (GJW) reflects their long interest in, and involvement with, ants. It is extensive, well curated and, in the case of material collected by the Wheelers, accompanied by field notes on file cards. This collection was invaluable to our study.

The collection of the Los Angeles County Museum of Natural History (LACM) is the largest collection of western American ants, especially of the southwestern United States and adjacent Mexico. It, of course, houses the material collected by RRS. In addition, it includes the very important collections of A. C. Cole, Jr. and W. S. Creighton, as well as their field notes. Here, too, is a large library of ant-oriented literature, with particular emphasis on systematics.

DATA CITATION

Information relative to the distribution of the ants of the Colorado and Mojave Deserts has been cited by three different methods. First indicated in RANGE: here is cited, in general terms, the total known range of the species. This is followed by DESERT RECORDS: under this heading the range of the species within the Mojave and Colorado Deserts is indicated. In the case of species for which there are many records a general statement is made.

Where there are few records (usually fewer than 20) collection data are cited in full: locality, date, collector(s), field numbers (where apropos) and depository of the sample.

A few abbreviations in data citation are used, in addition to those of specimen depositories, already noted above under ACKNOWLEDGEMENTS. These are: ABDP, Anza-Borrego Desert State Park; DG, Derham Giuliani collector; DVNM, Death Valley National Monument; GJW, George and

Jeanette Wheeler collectors; JTNM, Joshua Tree National Monument; RRS, R. R. Snelling collector; RRS & CDG, R. R. Snelling & C. D. George collectors; WSC, W. S. Creighton collector.

TERMINOLOGY

The morphological and other terms used here are, for the most part, those traditional to ant systematics. The worker caste of ants, a specialized female form, because of its structural modifications often presents some problems to the uninitiated. The explanations given below will, we hope, reduce possible confusion.

HEAD (Figures 1-9)

Eye length (EL). The greatest length of the eye, usually taken in lateral view (Fig. 3).

Gular teeth (Fig. 7, glrt) are present in major workers and females of Pheidole. One or two pair, an inner pair on either side of the gular suture, the outer pair near the base of the mandibles.

Head length (HL). With head in frontal view, the maximum length along the midline, from the anterior clypeal margin to the occipital margin. The head, in this position, is in full frontal view (Fig. 2).

Head width (HW). With head in full frontal view, the maximum width along a line perpendicular to that of HL, exclusive of the eyes (Figs. 2, 4).

Interocellar distance (IOD). The minimum distance between the inner margins of the posterior ocelli (Fig. 4).

Minimum ocular diameter (MOD). The minimum diameter of the compound eye, measured perpendicular to EL (Fig. 3).

Ocellar diameter (OD). The maximum transverse diameter of the anterior (middle) ocellus.

Ocellocular distance (OOD). The minimum distance between a posterior ocellus and the nearest compound eye (Fig. 4).

Oculomandibular distance (OMD). The distance between the lower margin of the compound eye and the nearest point of the base of the mandible (Fig. 3).

Mandibular teeth. The lower or outermost tooth is the longest and sharpest as a rule; this is the apical tooth (apl). The upper, or innermost, tooth is the basal tooth (bsl). Of the remaining, middle

teeth, that nearest the apical tooth is the preapical tooth (pap1); that nearest the basal tooth is the subbasal tooth (sbs1) (Fig. 9).

Psammophore (psm, Figs. 4-6). Located on the underside of the head and along the ventral margin of the mandible. Two types: 1. Complete: a row of very long, flattened, curled, closely spaced setae is present along the posterior margin of the gena. These setae extend over the gular area and are supplemented by similar setae along the ventral margin of the mandible. The enclosed gular area is flattened, devoid of hairs and smoother than adjacent areas of the gena (Figs. 63-68). 2. Incomplete: gula is usually more or less convex, often not sculptured differently from adjacent gena and short hairs may be present; the long setae are widely spaced and often do not completely enclose the gular area nor do they always extend the full length of the underside of the head. In Conomyrma (Fig. 6) and Myrmecocystus (Fig. 5) the maxillary palpi are elongate, beset with long bristles, and are folded back along the gular surface to supplement the incomplete psammophore.

Scape length (SL). The maximum length of the antennal scape, exclusive of the basal condyle (bslc) (Fig. 8).

Antennal segments are numbered 1-n, with the scape as the first segment. Segments beyond the scape are commonly called the funiculus but that term is not used here. The last 2, 3, or 4 segments may be enlarged to form an antennal club (antc, Fig. 8).

The following indices are used:

Cephalic index (CI): $(HW)(100/HL)$.

Ocular index (OI): $(EL)(100/HL)$.

Scape index (SI): $(SL)(100/HW)$.

Figures 1-9. Abbreviations

antc - antennal club
ants - antennal socket
apl - apical tooth (mandible)
atp - anterior tentorial pit
bsl - basal tooth (mandible)
bslc - basal condyle of scape
bsll - basal lobe of scape
cly - clypeus
frc - frontal carina
frl - frontal lobe

lp - labial palp
mdls - mandalus
mlcl - middle lobe of clypeus
mlra - malar area
mndl - mandible
mxp - maxillary palp
occ - occiput
occm - occipital margin
occr - occipital carina
OCOD - oculooccipital distance

 

frmg - foramen magnum
glrt - gular teeth
HL - head length
HW - head width
INOD - interocular distance
IOD - interocellar distance
llcl - lateral lobe of clypeus

OOD - ocellocular distance
pap1 - preapical tooth (mandible)
sbs1 - subbasal tooth (mandible)
sca - supraclypeal area
SL - scape length
tllm - trulleum
vtx - vertex

THORAX (Figures 11-15)

The thorax of the worker ant, although much modified, is usually more or less definitely divided into several segments. The prothorax is represented by the pronotum, distinct at least at the sides. The mesonotum is often distinctly separated from the pronotum by the promesonotal suture; when the two are fused, the resultant structure is the promesonotum. The side of the mesothorax, the mesopleura, is always free of the propleura, but fused with the metapleura, through the mesometapleural suture. Posteriorly, the metapleura is fused with the side of the propodeum, usually without a visible external suture. Dorsally, the metanotum, when visible, is a narrow transverse band immediately posterior to the mesonotum. This is followed by the propodeum (= epinotum of earlier literature), which may be tuberculate or bispinose at the junction of the dorsal and posterior faces.

The thorax of female and male ants is usually much more normal, with the usual, recognizable structures of aculeate Hymenoptera; refer to Figures 13-15.

Figures 11-15. Abbreviations

ax - axilla
mes - mesoscutum (mesonotum)
met - metanotum
mf - Mayrian furrow
msp - mesopleura
mtp - metapleura
mtsp - metathoracic spiracle
not - notaulus
paps - parapsis

ppm - propodeum
pps - parapsidal suture
ppt - postpetiole
prn - pronotum
prsp - propodeal spiracle
pt - petiole
sppt - subpostpetiolar process
spt - subpetiolar process
teg - tegula

 

PETIOLE (Figures 13, 14, 16, 17)

One-segmented in Ponerinae, Dolichoderinae and Formicinae; two-segmented in Ecitoninae, Pseudomyrmecinae and Myrmicinae. The first segment is the petiole. When a second segment is present, it is the postpetiole. The dorsal portion of the segment(s) is elevated to form a node or scale, depending upon its shape. Ventrally, the segments may possess subpetiolar and/or subpostpetiolar processes, often tooth-like or spiniform when seen from the side.

These segments are, morphologically, the true second and third abdominal segments. The true first is immovably fused to the thorax as the propodeum.

GASTER (Figures 16-21).

The remaining abdominal segments are the gaster. In females a sting is present except in the Dolichoderinae and Formicinae. The female castes of the latter have a structure at the apex of the gaster by which formic acid is sprayed in defense, the acidopore; dolichoderines possess an anal slit. Males, of course, have a genital capsule (Figs. 20, 21).

Figures 16-21. Abbreviations

ac - acidopore	pen - penis
aed - aedeagus	pmr - paramere
as - anal slit	ppt - postpetiole
cus - cuspis	pt - petiole
dig - digitus	sppt - subpostpetiolar process
gon - gonobase	spt - subpetiolar process
gs - gastric constriction	

NOTE: cuspis + digitus = volsella (vol)

THE KEYS

The keys are presented in the sincere hope that they will prove useful. Some are synthesized from preexisting keys, but most are newly prepared for this study. We are confident that most work well, provided care is taken to understand each statement. These keys are based on mounted, fully dry specimens and often the characters cannot be properly interpreted with specimens in fluid. All measurements are made with an ocular micrometer and anyone using the keys will find it necessary to utilize the same method.

THE ILLUSTRATIONS

The figures which accompany this text are intended to supplement the keys and taxonomic discussions to illustrate features used in distinguishing between the various genera and species. Usually, simple line drawings are sufficient and details of sculpturing and vestiture are omitted. When these are critical in identification they may be illustrated as supplemental figures (as in Fig. 38a).

A few habitus figures were done by Ruth Ann DeNicola and we are grateful for the opportunity to use them. The remaining figures are the work of the senior author.

 

KEY TO SUBFAMILIES
workers and females

- 1a. Petiole two-segmented (Fig. 14) 2
- b. Petiole one-segmented (Figs. 16, 51) 4
- 2a. Frontal carinae narrow, not expanded laterally, antennal sockets
fully exposed in frontal view (Figs. 31, 33) 3
- b. Frontal carinae expanded laterally, antennal sockets partially
or fully covered in frontal view (Figs. 60, 107, etc.)
. Myrmicinae
- 3a. Eye very large and covering much of side of head, consisting of
hundreds of ommatidia (Fig. 52); thorax of female with flight
sclerites Pseudomyrmecinae
- b. Eye absent or vestigial and consisting of a single ommatidium
(Fig. 38); thorax of female without flight sclerites (Fig. 48)
. Ecitoninae
- 4a. Gaster without constriction between first and second segments
(Fig. 17); functional sting absent 5
- b. Gaster constricted between first and second segments (Fig. 16);
sting present, functional Ponerinae
- 5a. Acidopore present, terminal, circular and usually with a fringe
of setae (Fig. 19); petiole usually erect and scalelike
. Formicinae
- b. Acidopore absent, gaster with preapical, ventral anal slit (Fig.
18a); petiole often low and strongly inclined . . Dolichoderinae

males

- 1a. Petiole two-segmented 2
- b. Petiole one-segmented 3

THE
FEDERAL GOVERNMENT

The Federal Government is the central authority of the United States. It is responsible for the national defense, foreign relations, and the regulation of interstate commerce. The Federal Government is composed of three branches: the Executive, the Legislative, and the Judicial. The Executive branch is headed by the President, who is elected by the people. The Legislative branch is composed of the House of Representatives and the Senate, which are elected by the people. The Judicial branch is headed by the Supreme Court, which is appointed by the President and confirmed by the Senate. The Federal Government is responsible for the protection of the rights of citizens and the maintenance of the rule of law. It is also responsible for the promotion of the general welfare of the United States. The Federal Government is the largest and most powerful of the three levels of government in the United States. It is responsible for the majority of the federal budget and the majority of the federal debt. The Federal Government is also responsible for the majority of the federal programs and services. The Federal Government is the central authority of the United States and is responsible for the protection of the rights of citizens and the maintenance of the rule of law.

- 2a. Clypeus not extending back between frontal carinae; eye large, elongate, subreniform; antenna 12-segmented; Mayrian furrows absent Pseudomyrmecinae
- b. Clypeus extending back between frontal carinae; eye often large, but usually more or less hemispherical; antenna 10-13 segmented; Mayrian furrows often present Myrmicinae
- 3a. Gaster not constricted between first and second segments; mandible usually well-developed 4
- b. Gaster constricted between first and second segments; mandible poorly developed Ponerinae
- 4a. Hypopygium with 3 apical teeth; mandibles always prominent, elongate and rather broad or distinctly sickle-shaped, never short and triangular; gaster elongate-cylindrical Ecitoninae
- b. Hypopygium entire or emarginate, but without distinct apical teeth; mandibles poorly developed or short and triangular; gaster more or less triangular, with apical segments distinctly telescoped 5
- 5a. Scape short, SL less than combined lengths of next four segments; anterior tentorial pit at or above level of lower margin of antennal socket; petiolar scale usually low and strongly inclined; head, in profile, often strongly flattened Dolichoderinae
- b. Scape elongate, SL equals or exceeds combined lengths of next five segments; anterior tentorial pit distinctly below level of lower margin of antennal socket (except Brachymyrmex); petiolar scale usually fully erect; head, in profile, not strongly flattened Formicinae

SUBFAMILY PONERINAE

This primarily tropical subfamily is very poorly represented in our area by three species in two genera. None of these has been collected in any abundance. The two species of Hypoponera are quite widely distributed elsewhere and have been commonly transported to new areas by commercial shipping

The third species, a Cerapachys, is certainly native but quite rare. It is known from a few males from widely separated localities. Workers which may be conspecific have been taken in an oak-chaparral area adjacent to the desert.

KEY TO GENERA AND SPECIES OF PONERINAE

- 1a. Eye, when present, small, occupying less than one-fourth of side of head in lateral view; antenna 12-segmented; sting present, usually exerted (females) 2
- b. Eye large, occupying most of side of head in lateral view; antenna 13-segmented; sting absent (males) 4
- 2a. Pygidium without row of stout setae on either side (Fig. 22); occipital and scrobal carinae absent (Figs. 22, 23) (Hypo-ponera) 3
- b. Pygidium with a row of coarse, erect spine-like setae on each side, convergent apicad (Fig. 26); occipital and scrobal carinae present (Figs. 26, 27) Cerapachys sp.

- 3a. Node of petiole, in profile, distinctly narrowed above (Fig. 22); pubescence very short, fine and mostly appressed
. H. opacior (Forel)
- b. Node of petiole, in profile, as thick above as below (Fig. 24); pubescence long, coarse, suberect to erect .. H. opaciceps (Mayr)
- 4a. Node of petiole, in profile, triangular, sharply differentiated from gaster; forewing, when present, with closed submarginal, marginal and two discoidal cells Hypoponera spp.
- b. Node of petiole, in profile, low, quadrate, not sharply set off from gaster (Fig. 28); forewing with open or weakly closed submarginal cell and one discoidal cell Cerapachys sp.

Genus HYPOPONERA Santschi

With the exception of Ponera pennsylvanica Buckley and P. exotica M. Smith, all New World Ponera were removed to Hypoponera by Taylor (1967). Members of this genus form small colonies of usually fewer than 100 individuals. In some species, such as H. opaciceps, males are wingless and workerlike in appearance.

Nests are generally situated under objects on the ground, such as rocks or stones, or in decaying logs. The ants are " . . . very timid and hide at the first opportunity after being disturbed." (Dennis, 1938) Species of Hypoponera are carnivorous, but not much is known about their foraging habits.

Hypoponera opaciceps (Mayr)

Figures 16, 24, 25

Ponera opaciceps Mayr, 1887:536: ♀ ♀. M. Smith, 1929:545: ♀.
M. Smith, 1936:428: ♀ ♀ ♂. Creighton, 1950:48, 49: ♀. Kempf, 1962:

7-9, figs. 8-9: ♀.

Ponera perkinsi Forel, 1899:117: ♀ ♀ ♂.

Ponera andrei Emery, 1900:318, fig. 47: ♀.

Hypoponera opaciceps, Taylor, 1967:11. Wilson and Taylor, 1967:12, 28, fig. 15: ♀. Taylor, 1968:65.

RANGE: Southern United States to Uruguay; introduced into Formosa, the Philippines, New Caledonia and Polynesia.

DESERT RECORDS. Inyo Co.: China Ranch, 29-30 Oct. 1955 (Blodgett & McDonald; LACM). Riverside Co.: Thousand Palms, 26 Feb. 1955 (W. Mason; LACM). Map 1.

DISCUSSION. Little can be said of this species. It seems to represent a relictual southern element in our fauna. This is the first record of H. opaciceps in California, although specimens are in LACM from other areas of the State. It has probably been confused with the following species, but the shape of the petiole is quite different.

Since males of H. opaciceps are wingless and worker-like (ergatoid) mating presumably occurs within the nest.

Hypoponera opacior (Forel)

Figures 22-23

Ponera trigona var. opacior Forel, 1893:363-364: ♀ ♀. Wheeler, 1923:317. Menozzi, 1935:320, 332. M. Smith, 1936b:421, 423-424. Creighton, 1950:48, 49; pl. 8: ♀ ♂.

Ponera opaciceps chilensis Forel, 1914a:264-265: ♀.

Ponera opacior, Kempf, 1962:10.

Hypoponera opacior, Taylor, 1968:65. Snelling & Hunt, 1976:66; figs. 12-13, map 1: ♀.

Hypoponera opaciceps chilensis, Kempf, 1970:19.

Hypoponera trigona var. opacior, Kempf, 1970:20.

 

RANGE: Coast to coast across the southern United States; south through the Caribbean and Central America to Argentina and Chile.

DESERT RECORDS. Inyo Co.: Salt Lake, 1060', Saline Valley, 23 Mar. 1976 (DG: LACM): spring, 1.5 mi W Salt Lake, 1200', Saline Valley, 22 Mar 1976 (DG: LACM); Pat Keyes Canyon, 3000', Inyo Mts., 14 June 1976 (DG: LACM). San Bernardino Co.: Saratoga Springs, 0', DVNM, 20 Mar 1955 (C. L. Hogue; LACM). Los Angeles Co.: Lancaster, 1 May 1958 (E. I. Schlinger; LACM). San Diego Co.: Hell Hole Canyon, nr. Borrego Springs, 25 Mar 1959 (LACM). Map 1.

DISCUSSION. While most of the above records apparently are representative of relict populations, it seems likely that the Lancaster specimens are introduced into that area with the advent of agriculture.

In our area H. opacior has been taken at elevations ranging from 0' to 3000'. The Lancaster specimens were taken from an alfalfa field; the others are from desert springs (Fig. 283) and all reflect the requirement for more or less permanently moist soil. Nests in moist soil beneath leaf mold were found in Bakersfield by Mallis (1941).

Headley (1952) studied this species in Ohio woodlands; nests were found in twigs and under bark of locust trees as well as in soil. Chambers in soil were small and the largest colony had 36 pupae; another had 15 workers and 18 pupae.

In our area, males were taken at Salt Lake on 23 March.

 

Cerapachys sp.

Figures 26-29

DESERT RECORDS. Imperial Co.: 2 ♂, 3 mi NW Glamis, 15-16 Sept 1972 (M. Wasbauer & A. Hardy; CDA), ex black light trap. San Bernardino Co.: 1 ♂, Yucca Valley, 26 Sept 1944 (P. H. Timberlake; LACM), on Eriogonum inflatum; 1 ♂, 10 mi E Twentynine Palms, 11 June 1966 (LACM), at fluorescent black light; 1 ♂, Needles, 30 June 1968 (J. C. Lambert; LACM), at black light. Map 1.

DISCUSSION. No cerapachyine ants have been previously recorded from California. These males are apparently conspecific with males from Sabino Cyn., Santa Catalina Mts., Arizona, tentatively identified as C. davisii M. Smith. However, as noted by Brown (1975), the few samples from North America are so limited and confusing that any attempt to sort out the species is hopeless at this time. More material must be procured and the males must be associated with workers.

Workers which may be conspecific with the above males are available, though not from a desert locality. These were collected in the Cleveland National Forest, about 3 mi N Warner Springs, San Diego Co. 19 May 1974, by Rudi Berkelhamer (LACM). They were taken from a column of Neivamyrmex californicus in a chaparral habitat.

Cerapachys colonies are small (in Arizona and Texas, a few dozen individuals or less). Even in tropical areas, most Cerapachys nests probably contain fewer than 200 workers (Brown, 1975).

 

In tropical regions these ants nest in the ground or in rotten wood. Sometimes the nest is constructed under a rock. Nest entrances are inconspicuous, rarely with a crater. A short passage from the entrance leads into several chambers 10-50 cm beneath the surface. It is not known whether cerapachyines are nomadic or not. Brown (1975) opined that the nests " . . . look impermanent, and the broods show a strong tendency to be synchronized, like those of army ants and nomadic Ponerinae (Onychomyrmex, Simopelta)."

Some tropical Cerapachys species are known to be carnivorous and predaceous, often raiding other ant colonies (such as those of Pheidole) to take brood and dead adults.

SUBFAMILY ECITONINAE

To this subfamily belong the New World legionary and army ants, until recently included within the Dorylinae. Taylor (1978) and Snelling (in press) have treated the ecitonines as a separate subfamily and limited the dorylines to the Old World.

In the desert region of California we have only the genus Neivamyrmex, represented by six species. Most are very poorly known within our area. Males are commonly attracted to lights. Workers are, as a rule, collected at night when the foraging or emigration columns may be found in rocky canyons and washes. Rarely is a bivouac colony located. Some species, such as N. leonardi, are probably wholly hypogaedic.

KEY TO SPECIES OF NEIVAMYRMEX

workers

- 1a. Node of petiole, from above, elongate, clearly longer than broad (Figs. 39-40); large workers more than 5 mm long 2
- b. Node of petiole, from above, stout, about as broad as long (Fig. 41); large workers 3-4 mm long leonardi (Wheeler)
- 2a. Head more or less shiny, not densely sculptured and opaque; at least side of pronotum usually distinctly shiny 3
- b. Head and thorax opaque, densely and often coarsely sculptured (fig. 38a) nigrescens (Cresson)
- 3a. Basal margin of mandible gradually curved into masticatory margin, without a tooth or corner at their junction (Fig. 33) californicus (Mayr)
- b. Basal margin of mandible straight, forming distinct tooth or angle with masticatory margin (Fig. 35) . . . opacithorax (Emery)*

males

- 1a. Mandible sickle-shaped (Figs. 44, 46) 2
- b. Mandible not sickle-shaped (Figs. 43, 47) 4
- 2a. Small, slender species, length 8-9 mm 3
- b. Large, robust species, length 11-13 mm . . . swainsoni (Shuckard)
- 3a. Lateral ocelli on raised area distinctly above level of rest of head and separated from eyes by less than half their diameter (Fig. 43) minus (Cresson)
- b. Lateral ocelli not on prominent raised area and separated from eyes by more than their diameter (Fig. 45) . . mojave (M. Smith)
- 4a. From above, dorsal surface of head forming distinct ridges over antennal sockets (Fig. 46); thoracic dorsum subopaque to opaque nigrescens (Cresson)
- b. From above, dorsal surface of head rounded, not forming distinct ridges over antennal sockets (Fig. 44); thoracic dorsum moderately shiny opacithorax (Emery)*

* N. opacithorax is included here as it very likely occurs within our area, at least marginally.

Neivamyrmex californicus (Mayr)

Figures 32, 33, 42

Eciton californicus Mayr, 1870:969: ♀.

Eciton (Labidus) californicum, Mayr, 1886a:121: ♀.

Eciton (Acamatus) californicum, Emery, 1894:184: ♀. Emery, 1900:

523: ♀.

Eciton (Acamatus) californicum var. obscura Forel, 1914a:265: ♀.

Eciton (Neivamyrmex) californicum, Creighton, 1950:70: ♀.

Neivamyrmex californicus, Borgmeier, 1953:11: o. Borgmeier,

1955:517-519: ♀. Watkins, 1976:15; map 32: ♀.

RANGE: California, Nevada, Utah.

DESERT RECORDS. Inyo Co.: Eureka Valley, 9 Apr 1978 (DG et al; CDA). Kern Co.: Lonetree Canyon, 6.8 mi S jct Hwy 14 & Randsburg Rd., 15 June 1970 (M. Wasbauer & F. Andrews; CDA). San Bernardino Co.: Cima, 14 Apr 1961 (CDA). Imperial Co.: 2.9 mi N Glamis, 335', 5 May 1978 (RRS & CDG, #78-22:LACM). Map 1.

DISCUSSION. The male form of this ant is unknown. The wide range of habitats indicated by the above records suggests that N. californicus probably can be found in many areas of the desert.

The sample from near Glamis consists of a single dead worker recovered from a forager of Forelius foetidus in a sandy Wash Woodland.

Neivamyrmex leonardi (Wheeler)

Figures 30, 31, 41

Eciton (Acamatus) leonardi Wheeler, 1915:392: ♀.

Eciton (Acamatus) peninsulare Mann, 1926:98: ♀.

Eciton (Neivamyrmex) leonardi, M. Smith, 1942:570: ♀. Creighton,

1950:72: ♀.

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Eciton (Neivamyrmex) peninsulare, Borgmeier, 1949:101: ♀.

Neivamyrmex leonardi, Borgmeier, 1955:431-434; pl 25, fig 6: ♀.
Watkins, 1971:101-103; figs. 1-7: ♀. Wheeler & Wheeler, 1973:38: ♀.
Watkins, 1976:13, 18; map 56: ♀.

RANGE: Southern California, Lower California, east to Oklahoma, Texas and Tamaulipas.

DESERT RECORDS. Inyo Co.: 9-mile Canyon, 3400', 7 mi S Little Lake, 17 June 1969 (RRS, #69-227; LACM). San Bernardino Co.: "Barstow Fossil Beds" (ex J. F. Watkins, pers. comm.); 4 mi NW Adelanto, 18 Sept 1978 (RRS & CDG, #78-87; LACM). Map 1.

DISCUSSION. This is a very poorly known ant. The synonymous form N. peninsulare was described from a few workers taken under a stone. Watkins (1971) also reported finding it under a stone in Texas and " . . . observed a few workers . . . in a weak nocturnal raiding column of N. opacithorax . . . " Our specimens from 9-mile Canyon were found in soft sand at a depth of about 45 cm. This was in Sagebrush Desert with some Larrea intermixed. N. leonardi has also been collected from Creosote Bush Scrub-Joshua Tree Woodland. In the chaparral biome of Deep Canyon, Wheeler & Wheeler (1973) found a nest under a slightly buried stone.

Specimen #78-87 is a worker head capsule found in nest debris of Pheidole barbata.

The female and male forms are unknown; N. minus is possibly the male form.

Neivamyrmex minus (Cresson)

Figure 43

Labidus minor Cresson, 1872:195: ♂.

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2. The second part of the report deals with the results of the work during the year. It is divided into two main sections: the first section deals with the results of the work in the field and the second section deals with the results of the work in the laboratory.

3. The third part of the report deals with the conclusions of the work during the year. It is divided into two main sections: the first section deals with the conclusions of the work in the field and the second section deals with the conclusions of the work in the laboratory.

4. The fourth part of the report deals with the recommendations of the work during the year. It is divided into two main sections: the first section deals with the recommendations of the work in the field and the second section deals with the recommendations of the work in the laboratory.

5. The fifth part of the report deals with the summary of the work during the year. It is divided into two main sections: the first section deals with the summary of the work in the field and the second section deals with the summary of the work in the laboratory.

Eciton (Labidus) minor, Mayr, 1886b:441: ♂. Emery, 1895:261: ♂.

Eciton (Acamatus) minus, Wheeler, 1908a:418; pl.26 fig.6: ♂.

Eciton (Neivamyrmex) minus, M. Smith, 1942:544; pl.4 fig.17: ♂.

Creighton, 1950:73: ♂.

Neivamyrmex minor, Borgmeier, 1955:630-632; pl.41 fig.5, pl.53 fig.4, 10, 20; pl.80 fig.3: ♂. Watkins, 1976:25; pl.18 fig.4; map 51: ♂.

RANGE: California and Lower California east to Kansas, Oklahoma and Texas; northern Mexico.

DESERT RECORDS. Los Angeles Co.: 2.5 mi SSW Valyermo, 4800', various dates, 8 July - 9 Aug (N. McFarland; LACM). San Bernardino Co.: NW fork, Long Canyon, 2 July 1963 (E. L. Sleeper; LACM). Riverside Co.: Juniper Flat, JTNN, 5 Aug 1959 (E. L. Sleeper; LACM); Upper Covington Flat, JTNN, 5 Aug 1959 (M. Knox & E. L. Sleeper; LACM); Lower Covington Flat, JTNN, 22 July 1960 (M. Y. & R. D. Knox; LACM); Smithwater Wash, JTNN, 23 July 1960 (E. L. Sleeper; LACM); Squaw Tank, JTNN, 6 Aug 1969 (E. L. Sleeper; LACM). Map 1.

DISCUSSION. This species is marginal in our area. The worker and female are unknown, but possibly are N. leonardi which has a similar distribution. It is easily recognized by its small size, sickle-shaped mandible and the ocellar prominence. It is most like N. mojave but that species lacks the ocellar prominence.

Neivamyrmex mojave (M. Smith)

Figure 45

Eciton (Neivamyrmex) mojave M. Smith, 1943a:196; ♂. Creighton, 1950: 73: ♂.

Neivamyrmex mojave, Borgmeier, 1955:633-635; pl.41 fig.2; pl.43 fig. 7, 8, 10, 13, 15; pl.56 fig. 5: ♂. Watkins, 1976:25; map 47: ♂.

RANGE: Known only from the Mojave Desert.

DESERT RECORDS. "Mojave Desert" (M. Smith, 1943a). San Bernardino Co.: 1 o, 4 mi NW Adelanto, 2900', 18 Sept 1978 (RRS & CDG; LACM), found dead on ground. Map 1.

DISCUSSION. This species has been previously known only from the type specimens from an unknown locality in the Mojave Desert. It is evidently nearest to N. minus and superficially looks much like that ant. However, the ocelli are much smaller and are not placed on a prominently raised area.

The recently described N. nyensis Watkins on Nevada may be the worker form of this species.

Neivamyrmex nigrescens (Cresson)

Figures 36-39, 46, 48-50

Labidus nigrescens Cresson, 1872:194: ♂. Cresson, 1887:250.

Eciton nigrescens, Dalla Torre, 1893:5.

Eciton sumichrasti, Mayr, 1886a:120. Mayr, 1886b:440 (in part, misident). Forel, 1899:27 (in part). Wheeler, 1900:563; fig. 1-3:

♀ ♀. Wheeler & Long, 1901:160, note 2. Mann, 1926:99. ♀.

Eciton (Acamatus) schmitti Emery, 1894:183: ♀. Emery, 1895:258: ♀. Forel, 1899:28. Wheeler & Long, 1901:161; fig 1, 2b: ♂. Wheeler, 1908c:410; pl.26 fig.13. M. Smith, 1924:84. M. Smith, 1927:401-404.

THE HISTORY OF THE

 

PUBLISHERS

Borgmeier, 1936:59. G. Wheeler, 1943:331; pl.2 fig.29-33.

Eciton (Labidus) nigrescens, Emery, 1895:261.

Eciton (Acamatus) nigrescens, Emery, 1900:517, 525. Wheeler, 1908c:417; pl.26 fig 2; ♂. Emery, 1910b:27. M. Smith, 1938:157.

Eciton (Acamatus) sumichrasti, Leonard, 1911:

Eciton (Neivamyrmex) nigrescens, M. Smith, 1942:551; fig. 4, 23:
♀ ♀ ♂. Borgmeier, 1948:193. Creighton, 1950:66, 69, 73-74; pl. 12:
♀ ♀ ♂.

Neivamyrmex nigrescens, Borgmeier, 1955:293, 295, 297, 494-501;
pl.27 fig.3; pl.34 fig.10; pl.40 fig.12; pl.43 fig.23-24; pl.50 fig.5,
13, 18; pl.72 fig.2: ♀ ♀ ♂. Watkins, 1972:358-363; figs.5-7, 12, 15,
20-22, 35-37, 50, 59, 62: ♀ ♀ ♂. Wheeler & Wheeler, 1973:37, 38-40;
♀ ♀ ♂. Watkins, 1976:15, 22; pl.6 fig.12; pl.9 fig 7-8; pl.13 fig.
12; pl.19 fig.2-4; map 33: ♀ ♀ ♂.

RANGE: Coast to coast in southern United States; in the East,
north to Virginia, Illinois, Iowa, Nebraska and Colorado; Mexico.

DESERT RECORDS. Riverside Co.: Deep Canyon, 1300', 20-27 June
1969 (S. Frommer, et al.;GJW). Map 1.

DISCUSSION. This common species evidently enters our area
only marginally. It may be expected to occur in other areas, especially
along stream courses running into the desert from chaparral
habitats (such as Deep Creek, San Bernardino Co.; Big Rock Creek,
Los Angeles Co.; Sentenac Canyon, San Diego Co.). The Deep Canyon
habitat is described as Desert Riparian by Wheeler & Wheeler (1973).

In Davis, California, Mallis (1938) noted nests in the cracks
of sidewalks and in Texas nests were found under large flat stones
(Wheeler & Long, 1901).

Colonies which Wheeler (1900) studied consisted of "thousands"

of individuals, while Schneirla (1958) estimated 150,000 to 250,000 workers per nest.

N. nigrescens has a nomadic-statory cycle like Neotropical army ants such as Eciton. The nomadic phase of the cycle begins when pupae eclose to workers. The whole colony then moves along a trail, usually during night hours, capturing any insects they encounter and raiding the nests of other ant species along the way. Columns may be 90 m long and are headed by scouts. The colony bivouacs before dawn, using natural cavities or nests of other species which they have pillaged. The following night they again move and raid. This nomadic cycle last for about three weeks or until the larvae in the colony (which they transport each night) begin to pupate. The statory phase then begins and the ants nest in subterranean cavities, either under stones or in abandoned ant nests for about 18 days (Schneirla, 1958). Raids continue but are less extensive than during the nomadic phase.

New colonies of N. nigrescens are formed when "a daughter queen leaves the parental nest, accompanied by a number of workers. A mature colony is capable of producing a small number of females, some of which may be fertilized in the nest by their brothers, but this does not preclude mating outside the nest, or with males of other colonies. Since females are never winged, they can make no nuptial flight." (Smith, 1965)

Watkins (1976) expressed the opinion that queens should not be collected from nests. Since colonies are monogynous, removal of the queen automatically means the death of the colony. He observed that " . . . less than one of every ten colonies produces new reproductives each year, and these reproductives from each colony form only one or two new colonies."

Other ants form an important part of the diet of N. nigrescens. Mallis (1938) observed this species carrying larvae and pupae of Tetramorium caespitum (L.), as well as click beetles, mayflies, water boatmen and crickets. Wheeler and Long (1901) found larvae of Solenopsis geminata (Fabr.) and three species of Pheidole, as well as dead carabid beetles, in nests which they studied in Texas.

The blind snake, Leptotyphlops dulcis, is able to follow the pheromone trails of N. nigrescens to locate columns and feed on the ant brood (Watkins et al., 1967). When the army ants attack the snake it forms a protective ball-like coil and smears a cloacal fluid on its body which discourages further ant attacks (Watkins et al., 1972)

Neivamyrmex swainsoni (Shuckard)

Figure 47

Labidus swainsonii Shuckard, 1840:201: ♂. Westwood, 1842:76. F. Smith, 1859:8; pl.2 fig.8: ♂.

Eciton (Acamatus) swainsoni, Emery, 1900:515, 525; fig. 22. Emery, 1910:27. Santschi, 1916:370. Santschi, 1931:74. Gallardo, 1920:379; fig. 30. Borgmeier, 1923:50.

Eciton (Acamatus) arizonense Wheeler, 1908c:414; pl.26 fig.5: ♂. Emery, 1910:25. M. Smith, 1942:581; fig. 19: ♂.

Eciton (Acamatus) lieselaei, Gallardo, 1920:fig. 32 (misident.)

Eciton (Neivamyrmex) swainsoni, Borgmeier, 1948b:462.

Eciton (Neivamyrmex) arizonense, Creighton, 1950:69-70: ♂.

Neivamyrmex swainsoni, Borgmeier, 1953:16. Borgmeier, 1955: 454-458; pl.37 fig.5-6; pl.49 fig.1-2, 7-9, 17-21: ♂. Watkins, 1972:

352: ♂. Watkins, 1976:24; map 54; pl.16 fig.10; pl.17 fig.17-19; pl.20 fig.8-9: ♂.

Neivamyrmex swainsoni arizonensis, Borgmeier, 1953:19: ♂.

RANGE: Rio Grande Valley of Texas west to southeastern California; south to Argentina.

DESERT RECORDS. San Bernardino Co.: Vidal Jct., 4 Sept 1947 (G. H. & J. L. Sperry; ex Borgmeier, 1955). Riverside Co.: Blythe, various dates and collectors (CDA, LACM, UCB). Imperial Co.: Bard, 11 July 1966 (Ratcliff; CDA); Winterhaven, 4 Aug 1961 (Maxwell; CDA); Holtville, 7 Aug 1961 (Curran; CDA); same locality, 11 Sept 1959 (C. R. Waegner; CDA); Calexico, 22 June 1957 (E. I. Schlinger; UCD). Map 1.

DISCUSSION. Surprisingly, the worker form of N. swainsoni is unknown. No species known only from workers has a distribution sufficiently extensive to suggest an affinity with this species. It is possible that the current concept of N. swainsoni actually includes more than one species. Differences do exist between the North and South American populations; a modern study of this problem might recognize at least two distinct forms.

Our records are all from lower elevation desert, -13' to 800', in areas of Wash Woodland, Alkali Sink and Saltbush Scrub.

 

SUBFAMILY PSEUDOMYRMECINAE

This subfamily is represented in our area by two superficially similar species of Pseudomyrmex. The genus is moderately large, with numerous species in the tropics. All species are arboreal and some, such as the acacia-ants, have evolved very close interrelationships with certain plants. Our species are much more generalized and nest in dead limbs and branches of mesquite, palo verde, ironwood, oak, manzanita and other hardwoods.

KEY TO SPECIES OF PSEUDOMYRMEX

- 1a. Antenna 12-segmented; ocelli small, OOD more than five times OD;
female/worker 2
- b. Antenna 13-segmented; ocelli large, OOD about twice OD; male . 3
- 2a. Integument of head moderately shiny, weakly sculptured between
between fine, obscure punctures which are mostly more than two
puncture diameters apart; EL greater than half distance between
base of mandible and occipital corner (Fig. 56); posterior slope
of petiolar node, in profile, much steeper than anterior slope
(Fig. 56) pallidus (F. Smith)
- b. Integument of head less shiny, sharply sculptured between sharp,
fine punctures separated by a puncture diameter or less; EL less
than half distance between base of mandible and occipital cor-
ner (Fig. 51); posterior and anterior slopes of petiolar node
about equal (fig. 51) apache Creighton

- 3a. Frons shiny, without conspicuous punctures; distance between eyes about equal to EL; HW (through eyes) no more than 0.76 mm pallidus (F. Smith)
- b. Frons slightly shiny, with conspicuous, sharp punctures, mostly separated by a puncture diameter or less; distance between eyes about 1.2 times EL (fig. 55); HW (through eyes) at least 0.90 mm apache Creighton

Pseudomyrmex apache Creighton

Figures 51-55

Pseudomyrmex apache Creighton, 1952a:134-139: ♀ ♂. Creighton, 1954:9-15. Creighton, 1963:1-4. Wheeler & Wheeler, 1973:41-42.

RANGE: Western Texas to southern California, north in California through the San Joaquin-Sacramento Valleys to Yuba Co.; Chihuahua, Durango, Nuevo Leon, Sonora and Baja California in Mexico.

DESERT RECORDS. Riverside Co.: Deep Canyon, 2 mi up from Boyd Res. Sta., no date (W. P. McCay; UCR); Blythe, 16 May 1962 (R. M. Hardman; LACM). Imperial Co.: Seeley, 2 July 1965 (L. Pineda; CDA); El Centro, 8 Apr 1971 (E. L. Paddock; CDA); Andrade, 19 Mar 1964 (G. Beevor; CDA); Winterhaven, 22 June 1963 (R. L. Westcott; UCD). Map 1.

DISCUSSION. Many early records, attributed to P. pallidus are possibly based, in part, on P. apache. The two are sympatric across northern Mexico and the adjacent southwestern United States but P. apache is the more common of the two. The characters enumerated in the key will readily distinguish between the two species.

 

This is one of the few arboreal ants in our area where its occurrence seems to be sporadic.

Creighton (1952a) indicated that this species, in California, is found in mountain areas above 2500 feet, most commonly nesting in evergreen oaks such as Quercus chrysolepis in Oak Woodlands and switching to mesquite at lower elevations. Our Imperial Valley collections indicate that the species ranges down to elevations as low as -45 feet. Nests are situated in hard dead wood, in abandoned galleries of wood-boring insects, such as Coleoptera and Isoptera. In the deserts, P. apache has been found nesting in mesquite (Prosopis) and desert willow (Chilopsis) but is likely to be found in a variety of desert trees.

Deŕlated females have been found establishing new colonies during the month of September. Females have also been taken at lights at night during May, so there are possibly two mating flights for this species, one in the Spring months and another in the Fall.

Pseudomyrmex pallidus F. Smith

Figures 56-58

Pseudomyrma pallida F. Smith, 1855:160: ♀. Forel, 1899:92: ♀. Wheeler, 1908c:419: ♀. Creighton, 1950:79, 80; pl. 13: ♀ ♀ ♂.

Pseudomyrma flavidula var. pallida, Enzmann, 1944:66: ♀.

Pseudomyrma flavidula, M. Smith, 1947:544; pl.5 fig.17: ♀.

Pseudomyrmex pallida, Creighton, 1952:139-140: ♀. Creighton, 1955:20: ♀.

Pseudomyrmex pallidus, Wheeler & Wheeler, 1973:41, 42-44: ♀ ♀.

RANGE: North Carolina to Florida, west along Gulf Coast to Texas; southern Arizona and southeastern California; south to Amazon Basin of Brazil, including the Caribbean.

DESERT RECORDS. San Bernardino Co.: Yucca Valley, 3300', 29 Oct 1934 (A. L. Melander; LACM). Riverside Co.: Deep Canyon, 1250', 15 Apr 1969, 4 May 1969 (GJW, #Cal.596, 720; GJW). Imperial Co.: El Centro, -45', 3 Jan 1945 (C. G. Anderson; CDA); Holtville, -13', 28 July 1969 (R. A. Flock, J. Johnson; CDA); same locality, 16 Oct 1968 (H. Knipp, J. Johnson; CDA); Bard, 150', 23 June 1965 (R. A. Flock; CDA); same locality, 1 Sept 1961 (Harrison; CDA). Map 1.

DISCUSSION. The characteristics given in the key should readily distinguish between this ant and the very similar P. apache. In addition to the differences noted in the key, P. pallidus is, on the average, a slightly smaller ant.

Collections of P. pallidus in California deserts range in elevation from -45 to 3300 feet. Wheeler & Wheeler (1973) cite a colony found nesting in a cavity within a twig of desert lavender (Hyptis emoryi). The habitat was a Riparian community with Tamarix sp., Chilopsis linearis, Salix sp. and H. emoryi. In other desert areas P. pallidus has been found nesting in Quercus emoryi and in Algerian ivy associated with the coccid, Coccus hesperidum.

Males have been collected in light traps in September near Bard.

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SUBFAMILY MYRMICINAE

The Myrmicinae are our largest group of desert ants and include our commonest and most conspicuous species, the harvester ants of the genera Pogonomyrmex and Veromessor. Many other myrmicines are small and inconspicuous, though they may actually be quite abundant. Solenopsis maniosa and some species of Pheidole are in this category. Others, however, are genuinely uncommon.

Ants of the subfamilies Ponerinae, Ecitoninae and Pseudomyrmecinae are largely carnivorous-predaceous, which may partially explain their lack of apparent success in arid environments where available food resources are patchily distributed in space and time. While many of our myrmicines may be opportunistically predaceous, most are omnivores and many have evolved to exploit plants. Some are seed predators (Pogonomyrmex, Veromessor, some Pheidole). Others (Solenopsis, Crematogaster) utilize plant exudates, either directly or through intermediaries such as aphids and mealy-bugs. Fungus cultivation by attines is also represented, but these ants are not notably successful here.

In general, the taxonomy of our myrmicines is not especially difficult. The two largest genera, Pogonomyrmex and Pheidole, are reasonably well studied. The other genera are represented by so few species that no serious difficulties arise with our limited fauna.

KEY TO GENERA OF MYRMICINAE

workers

- 1a. Dorsal surfaces with at least a few conspicuous erect hairs . . . 2
- b. Dorsal surfaces of head and thorax without erect hairs (Fig. 149) Cardiocondyla
- 2a. Postpetiole attached anteriorly on gaster; gaster subcircular in dorsal view, in lateral view about equally convex above and below 3
- b. Postpetiole attached anterodorsally on gaster; gaster subcordate in dorsal view; in lateral view, flattened or slightly concave above and strongly convex below (Fig. 17) Crematogaster
- 3a. Antenna 11- or 12-segmented; propodeum often bispinose 4
- b. Antenna 10-segmented, with a distinct 2-segmented club (Fig. 161) propodeum without spines (Figs. 160, 163) Solenopsis
- 4a. Antenna 11-segmented 5
- b. Antenna 12-segmented 6
- 5a. Frontal carinae projecting over clypeus and concealing most or all of its lateral areas (Figs. 182, 184); thoracic dorsum with bosses or ridges (Figs. 183, 185) Cyphomyrmex
- b. Frontal carinae not projecting over clypeus (Fig. 187); thoracic dorsum conspicuously spinose (Fig. 186) Acromyrmex
- 6a. Spurs of middle and hind tibiae, when present, simple; thoracic sutures often present on dorsum; thorax, in profile, often impressed between mesonotum and propodeum; psammophore usually absent 7
- b. Spurs of middle and hind tibiae pectinate; thoracic sutures usually obsolete or absent on dorsum; psammophore usually

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- present, fully developed 12
- 7a. Suture between mesonotum and propodeum distinctly impressed; propodeum depressed well below level of pronotum, mesonotum forming a sloping or stepped declivity between 8
- b. Suture between mesonotum and propodeum not impressed, mesonotum and propodeum forming a continuous slope behind pronotum or a single long, more or less flat surface 11
- 8a. Propodeum spinose or at least sharply angulate at juncture of basal and posterior faces, basal face often sharply depressed below level of mesonotum 9
- b. Propodeum not spinose or angulate, basal face on same level as mesonotum (Fig. 158) Monomorium
- 9a. Postpetiole strongly constricted behind, node distinct and sharply set off from posterior peduncle; head longer than broad often much narrower above eyes than in front; psammophore usually absent 10
- b. Postpetiole weakly constricted behind, node low and not sharply set off from thick posterior peduncle; head subquadrate, not notably narrower above eyes; psammophore usually present and conspicuous (if not, base of scape is flared and trumpet-like) Veromessor
- 10a. Antennal club 4- or 5-segmented, each segment not much longer than other flagellar segments; 3 terminal segments combined much shorter than remainder of flagellum; propodeal spines reduced to angles; HW at least 0.80 mm; monomorphic Aphaenogaster

- b. Antennal club 3-segmented, each segment about twice longer than other flagellar segments; three terminal segments combined much longer than remainder of flagellum (one species, clydei, with 4-segmented club, has exceptionally long propodeal spines); propodeal spines usually distinct, rarely dentiform;;dimorphic, majors with pronounced occipital lobes, minors with HW less than 0.80 mm Pheidole
- 11a. Small, length less than 5 mm; thoracic dorsum flat or feebly convex in profile (Figs. 174-176); antennal scape barely, if at all, surpassing occipital margin (Fig. 178) Leptothorax
- b. Large, length more than 10 mm; propodeum well below level of pronotum, mesonotum forming a long sloping surface between (Fig. 106); antennal scape projecting well beyond occipital margin (Fig. 106) Novomessor
- 12a. Thoracic sutures absent or obsolescent on dorsum, no depression, or a weak one, between mesonotum and propodeum (Figs. 69-71); psammophore distinct or, if obsolete, propodeum bispinose Pogonomyrmex
- b. Thoracic sutures distinct; deep depression between mesonotum and propodeum (Fig. 59); psammophore absent; propodeum without spines Manica

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Males

- 1a. Erect body hairs more or less numerous; wings present; antenna 12- or 13-segmented 2
- b. Erect body hairs absent except a few at apex of gaster; apterous; antenna 12-segmented (fig. 151) Cardiocondyla
- 2a. Antenna 12-segmented 3
- b. Antenna 13-segmented 5
- 3a. Postpetiole attached to anterior face of gaster; gaster not subcordate in dorsal view; flagellum moniliform 4
- b. Postpetiole attached anterodorsally on first gastric segment; gaster subcordate in dorsal view; flagellar segments somewhat bead-like Crematogaster
- 4a. First flagellar segment annular or globular (fig. 171); no Mayrian furrows; ocellar area strongly elevated above vertex (fig. 171) Solenopsis
- b. First flagellar segment not annular or globular (fig. 170); Mayrian furrows present; ocellar area not elevated (fig. 170) Leptothorax
- 5a. Scape about as long as first 8 flagellar segments combined; Mayrian furrows present 6
- b. Scape no longer than first 4 flagellar segments combined; Mayrian furrows present or absent 7

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- 6a. Dorsal surface of first gastric segment with median impression and laterobasal impression on each side; frontal carinae not greatly expanded; length over 7 mm Acromyrmex
- b. Dorsal surface of first gastric segment without distinct impressions; frontal carinae greatly expanded; length less than 3 mm Cyphomyrmex
- 7a. Middle and hind tibial spurs simple; Mayrian furrows usually present and distinct; body hairs sparse. 8
- b. Middle and hind tibial spurs distinctly pectinate; Mayrian furrows usually absent, or weakly developed when present; body hairs often abundant, usually long, flexuous 12
- 8a. Head, in profile, not flattened; propodeum, in profile, rounded and not unusually depressed; forewing with 1 or 2 closed cubital cells 9
- b. Head, in profile, unusually flattened; propodeum abruptly depressed below mesothorax in profile, basal face long; forewing with 2 closed cubital cells Aphaenogaster
- 9a. Forewing with 1 closed cubital cell; scape usually as long as first 3 or 4 flagellar segments; ocelli small, ocellar area not strongly elevated above vertex 10
- b. Forewing with 2 closed cubital cells; scape about as long as first 2 flagellar segments, first somewhat annular or globular; ocelli large, ocellar area strongly elevated Pheidole
- 10a. Length 6 mm or more; Mayrian furrows present but weak; scape at

- least as long as first 3 flagellar segments combined11
- b. Length less than 5 mm; Mayrian furrows absent; scape about as long as first 2 flagellar segments combined Monomorium
- 11a. Head narrow dorsoventrally, moderately convex above, flattened beneath; occipital margin slightly constricted to form a weak flange (fig. 108); legs unusually long and slender . . Novomessor
- b. Head moderately convex dorsally and ventrally; occipital margin not constricted (fig. 114, 116, 118); legs normal . . Veromessor
- 12a. Mayrian furrows well developed; body hairs short, stiff; mandible with more than 10 teeth; antennal scape no longer than following 2 segments combined Manica
- b. Mayrian furrows absent; body hairs almost always long, slender flexuous; mandible with fewer than 8 teeth; scape (except P. imberbicus) longer than following 3 segments combined. Pogonomyrmex

Genus MANICA Jurine

This is a small, Holarctic genus with four species in North America. The North American species are all western, discussed in some detail by Wheeler & Wheeler (1970). One barely enters the Mojave Desert in the north.

Manica mutica (Emery)

Figures 59-62

Myrmica mutica Emery, 1895:311: ♀.

Myrmica (Oreomyrma) mutica, Wheeler, 1914a:119; fig. 1d: ♀ ♂.

Myrmica (Manica) mutica, M. Smith, 1943b:296:o. M. Smith, 1947: 544; pl.5 fig.19: ♀.

Manica mutica, Creighton, 1950:108, 109; pl. 15: ♀ ♂. Wheeler & Wheeler, 1963:108-110; map 8: ♀ ♂. Gregg, 1963:314-317. Wheeler & Wheeler, 1970:134, 154-159; fig. 13-14; ♀ ♂.

RANGE: Alaska south to eastern slopes of Sierra Nevada, California; east to northeastern New Mexico and southwestern North Dakota.

DESERT RECORDS. Inyo Co.: Lone Pine, 3900', 17 July 1952 (WSC; LACM); Owens Lake, 3650', 22 Feb-16 Mar 1978 (DG et al.; CDA). Map 2.

DISCUSSION. As with many other ants treated in this study, M. mutica must be considered an intrusive element from the Great Basin Sagebrush Desert. No doubt this species will be found at a few other locations at the northern periphery of our area. The characters in the generic key, together with the figures, should make identification of this ant an easy matter.

M. mutica occurs in a variety of higher elevation habitats from cold deserts (Great Basin Sagebrush Desert) to Piñon-juniper Woodlands, Deciduous Forests and meadows in Coniferous Forests.

Nests are situated in soil with galleries running to chambers which are positioned under stones. Craters are 8 to 10 cm in diameter, eccentric and constructed of coarse pellets of excavated soil. They may be built among plants. Mature nests contain about 1800 workers (Wheeler & Wheeler, 1970).

Foraging workers have been observed returning to the nest with seeds and living and dead insects. Foraging activity on any one day seems to be of very short duration.

Mating flights have been observed in late September.

Genus POGONOMYRMEX Mayr

This is a moderate-sized genus, exclusively New World. The species are found in arid and semiarid regions of North and South America. The North American species were revised by Cole (1968) who recognized twenty-two species which he placed in two subgenera, Pogonomyrmex s. str. and Ephebomyrmex. Subsequent to Cole's revision a few new species have been discovered, but only one of these occurs in our area.

Ephebomyrmex, of which we have one species, may be best regarded as a separate genus. In this group the psammophore is not well developed and the species are matinal/crepuscular, less strictly granivorous than species of Pogonomyrmex s. str.

KEY TO SPECIES OF POGONOMYRMEX

workers

- 1a. Eye at center of side of head; psammophore fully developed; propodeal spines, when present, not connected basally by a transverse ridge or keel (Pogonomyrmex s. str.) 2

- 249
- b. Eye distinctly below middle of side of head; psammophore weakly developed; propodeal spines joined by a prominent ridge between their bases (Ephebomyrmex) imberbiculus Wheeler
- 2a. Venter of petiole with a few long, erect hairs; eye small and weakly convex, not extending beyond side of head in frontal view; in frontal view, cephalic rugae mainly straight and parallel, diverging slightly into posterior corners 3
- b. Venter of petiole without erect hairs; eye large and strongly convex, extending beyond side of head in frontal view; in frontal view, cephalic rugae tending notably to curve above eye and toward occipital corner 5
- 3a. Cephalic rugae extremely fine and close, producing silky luster; pronotal rugae fine, not forming reticulae; pronotal dorsum convex 4
- b. Cephalic rugae very coarse, widely spaced, usually wavy; pronotal rugae coarse, irregular, tending to form coarse reticulae; pronotal dorsum somewhat flattened . . . rugosus Emery
- 4a. Propodeal spines slender, scarcely tapering from base to apex; clypeal angles strongly protuberant in front of antennal sockets; petiole without prominent ventral lobe
. tenuispinus Forel
- b. Propodeal spines notably tapering from base to apex; clypeal angles weakly protuberant in front of antennal sockets; petiole with prominent ventral lobe desertorum Wheeler

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- 5a. Mandible with seven teeth, basal tooth larger than subbasal tooth; petiole and postpetiole without prominent ventral processes; posterior corner of occiput not carinate 6
- b. Mandible with six teeth, basal tooth smaller than subbasal tooth; petiole and postpetiole each with prominent ventral process (fig. 72); posterior corners of occiput with sharp, short carina (fig. 73)anzensis Cole
- 6a. In profile, cephalic rugulae forming concentric loops over eye (fig. 65); propodeum unarmed or, at most, with very short denticles (figs. 78-80) 7
- b. In profile, cephalic rugulae not forming concentric loops over eye (fig. 75); propodeum spinose (fig. 74)subnitidus Emery
- 7a. Eye not unusually large; EL notably less than OMD; larger species, length 6.8-8.7 mm8
- b. Eye large, EL more than; equal to, or only slightly less than OMD; smaller species, 4.7-5.2 mmmagnacanthus Cole
- 8a. Cephalic interrugal punctulae absent to moderate; interrugal punctulae of mesopleura and pronotal side very weak or absent; interrugal spaces shiny (fig. 65)californicus (Buckley)
- b. Interrugal punctulae of head, pronotal side and mesopleura moderate to strong, interrugal spaces subopaque (fig. 68)maricopa Wheeler

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females

- 1a. Outer margin of frontal lobes distinctly convex, not subparallel; anterior portion of scutellum much higher than adjacent area of scutum; hairs on wing membrane mostly very short, stiff and blunt (Pogonomyrmex s. str.) 2
- b. Outer margin of frontal lobes nearly straight, subparallel; anterior portion of scutellum no higher than adjacent area of scutum; hairs on wing membrane very long, slender and flexuous (Epebomyrmex) imberbiculus Wheeler
- 2a. Venter of petiole with a few erect hairs, usually long; scape notably shorter than distance from mandibular base to posterior corner of head; forewing usually with one cubital cell 3
- b. Venter of petiole without erect hairs; scape usually at least as long as distance from mandibular base to posterior corner of head; forewing usually with two cubital cells 5
- 3a. Cephalic dorsum uniformly longitudinally rugulose or striate between eye and midline; dorsum of petiolar node without longitudinal furrow; HW at least 1.9 mm, usually more than 2.2 mm 4
- b. Cephalic dorsum weakly longitudinally striate in middle, closely punctulate on either side (fig. 92); dorsum of petiolar node with longitudinal furrow which divides summit of node (fig. 93); HW no more than 1.8 mm new species

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- 4a. Cephalic and mesoscutal rugae very fine and closely spaced, producing a silky luster; outer surface of scape base, in repose, not strongly concave; less than 10 mm long desertorum Wheeler
- b. Cephalic and mesoscutal rugae coarse and widely spaced, not producing a silky luster; outer surface of scape base, in repose, strongly concave; more than 11 mm long . . . rugosus Emery
- 5a. In profile, cephalic rugulae forming concentric loops over eye; propodeum generally unarmed, rarely with a pair of very short denticles 6
- b. In profile, cephalic rugulae not forming concentric loops over eye; propodeum with a pair of distinct spines . . subnitidus Emery
- 6a. Eye small, O1 21-24; OMD nearly twice EL 7
- b. Eye large, O1 31; OMD no more than EL magnacanthus Cole
- 7a. Interrugal space of head smooth and shiny, without definite sculpture; propodeum unarmed californicus (Buckley)
- b. Interrugal spaces of head moderately shiny, with weak to moderate sculpture; propodeum generally unarmed, but a pair of tuberculate spines sometimes present maricopa Wheeler

males

- 1a. SL more than combined lengths of antennal segments 3 + 4; flagellum hairy, with numerous long, decumbent to suberect

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- hairs; body hairs long, fine, mostly flexuous or curved; (except one species); hairs on wing membrane mostly short, stiff and blunt; frontal carinae well developed 2
- b. SL less than length of antennal segment 3 (fig. 89); flagellum without long, decumbent to suberect hairs; body hairs short, stiff and straight; hairs on wing membrane long, fine and flexuous; frontal carinae undeveloped imberbicus Wheeler
- 2a. Venter of petiole with numerous long, erect, ventrally directed hairs; forewing usually with one cubital cell; head, in frontal view, with margin between eye and occipital corner evenly, rather strongly, convex 3
- b. Venter of petiole usually with no erect hairs, rarely a few present; forewing usually with two cubital cells; head, in frontal view, not evenly or strongly convex between eye and occipital corner 5
- 3a. Outer surface of base of antennal scape strongly flattened or broadly concave; body color generally fuscous yellow or brown . 4
- b. Outer surface of base of antennal scape neither flattened nor concave; petiole, postpetiole and gaster lighter colored than head and thorax desertorum Wheeler
- 4a. Large, HW at least 2.1 mm; hairs abundant, long, flexuous, pale; node of petiole, in profile, low broadly rounded (fig. 90) rugosus Emery

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b. Smaller, HW about 1.5 mm; hairs straight, stiff, with blunt tips, yellowish; node of petiole, in profile, high and sharply rounded at summit (fig. 91).new species

5a. Denticulate margin of mandible transverse, with 2 to 5 teeth (figs. 95-96); vertex usually without sharply elevated longitudinal ridge; apex of paramere, in profile, angulate with lower margin (figs. 98-99)6

b. Denticulate margin of mandible oblique, with 4 or 5 teeth (fig. 94); vertex usually with sharply elevated median, longitudinal ridge (fig. 85); apex of paramere, in profile, broadly rounded into lower margin (fig. 97)subnitidus Emery

6a. Eye small, OI 32-43; OMD more than 0.33 X EL7

b. Eye large, OI 52-54; OMD equal to, or less than, 0.33 X ELmagnacanthus Cole

7a. Mandible with 2-4 (usually 2 or 3) teeth; anterior declivity of pronotum, in profile, straight, meeting collar at abrupt angle; length and width of terminal lobe of paramere, in profile, subequalcalifornicus (Buckley)

b. Mandible with 3-5 (usually 3 or 4) teeth; anterior declivity of pronotum, in profile, concave, meeting collar at well-rounded angle; terminal lobe of paramere, in profile, broader than longmaricopa Wheeler

1. The first part of the report is a general introduction to the subject.

2. The second part is a detailed description of the methods used in the study.

3. The third part is a discussion of the results of the study.

4. The fourth part is a conclusion and a list of references.

5. The fifth part is a list of figures and tables.

6. The sixth part is a list of appendices.

7. The seventh part is a list of footnotes.

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9. The ninth part is a list of the author's address and contact information.

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30. The thirtieth part is a list of the author's other legal activities.

Pogonomyrmex anzensis Cole

Figures 72, 73

Pogonomyrmex (P.) anzensis Cole, 1968:84, 7-89; pl.III fig.13; pl.IV fig.11; pl.VI fig.12; pl.VII fig.15: ♀.

RANGE: Known only from the Borrego Desert area.

DESERT RECORDS. The only known locality for this ant is Split Mountain, 500', in Anza-Borrego Desert State Park, San Diego County; it has been collected only once. Map 2.

DISCUSSION. Since this species is known only from a single collection little can be said about it. The workers are distinctive by their six-toothed mandible and the prominent posterolateral carina on the head. The female, which is unknown, probably shares these characteristics. The male, too, is not known.

According to Creighton's field notes, the type nest was found in gravelly soil located under a large, partly buried boulder. The entrance was obscure and to one side of the boulder. This locality was apparently in Wash Woodland. One hundred seventy workers were taken. Workers were noted to often tuck their gasters under the thorax when foraging.

Pogonomyrmex californicus (Buckley)

Figures 65, 78, 81, 83, 84, 96, 98

Myrmica californica Buckley, 1867:336: ♀.

Pogonomyrmex californicus, Emery, 1895:311. Wheeler, 1902:96; fig. 7: ♀. Wheeler, 1902b:391: ♀. Wheeler, 1914b:153: ♀ ♀ ♂. Olsen, 1934:499; pl.2 fig.3: ♀. Creighton, 1950:120. Wheeler & Wheeler, 1973:53-60; figs. 16-18: ♀ ♀ ♂.

Pogonomyrmex badius, Mayr, 1868:170. Mayr, 1870:971. o. (misident.)

Pogonomyrmex badius subsp. estebanius Pergande, 1893:33: ♀.

Pogonomyrmex californicus var. estebanius, Emery, 1895:311.

Wheeler, 1902a:98. Wheeler, 1902b:391: ♀.

Pogonomyrmex californicus subsp. longinodis Emery, 1895:311: ♀.

Wheeler, 1902a:99. Wheeler, 1902b:392: ♀. Wheeler, 1914b:155. Olsen, 1934:499.

Pogonomyrmex californicus var. hindleyi Forel, 1914:270: ♀. NEW

SYNONYMY.

Pogonomyrmex californicus subsp. estebanius, Wheeler, 1914b:154:

♀ ♀ ♂. Olsen, 1934:499. Creighton, 1950:128.

Pogonomyrmex longinodis, Creighton, 1950:126 (in part).

Pogonomyrmex californicus nitratus Cook, 1953:99: ♀.

Pogonomyrmex (P.) californicus, Cole, 1968:118, 119, 120-125; pl.III fig.9; pl.IV fig.9; pl.VI fig.8; pl.VII figs.12, 13; pl.VIII fig. 8; pl.X fig.7; pl.XI fig.7; map 8; ♀ ♀ ♂.

RANGE: Western Texas, southern New Mexico, Arizona, southern Utah, western Nevada, southern California and adjacent northern Mexico.

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 1, 1861. It is a very important document, as it sets out the President's policy for the new year.

2. The second part of the document is a report from the Secretary of the Treasury, dated January 1, 1861. It contains a detailed account of the financial state of the country at the beginning of the year, and of the measures which have been taken to improve it.

3. The third part of the document is a report from the Secretary of the Interior, dated January 1, 1861. It contains a detailed account of the state of the public lands, and of the measures which have been taken to improve them.

DESERT RECORDS. Ubiquitous in our area; we have 261 records.

Map 2.

DISCUSSION. This is one of the commonest ants in both the Colorado and Mojave Deserts. Since it is also one of our larger species, is brightly colored and active during the day, it is frequently collected. It is replaced in much of the Imperial Valley by the related species, P. maricopa, especially in cultivated regions.

Separation of the two species is often very difficult. I have followed Cole (1968) in utilizing the differences in cephalic and thoracic punctuation, even though I am not convinced of the efficacy of this character. An additional difference between the two has been noted, but not yet verified by examination of all the available material. In workers of P. californicus the pronotal hairs are mostly long, slender and are usually a little curved and flexuous. The longest are two-thirds or more the length of the eye. The short hairs of the cephalic dorsum are slender and acuminate. The pronotal hairs of P. maricopa, on the other hand, are shorter, straight and flattened; the longest are about half as long as the eye; the short hairs of the cephalic dorsum are flattened, usually blunt-tipped. How well these apparent differences will hold up remains to be determined, so caution is urged.

The form which Forel described as var. hindleyi in 1914 has long been an enigma. It was based on a single worker from Escondido, California. Creighton (1950) attributed to this name specimens ranging from California to New Mexico, but Cole (1968) recognized

that Creighton's material all belonged to P. maricopa. He considered var. hindleyi unrecognizable. I have studied the type of var. hindleyi; it is a normal P. californicus crusted with dirt, hence the above synonymy.

In California, this ubiquitous desert species has been collected at elevations ranging from -250' to 5800'.

P. californicus generally nests in exposed areas in sandy soils. It occurs in every vegetation biome one might encounter in the deserts. We have records from Palm Oases, Wash Woodlands, Creosote Bush Scrub, Saltbush Scrub, Alkali Sink, Dunes, Sagebrush Scrub, Joshua Tree Woodland, Cactus Scrub, Shadscale Scrub and Blackbush Scrub. There are also records from Pinon-juniper Woodland.

Craters of mature nests are usually circular, 25-60 cm in diameter and may have one or as many as 10 entrances (fig. 296). Incipient nests have semicircular craters and are often situated on a slope.

Although P. californicus is an individual forager species,³ as many as 1000 workers may be out at any one time. The species is diurnal and forages when surface temperatures are between 32 C and 53 C (Bernstein, 1971). Maximum foraging peaks occur at 45 C (Whitford & Ettershank, 1975). During hot summer months, some foraging activity becomes nocturnal.

We have seen foragers collecting seeds of Phacelia spp.,

Atriplex confertifolia, A. canescens, Encelia farinosa, Lycium andersonii, Euphorbia micromera, Sarcobatus vermiculatus and Datura discolor. Seeds of Cryptantha sp., Encelia sp., Euphorbia micromera and Cercidium floridum have been found in seed chambers by Wheeler & Wheeler (1973). Whitford (1978b) observed this species near Las Cruces, New Mexico, collecting seeds of Baileya multiradiata, Bouteloua barbata, Chenopodium incanum, Cryptantha spp., Descurainaea pinnata, Eriogonum abertianum, E. trichopes, Erioneuron pulchellum and Euphorbia sp. Foragers were also found to take termites in June, July and August at that site. We have seen P. californicus struggling with live prey such as adult and larval lepidopterans and syrphid flies. Aside from such arthropod fragments and feces as they collect, workers occasionally take nectar from Euphorbia spp.

Males have been observed at lights in April and dealated females have been taken on the ground in May. Reproductives of both sexes may be found in the nests during the winter and early spring months.

The thysanuran, Mirolepisma deserticola, is a common inhabitant of nests of this species.

This species, by virtue of its large size, abundance and diurnal activity is an important element in the diet of insectivorous lizards. We have seen many samples of scats of Phrynosoma coronatum, P. mcalli and Uma sp. which contain large numbers of individuals of this species.

Pogonomyrmex desertorum Wheeler

Figures 63, 70

Pogonomyrmex desertorum Wheeler, 1902:387: ♀. Emery, 1921:pl. 1 fig. 8: ♀. Olsen, 1934:496; pl.3 fig.2. Creighton, 1950:124: o. Cole, 1954:119. Cole, 1968:64-70; map 3; pl.III fig.4; pl.IV fig.16; pl.V fig.3; pl.VII fig.22; pl.VIII fig.13; pl.X fig.13; pl.XI fig.14.

Pogonomyrmex desertorum var. ferrugineus Olsen, 1934:506: ♀.

Pogonomyrmex desertorum subsp. ferrugineus, Creighton, 1950:124. Cole, 1954:119.

Pogonomyrmex deserotorum, Cook, 1953:90 (lapsus).

RANGE: Western Texas, southern New Mexico, southern Arizona, northern Tamaulipas, San Luis Potosi, Durango, Coahuila, Chihuahua, Sonora; southeastern California. Map 2.

DISCUSSION. The inclusion of this ant in California is based on an old record that it was taken on the Colorado River near Needles. It has not been collected here since and must be considered a rare element in our fauna.

P. desertorum constructs circular craters of sand or gravel which may be somewhat flattened. Colonies are small, usually with fewer than 500 workers (Creighton, 1956a). According to Whitford and Ettershank (1975) this ant is a diurnal forager. The ant is timid and often will not leave the nest when disturbed.

Pogonomyrmex imberbicus Wheeler

Figures 76, 77, 89

Pogonomyrmex imberbicus Wheeler, 1902a:86-88; figs. 1, 2: ♀.

Pogonomyrmex (Ephebomyrmex) imberbicus, Wheeler, 1902b:390: ♀.

Olsen, 1934:495; pl.6 fig.3: ♀. M. Smith, 1947:544; pl.5 fig.21: ♀.
Creighton, 1950:132: ♀. Creighton, 1956:63: ♀. Gregg, 1963:317,
334-336; map: ♀. Cole, 1968:156, 157, 167-174; pl.I fig.5; pl.III
fig.21; pl.V fig.10; pl.VII fig.27; pl.VIII fig.18; pl.IX figs. 5, 8;
pl.X figs.16, 19; pl.XI fig.18; pl.XII figs.8, 17; map 12: ♀ ♀ ♂.
Wheeler & Wheeler, 1973:63-64; fig. 21: ♀ ♀ ♂.

Pogonomyrmex (Ephebomyrmex) townsendi Wheeler, 11909:80: ♀. Olsen,
1934:495; pl.8 fig.2: ♀. Creighton, 1956:54: ♀.

Pogonomyrmex (Ephebomyrmex) imberbicus subsp. townsendi,
Creighton, 1950:115: ♀.

RANGE: Southwestern Oklahoma and western Texas, New Mexico,
central Colorado, Arizona, southern Nevada, southern California;
adjacent northern Mexico.

DESERT RECORDS. San Bernardino Co.: 5.25 mi NNE Cima, 1200-
1250 m, 15 Apr 1977 (RRS & CDG, #77-18; LACM); 9.5 mi NNE Cima,
1280-1300 m, 13 Apr 1977 (RRS & CDG, #77-4; LACM); Pisgah Crater,
18 Aug 1962 (Norris & Heath; LACM); 7 mi W Needles, 2500', 8 Apr
1959 (WSC; LACM). Riverside Co.: Deep Canyon, 1100', 29 Mar 1963
(M. P. Creighton; LACM); same locality, 7 May 1969 (GJW, #Cal.738;
GJW). San Diego Co.: Yaqui Well, 1400', ABDP, 16 Apr 1952 (WSC: LACM).
Map 2.

DISCUSSION. This small, rather timid ant is easily recognized
by the characteristics indicated in the key. It is our only member

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and the establishment of colonies. The American Revolution led to the birth of a new nation, and the subsequent years saw the expansion of territory and the growth of industry. The Civil War was a pivotal moment in the nation's history, leading to the abolition of slavery and the strengthening of the federal government. The late 19th and early 20th centuries were characterized by rapid industrialization and the rise of the United States as a world power. The 20th century has seen significant social and political changes, including the Civil Rights Movement and the Vietnam War. Today, the United States continues to be a nation of innovation and progress, facing new challenges and opportunities in the 21st century.

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of the subgenus (or genus) Ephebomyrmex.

Our desert collections of P. imberbiculus have been between elevations of 1100 and 4265 feet. They have been taken in hard-packed sandy-gravelly soil in areas of Creosote Bush Scrub, Cactus Scrub and Joshua Tree Woodlands.

Nests may be situated in exposed areas or beneath stones. The craters of fine sand usually are less than 8 cm in diameter and are often dispersed by wind and/or rain. "There is a single small nest entrance 3-4 mm in diameter. Delicate passages run from the entrance down to storage chambers. Colonies are generally small, with fewer than 75 workers." (Creighton, 1956a)

This species forages for most of the year. Workers have been seen in late afternoon foraging individually. Chew (1977) found that of those workers attracted to bait boards, 74% arrived between 0710 and 0850; 26% were collected at the boards during the remaining day-time hours. His observations were made in southeastern Arizona during August. "Seeds make up a considerable part of their diet which includes dead arthropods and especially insects." (Cole, 1968) According to Wheeler (1910c) larvae are fed fragments of crushed or broken seeds.

No mating flights have been observed in California. In New Mexico they take place in early July.

Pogonomyrmex magnacanthus Cole

Figures 64, 79, 84, 99

Pogonomyrmex (P.) magnacanthus Cole, 1968:118, 119, 133-137; pl. II fig.5; pl.III fig.12; pl.IV fig.10; pl.VI fig.9; pl.VIII fig.10; pl.XI fig.10: ♀ ♀ ♂.

Pogonomyrmex magnacanthus, Wheeler & Wheeler, 1973:52, 60-61; figs. 19, 20: ♀ ♀ ♂.

RANGE: Deserts of southern California, east to western Nevada and Arizona; northwestern Sonora; northeastern Baja California.

DESERT RECORDS. We have 63 records, from Inyo to Imperial Counties. Map 2.

DISCUSSION. Although superficially similar to P. californicus and P. maricopa this ant is easily recognized by the proportionately larger eyes of all castes. This is also a smaller species than the others, but individuals from new nests of P. californicus and P. maricopa may be as small.

According to our data this species occurs at elevations between -190' and 2300 feet. There is a preference for fine sand and the ant is generally to be found in or around dune areas with Creosote Bush Scrub associations. Colonies are small, generally between 100 and 250 workers present (Cole, 1968).

Craters may be circular or semicircular and usually range from 4-15 cm in diameter. Wind may disperse the sand forming the crater leaving only a small irregular entrance hole (s).

Foraging patterns are about the same as those of the closely related P. californicus: individual, diurnal foraging.

Both males and females have been collected at black lights during April and June. DeKlate females have been collected on the ground in May.

Mirolepisma deserticola, a thysanuran, is commonly encountered in nests of this species.

P. magnacanthus is regularly preyed upon by the flat-tailed horned lizard, Phrynosoma mcalli; we have seen head capsules in many scat samples.

Pogonomyrmex maricopa Wheeler

Figures 68, 80, 82, 86, 95

Pogonomyrmex californicus subsp. maricopa Wheeler, 1914b:155: ♀. Olsen, 1934:500: ♀.

Pogonomyrmex californicus subsp. barnesi M. Smith, 1929:546: ♀. Olsen, 1934:499: ♀.

Pogonomyrmex californicus subsp. sinaloanus Olsen, 1934:504: ♀.

Pogonomyrmex maricopa, Creighton, 1950:126. Cole, 1968:118, 119, 120, 138-147; pl.III fig.10; pl.IV fig.7; pl.VI fig.11; pl.VII fig.7; pl.VIII fig.7; pl.X fig.8; pl.XI fig.8; map 10; ♀ ♂. Wheeler & Wheeler, 1973:52, 61-62: ♀ ♂.

Pogonomyrmex maricopa subsp. barnesi, Creighton, 1950:127.

Pogonomyrmex hindleyi, Creighton, 1950:125 (in part).

Pogonomyrmex longinodis, Creighton, 1950:126 (in part).

RANGE: Western Texas, New Mexico, southern Colorado, southern Utah, Arizona, southern Nevada, southeastern California, adjacent northern Mexico, south to Sinaloa on the west coast.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year.

2. The second part of the report deals with the results of the work during the year and the progress of the work during the year.

3. The third part of the report deals with the results of the work during the year and the progress of the work during the year.

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7. The seventh part of the report deals with the results of the work during the year and the progress of the work during the year.

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9. The ninth part of the report deals with the results of the work during the year and the progress of the work during the year.

10. The tenth part of the report deals with the results of the work during the year and the progress of the work during the year.

DISCUSSION. Although the key characters will usually separate this species from P. californicus, samples based on single specimens may be very difficult to place. In general, P. maricopa, in the field, seems to be larger, stouter and less shiny, but no significant morphometric differences have been found.

Our desert records for this species in California show an elevation range from -100 to 935 feet. It has been collected in Creosote Bush Scrub, Wash Woodlands, Cactus Scrub and in cultivated fields in former Saltbush Scrub habitats. Soil types range from moderately fine sand to gravel. Craters are circular or semicircular, 8-10 cm in diameter, often with gravel on the mound (Figs. 298, 299).

P. maricopa is an individual forager. However, when a concentrated resource is discovered, workers will " . . . recruit nestmates by laying a trail with poison gland contents from feeding site to nest." (H81ldobler, 1976a) We have also found that naive workers may be recruited to a foraging area by another method: they are literally carried to the site by experienced workers. The naive ant tucks its appendages close to the body, is grasped by the mandibles and carried to the site (Fig. 297) then released. Once released, the ant searches for food and then makes its own way back to the nest, apparently by following the pheromone trail.

Our records show foraging activity between 0830 and 1530. Activity periods vary considerably with season and climate. We have found the species taking seeds of Atriplex spp.

Reproductives have been found in nests throughout the year in California. Mating flights take place here in July according to present data, but we suspect that there may be additional flights in the Fall. H81ldobler (1976b) reports that in Arizona this species uses

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25. twenty-fifth of these is the fact that the

26. twenty-sixth of these is the fact that the

27. twenty-seventh of these is the fact that the

28. twenty-eighth of these is the fact that the

29. twenty-ninth of these is the fact that the

30. thirtieth of these is the fact that the

perennial mating sites on bushes and trees which males have marked with mandibular gland secretions. Males compete for access to a female and multiple matings have been observed.

The inquiline scarabaeids, Cremastocheilus stathamae Cazier and C. mentalis Cazier, have been found in nests of P. maricopa. (Cazier & Statham, 1962; Cazier & Mortenson, 1965)

Pogonomyrmex rugosus Emery

Figures 66, 71, 87, 90

Pogonomyrmex barbatus subsp. rugosus Emery, 1895:309: ♀ ♂.
Wheeler, 1902a:98: ♀. Wheeler, 1902b:391: ♀. Olsen, 1934:497: ♀.
Creighton, 1950:120. Gregg, 1963:327.

Pogonomyrmex barbatus var. fuscatus Emery, 1895:309: ♀ ♀. Wheeler, 1902b:391: ♀. Olsen, 1934:497: ♀.

Pogonomyrmex barbatus var. marfensis Wheeler, 1902a:98: ♀.
Wheeler, 1902b:391: ♀. Olsen, 1934:497: ♀.

Pogonomyrmex barbatus subsp. curvispinosus Cole, 1936:120: ♀.

Pogonomyrmex barbatus subsp. fuscatus, Creighton, 1950:119 (in part). Gregg, 1963:323.

Pogonomyrmex barbatus spadix Cook, 1953:99: ♀.

Pogonomyrmex rugosus, Cole, 1968: 43, 44, 45, 70-77; pl.IV fig.15; pl.V fig.7; pl.VII fig.18; pl.VIII fig.22; pl.X fig.11; pl.XI fig.12; map 4; ♀ ♀ ♂. Wheeler & Wheeler, 1973:49, 50; fig. 15: ♀ ♀ ♂.

RANGE: Western Texas to southern Nevada, central California; adjacent northern Mexico.

DESERT RECORDS. Sporadic but general in the Mojave Desert, marginal at suitable elevations in the Colorado Desert; 40 records. Map 2.

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey in the different regions of the country.

3. The third part of the report deals with the results of the survey in the different sectors of the economy.

4. The fourth part of the report deals with the results of the survey in the different social groups of the population.

5. The fifth part of the report deals with the results of the survey in the different administrative regions of the country.

6. The sixth part of the report deals with the results of the survey in the different economic sectors of the country.

7. The seventh part of the report deals with the results of the survey in the different social groups of the population.

8. The eighth part of the report deals with the results of the survey in the different administrative regions of the country.

9. The ninth part of the report deals with the results of the survey in the different economic sectors of the country.

10. The tenth part of the report deals with the results of the survey in the different social groups of the population.

11. The eleventh part of the report deals with the results of the survey in the different administrative regions of the country.

12. The twelfth part of the report deals with the results of the survey in the different economic sectors of the country.

13. The thirteenth part of the report deals with the results of the survey in the different social groups of the population.

DISCUSSION. This large, usually dark, species is easily recognized by the characteristics given in the keys. Workers often are seen running with the gaster tucked forward under the thorax, especially when excited. The sting of this species is particularly painful.

Our California records show elevations ranging from 800 to 4317 feet although, according to Bernstein (1971) it occurs at elevations exceeding 5000 feet in the Mojave Desert. Habitats include Creosote Bush Scrub, Saltbush Scrub, Joshua Tree Woodland and Blackbush Scrub.

Nest superstructure varies from a flattened gravel disc with a central entrance to a low mound up to 23 cm in diameter with chaff at one side to no mound at all. Colonies have also been found under stones on rocky slopes.

P. rugosus is a diurnal species with flexible foraging patterns. When seeds are rare or widely dispersed, foraging is individual. However, when a seed resource is rich, nestmates are recruited as in P. maricopa and long, well defined foraging trails may result. In the Mojave Desert, this species forages at surface temperatures between 22°C and 46°C (Bernstein, 1971). Whitford et al. (1976) found P. rugosus foraging at night in New Mexico during hot summer months.

Workers take seeds of a broad size category, <0.64 to 3.33 mm wide (Davidson, 1977a). Seeds of the grass Panicum arizonicum were commonly foraged in New Mexico during the peak activity period of this species in September. We have seen P. rugosus gathering seeds of Encelia farinosa in May.

Mating behavior is similar to that of P. maricopa but mating sites are on the ground. Mating flights occur in the afternoon during July and August.

Pogonomyrmex tenuispinus Forel

Figures 67, 69

Pogonomyrmex barbatus, Pergande, 1895:894. (misident.)

Pogonomyrmex desertorum var. tenuispina Forel, 1914:269: ♀.

Olsen, 1934:507: ♀.

Pogonomyrmex dentatus Olsen, 1934:505: ♀.

Pogonomyrmex desertorum subsp. tenuispina, Creighton, 1950:114:

♀.

Pogonomyrmex tenuispina, Cole, 1968:43, 77-81; pl.III fig.18;

pl.IV fig.14; pl.V fig.6; pl.VII fig.23: o. Wheeler & Wheeler, 1973:

49, 50-51: ♀.

RANGE: Western fringe of Colorado Desert of southern California to the Cape Region of Baja California Sur.

DESERT RECORDS. In southern California, known thus far only from Deep Canyon, Riverside Co.; two collections. Map 2.

DISCUSSION. Little is known of this ant. Among our species it is easily recognized by the very fine, close cephalic rugulae. In Lower California it has been found nesting on rocky hillsides and in sand at the edge of arroyos. In Deep Canyon, at 1200 feet, it was found in a soil-filled crack in a large rock. The area was above a stream and the perennial vegetation consisted of Larrea, Ambrosia, Hyptis, Agave and Echinocactus. (Wheeler & Wheeler, 1973)

THE UNITED STATES OF AMERICA

IN SENATE

COMMITTEE ON THE JUDICIARY

REPORT OF THE COMMITTEE ON THE JUDICIARY

ON THE NOMINATION OF

JOHN EDGAR HOOVER, ATTORNEY GENERAL

AND ON THE NOMINATION OF

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JOHN EDGAR HOOVER

Pogonomyrmex subnitidus Emery

Figures 74, 75, 85, 94, 97

Pogonomyrmex occidentalis var. subnitidus Emery, 1895:310: ♀.
Wheeler, 1902a:98: ♀.

Pogonomyrmex subnitidus, Wheeler, 1914b:156. Olsen, 1934:498;
pl. 4 fig. 8: ♀. Creighton, 1950:114: ♀. Cole, 1968:85, 86, 114-
117; pl.III fig.7; pl.IV fig.5; pl.VI fig.4; pl.VII fig.5; pl.VIII
fig.5; pl.X fig.6; pl.XI fig.6; pl.XII fig.10: ♀ ♀ ♂. Wheeler &
Wheeler, 1973:51, 52; ♀ ♀ ♂.

RANGE: Western Nevada, southcentral California to coastal
southern California and northern Baja California.

DESERT RECORDS. Los Angeles Co.: Juniper Hills, 4200', 13 Apr
1952 (WSC: LACM). San Bernardino Co.: Needles, 500', 18 July 1931
(A. C. Cole; LACM). Riverside Co.: Upper Covington Flat, 5325', JTNM,
10 July 1966 (RRS: LACM). Map 2.

DISCUSSION. P. subnitidus is a chaparral species occurring mar-
ginally in higher elevation desert areas (3500-5325 feet).

Nest craters are semicircular or circular and are constructed
in sandy soil. Our records are from Joshua Tree Woodland-Creosote
bush Scrub ecotone and Piñon-juniper biomes.

The Needles record is far outside the normal range of P. subnitidus
and is possibly based on incorrectly labelled specimens.

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey in the different regions of the country.

3. The third part of the report deals with the results of the survey in the different districts of the country.

4. The fourth part of the report deals with the results of the survey in the different villages of the country.

5. The fifth part of the report deals with the results of the survey in the different towns of the country.

Genus APHAENOGASTER Mayr

There are but two species of this worldwide genus in our desert area. Most Aphaenogaster are forest or forest-clearing ants; true xerophily in this genus is rare. The taxonomy of the North American representatives of Aphaenogaster is unchanged from that of Creighton (1950). Some of the eastern groups, at least, are evidently more complex than Creighton realized and some modifications will be necessary when the group is carefully studied.

KEY TO SPECIES OF APHAENOGASTER

workers only

- 1a. Eye large, OMD equal to or less than EL; distance from eye to occipital flange, in profile, 1.2-1.3 x EL (Fig. 103); color pale yellow to yellowish tan megommatus M. Smith
- b. Eye small, OMD 1.2-1.35 x EL; distance from eye to occipital flange, in profile, 1.5-1.8 x EL (Fig. 100); color usually ferruginous but may be yellowish red
. boulderensis M. Smith

Aphaenogaster boulderensis M. Smith

Figures 100-102

Aphaenogaster (Attomyrma) boulderensis M. Smith, 1941:120: ♀.
Creighton, 1950:141, 142-143: ♀. Cole, 1966:8-9: ♀.

Aphaenogaster (Attomyrma) boulderensis subsp. smithi Gregg,
1949:171-172: ♀. NEW SYNONYMY.

RANGE: Southern Nevada and southeastern California to western Texas.

DESERT RECORDS. Inyo Co.: Grapevine Ranger Sta., 2200', DVNM,
4 Sept 1968 (GJW, #Cal.525a; GJW); Death Valley, 2100', 5 Sept 1968

(GJW, #Cal.526; GJW); south Saline Range, 2500', 22 Apr 1975 (DG; LACM); Craig Cyn., 3400', Inyo Mts., 18 Sept 1976 (DG; LACM); Paiute Cyn., 3500-5000', Inyo Mts., 17 June 1976 (DG; LACM). Riverside Co.: Palm Springs, 500', 10-11 July 1967 (A. E. Lewis; LACM). Map 3.

DISCUSSION. When Gregg (1949) described the subspecies smithi, the nominate form was very poorly known. The noted differences in head shape, sculpturing and color will not hold up now that more material is available from California and western Arizona.

We have one male of this species from Paiute Canyon. Although similar to that of A. megommatus there are numerous differences. Most conspicuous is the difference in ocellar size. In A. boulderensis the ocellocular distance is about 1.5 x the diameter of the anterior ocellus. The ocelli of A. megommatus are much enlarged and prominently elevated above the general level of the vertex; the ocellocular distance is about 0.5 x the diameter of the anterior ocellus. There are differences, too, in the shape of the propodeum and the petiole; the ocellar character is the most pronounced.

Little is known of this species. It has been collected in California at elevations between 500 and 3500 feet. Stray workers have been found on rocky canyon walls and nests may be in cracks in the canyon walls (Fig. 281). All foragers have been taken in morning hours.

Aphaenogaster megommatus M. Smith

Figures 103-105

Aphaenogaster (Attomyrma) megommatus M. Smith, 1963:2 4-246;

fig. 1: ♀.

Aphaenogaster megommatus, Cole, 1966:8, 9-11; figs. 8-14: ♀ ♂.

RANGE: Southern Oregon, Nevada, western Arizona, southeastern California, northeastern Baja California, northwestern Sonora.

DESERT RECORDS. Northern and eastern Mojave, most of Colorado Desert, at lower elevations: 27 records. Map 3.

DISCUSSION. The pale color and large, dark eyes of this nocturnal ant are distinctive. Its nearest relatives appear to be A. boulanderensis and A. mutica Pergande, the latter known only from Lower California. These, however, have smaller eyes and are usually distinctly reddish in color.

A. megommatus is found in our deserts from -250' in Death Valley to 4400' near Lone Pine. Sandy soil seems to be preferred and the ant is often associated with Wash. Woodland and Creosote Scrub.

Nest tumuli are circular, about 3 inches diameter. In sandy, windy areas the excavated material may be blown away, leaving a simple hole without a crater (Smith, 1963).

Foraging workers move rapidly. These scavengers are crepuscular and nocturnal and forage at temperatures as low as about 10°C.

Males and females have been taken at black lights during the months of May, June, August, October and November.

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OF THE

AMERICAN PEOPLE

FROM THE FIRST SETTLEMENTS TO THE PRESENT

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OF THE

Genus NOVOMESSOR Emery

Novomessor is a genus restricted to western North America and includes two species, one of which occurs in California. The status of the genus is uncertain, for it may prove to be a synonym of Aphaenogaster, to which it is certainly closed allied. Brown (1974) discovered that N. manni Wheeler & Creighton, a Mexican species, was a synonym of Aphaenogaster ensifera Forel. On the strength of that fact he proceeded to propose that Novomessor was a synonym of Aphaenogaster and this may well be correct. However, Hölldobler et al. (1976) discovered the existence of a complex exocrine gland in N. albisetosus (Mayr) and N. cockerelli (Andre); this gland was absent from N. manni and various species of Aphaenogaster which they examined. Their conclusion was that while Brown was correct in removing N. manni to Aphaenogaster, Novomessor with its two remaining species was still a defensible genus. For the present we are recognizing Novomessor as a valid taxon until all the pheidoline genera can be comprehensively reviewed.

The question of the occurrence of N. cockerelli in California has been a peculiarly tangled one. Cole (1934a) stated that the ant was abundant near Barstow, Ludlow and Tehachapi. No specimens from these localities have ever been seen, nor had the ant ever been taken anywhere in the State over the next 30 years. Cook (1953) aggravated the problem by repeating Cole's records and adding his own claim to have specimens from Oakland, Alameda Co.

Creighton (1955) took up the problem and came to the following conclusions: (1) The Cole records appear to have been based on mis-identifications of chaff-free nests of Veromessor pergandei; (2) The Cook specimens from Oakland were V. andrei; (3) the Mojave Desert

sites in question are all too low in elevation for N. cockerelli;

(4) there are no proven records for this ant in California; (5) "none of the range of cockerelli lies west of Longitude ^{Not} 115° and only a very small part of it lies west of Longitude 114°."

Creighton's first four points were certainly correct and it is safe to state that the records by Cole (1934a) and Cook (1953) are based on species of Veromessor and may be disregarded. Only on the last point was he incorrect, for we now have verified records for several localities in the eastern part of the deserts, some of which are for stations well to the west of Longitude 115°.

Novomessor cockerelli (Andre)

Figures 106-109

Aphaenogaster cockerelli Andre, 1893:150: ♀. Brown, 1974:

45-47.

Novomessor cocquerelli, Emery, 1915:73: ♀.

Novomessor cockerelli, Wheeler & Creighton, 1934:352; pl.1 fig.

1, 4: ♀ ♂. M. Smith, 1947:554; pl.6 fig.24: ♀. Creighton, 1955: 89-97. H81ldobler et al., 1976:32-41.

RANGE: Western Texas to southern Nevada and southeastern California; Mexico.

DESERT RECORDS. San Bernardino Co.: 9.5 mi NNE Cima, 4200-4265', Ivanpah Mts., 13 Apr 1977 (RRS & CDG; LACM); nr. Piute Spgs. ab. 3000', Piute Range, 1 Oct 1978 (RRS, #78-107; LACM); 1 mi S Sunflower Spg., 3100', Old Woman Mts., 8 May 1965 (RRS; LACM); Goffs, 2 Sept 1967 (G. W. Carman; CDA); nr. Kelso, 5000', 27-28 Apr 1968 (R. Bernstein; LACM). Imperial Co.: Picacho Peak Camp, 29 May 1964 (W. Ewart; LACM). Map 3.

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey and the conclusions drawn from them.

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8. The eighth part of the report deals with the results of the survey and the conclusions drawn from them.

DISCUSSION. This exceptionally long-legged, slender ant, dark reddish brown in color, cannot be confused with any other in our fauna. These are the first verified records of its occurrence in California. It seems to be limited to eastern areas of our deserts, on slopes above 3000 feet elevation. The specimens marked simply "Goffs" probably were taken in higher terrain to the north, for the elevation at Goffs is only about 2600 feet.

Although in other desert regions N. cockerelli may be found in open areas, in our deserts it has been found only on rocky hillsides and canyons, at elevations between 3000 and 5000 feet. The nest has an irregular central entrance 8-10 cm across, surrounded by a disc of coarse gravel and soil which may be up to 2 m across (Wheeler & Creighton, 1934). The disc is often absent from those nests which are situated on very rocky slopes (Fig. 300).

Workers forage individually, beginning late in the afternoon and continuing through the night. They remain within the nest during midday hours. Seeds, pieces of fruit, bits of plant tissue and other insects are collected as food. Although the ant appears to be quite clumsy, freshly caught insects are often brought back to the nest. Mostly these are much smaller than the worker ant which simply picks up the other insect and walks away with it.

Genus VEROMESSOR Forel

The mention of Veromessor almost automatically conjures an image of polymorphic, shiny black ants streaming out of a large chaff-ringed crater to forage in a long file across the desert. In the hot deserts this certainly is a good enough image, for V. pergandei is the only member of the genus to have successfully invaded the hot deserts. And, it has done so very well, for it is one of the commonest desert ants.

Veromessor is an exclusively New World genus, limited to western North America. One Caribbean ant, traditionally placed in Veromessor, does not belong here and probably should be placed in Aphaenogaster. Veromessor is primarily southwestern but with one species ranging from southwestern North Dakota to Colorado, west to Nevada. The nearest relative of Veromessor appears to be the genus Aphaenogaster. In our area, Veromessor may be separated by the presence of a psammophore. The only other myrmecines commonly encountered which possess a psammophore are species of Pogonomyrmex, easily recognized by their bright coloration, diurnal foraging period and the fact that they sting.

This is a small genus, with but eight described species, and was last revised by Wheeler & Creighton (1934). More recent keys to workers are by Creighton (1950) and M. Smith (1956). Those species found at the Nevada Test Site were treated by Cole (1966). All these keys deal with workers only and none includes all the presently known species. The genus is now in the process of being revised by RRS.

KEY TO SPECIES OF VEROMESSOR

workers/females only

- 1a. Clypeus without anteromedian projection (Figs. 113, 115); eye of worker, in profile, evenly rounded below (Figs. 110, 111); base of scape usually flattened or enlarged 2
- b. Clypeus with more or less triangular anteromedian prominence (Fig. 117); eye of worker, in profile, distinctly narrowed and angular below (Fig. 112); base of scape narrow, not flattened pergandei (Mayr)
- 2a. Head with weak longitudinal rugulae and scattered coarse punctures; psammophore sharply defined (Fig. 110); EL equals or exceeds OMD; base of scape flattened 3
- b. Head with coarse, somewhat wavy rugae over entire dorsum and scattered coarse punctures; psammophore weak, gular area with sparse, long erect hairs (Fig. 112); EL much less than OMD; base of scape enlarged, trumpet-like andrei (Mayr)
- 3a. Base of scape strongly flattened and broader than apex; propodeal spines about as long as distance between their bases; rugae around antennal socket straight smithi Cole*
- b. Base of scape weakly flattened, narrower than apex; propodeal spines shorter than distance between their bases; rugae around antennal socket curved toward midline . . . lariversi M. Smith

* V. smithi has been included in the key because it may ultimately be found in the northeastern part of our area.

Veromessor andrei (Mayr)

Figures 111, 115-116

Aphaenogaster andrei Mayr, 1886b:443: ♀.

Stenamma (Messor) andrei, Emery, 1895:306: ♀.

Novomessor andrei, Emery, 1915:73.

Novomessor (Veromessor) andrei, Forel, 1917:235.

Veromessor andrei, Wheeler & Creighton, 1934:362; pl.2 fig.2:

♀. Creighton, 1950:158-159; pl. 20: ♀ ♂. Creighton, 1953a:17.

M. Smith, 1956:36: ♀. Cole, 1963:6: ♀. Wheeler & Wheeler, 1973:

64, 65-67; figs. 22-23: ♀ ♀.

Veromessor andrei subsp. castaneus Wheeler & Creighton, 1934:
365: ♀. Creighton, 1950:158, 159: ♀.

Veromessor andrei subsp. flavus Wheeler & Creighton, 1934:366. ♀.

RANGE: Southern Oregon to northern Baja California; Ormsby Co.,
Nevada.

DESERT RECORDS. Los Angeles Co.: 5 mi SE Palmdale, 2 May 1965
(R. H. Crandall; LACM). Map 3.

DISCUSSION. Our one record represents an obvious intrusion from
the chaparral south of Palmdale. However, prior to the retreat of
the Tertiary oak forests, it is possible that the range of V. andrei
included much of the present Mojave Desert and isolated relict popu-
lations may yet persist in suitable mountain ranges of the Mojave.

Our record is from an area of Joshua Tree Woodland with juniper.
Wheeler & Wheeler (1973) provide data on the biology of this ant as
it occurs at higher elevations in Deep Canyon. Nests may be situated
in any kind of soil. Craters may be present and, if so, are composed
of a thin disc of excavated soil mixed with chaff. Entrances may be

simple (as in incipient nests) or multiple (mature colonies).

In warm weather there are two foraging periods: one in the morning, 0900 to 1000; one in the evening beginning about an hour before sunset and ending at dusk.

Mating flights take place late in July. The Wheelers observed that deflated females may return to established nests.

Known inquillines include roaches (Ischnoptera sp.), ant crickets (Myrmecophila oregonensis Bruner) and scarabaeid beetles (Cremastocheilus pilisicollis Horn and C. schauvi LeConte) (Mann, 1922; Cazier & Statham, 1962).

Veromessor lariversi M. Smith

Figures 110, 113-114

Veromessor lariversi M. Smith, 1951b:94-96: ♀. Cole, 1955: 51-52: ♀ ♀. M. Smith, 1956:37: ♀. Cole, 1963:680: ♀ ♀ ♂. Cole, 1966:11, 12; fig. 16B: ♀.

RANGE: Western Nevada and eastern California.

DESERT RECORDS. Inyo Co.: Eureka Valley, Mar 1978 (DG et al.; CDA); Eureka Valley Dunes, 14 July 1975 (F. G. Andrews, A. R. Hardy; CDA); Grapevine Ranger Sta., 2300', DVM, 11 June 1973 (GJW, S. Rissing, #Cal.1005; GJW); 3 mi W Lone Pine 4300', 2-3 May 1952, 17 July 1952 (WSC; LACM). Map 3.

DISCUSSION. This is a primarily Great Basin species which barely enters our area. The characters enumerated in the key will readily identify it. The pale yellowish red color and presence of a psammore will serve as recognition characters in the field.

In his treatment of the ants of the Nevada Test Site Cole (1966) described nesting habitats of V. lariversi as sandy areas with mixed

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey in the different regions.

3. The third part of the report deals with the results of the survey in the different districts.

4. The fourth part of the report deals with the results of the survey in the different villages.

5. The fifth part of the report deals with the results of the survey in the different households.

6. The sixth part of the report deals with the results of the survey in the different families.

7. The seventh part of the report deals with the results of the survey in the different groups.

8. The eighth part of the report deals with the results of the survey in the different communities.

9. The ninth part of the report deals with the results of the survey in the different regions.

vegetation such as Grayia-Lycium, Salsola and Coleogyne communities.

Craters were circular, about 8 cm in diameter, and of sand.

Nests were about 60 cm deep. The colonies were relatively small, consisting of about 350 workers.

This granivorous species is nocturnal and estivates during hotter summer months.

Mating flights occur during July.

Veromessor pergandei (Mayr)

Figures 112, 117-118

Aphaenogaster pergandei Mayr, 1886b:444: ♀.

Stenamma (Messor) pergandei, Emery, 1895:307: ♀.

Novomessor pergandei, Emery, 1915:73.

Novomessor (Veromessor) pergandei, Forel, 1917:234.

Veromessor pergandei, Wheeler & Creighton, 1934:347; pl.2

fig.3; ♀ ♀ ♂. M. Smith, 1947:554; pl.5 fig.26: ♀. Creighton, 1950: 158, 160: ♀. Creighton, 1953a:1-16: ♀. M. Smith, 1956:37: ♀. Cole, 1963:681: ♀. Cole, 1966:11, 13-14; fig. 17: ♀. Wheeler & Wheeler, 1973:65, 67-72; figs. 24-26: ♀ ♀ ♂.

RANGE: Southern Nevada, southeastern California, northern Baja California, western and southern Arizona, western Sonora.

DESERT RECORDS. Ubiquitous; we have 183 records. Map 3.

DISCUSSION. The dark color, polymorphic workers and presence of a psammophore will easily identify this ant in the field.

V. pergandei has been collected on our California deserts at elevations between -200 and 4320 feet in a broad array of habitats. It appears in Creosote Bush Scrub, Shadscale Scrub, Saltbush Scrub, Wash Woodlands, Palm Oases, Joshua Tree Woodland and Cactus Scrub.

Nests are generally in exposed areas and have large circular or semicircular craters, sometimes exceeding 30 cm in diameter, generally surrounded by conspicuous chaff rings (Fig. 301).

Colonies are often located on or adjacent to desert roads. Mature colonies may have several craters closely situated. Typically, one to three of these may be active at any one time, the others closed and no longer in use (Fig. 302). Tevis (1958) noted that entrances were abandoned about ten times per year with new ones established. He postulated that " . . . full granaries in one department of a formicary may cause the ants to transfer their attention to a section which can be supplied more efficiently from a new and closer entrance hole." Incipient colonies may have crescentic or circular mounds with no chaff ring. Wheeler & Rissing (1975a) found the sand nearest the entrance and on the gallery walls cemented with a yellowish substance which they postulated was fecal material smeared there by the ants.

Underground nest structure is described by Wheeler & Rissing (1975a). Immediately below the entrance is a large chamber, the vestibule, containing chaff and a few seeds; in their opinion this is a seed cleaning chamber. The vestibule opened into a series of anastomosing chambers containing husked seeds. Brood was maintained in chambers below. One larva had a seed on its venter and another a seed in its mouthparts. Tevis (1958) estimated that the underground area of a mature nest was about 15 m in diameter.

Mature colonies of V. pergandei are large. Based on foraging column counts Went, Wheeler & Wheeler (1972) have estimated the total population of one mature nest to be 50,000 ants. As many as nine queens have been found upon excavation of incipient nests.

Workers forage in a long column which may extend as much as 70 m to a food source and may include as many as 20,000 ants. An individual ant does not always use the same trail (Wheeler & Rissing, 1975b).

Individual colonies exhibit a high degree of variability in foraging times but basically a bimodal pattern is followed. During Spring (April) foraging in Death Valley Clark & Comanor (1973) found a morning foraging period began around 0500-0600 (ST 13.3°C) and lasted on the average four hours (ST at termination, about 40.6°C). This period was followed by "housekeeping" activity. An afternoon foraging period was initiated at about 1615 when ST was about 33°C. This period lasted on the average 3.25 hours with ST at about 19.4°C at termination.

Creighton's observations (1953) during the month of June at Jacumba, a Chaparral Biome site, corroborate these data although temperature thresholds vary. Morning foraging terminated during June at STs ranging from 31°C to 44.4°C. Afternoon columns would form at temperatures of 32°C to 47.8°C. These somewhat contradictory figures strongly suggest that ST is not a limiting factor. However, it must be noted that V. pergandei exhibits a strong avoidance reaction when ST approaches 49°C and, according to Creighton (1953) a temperature of 52°C is lethal. During hot summer months foraging switches to a nocturnal and crepuscular mode.

Davidson (1978) has shown that worker body size is positively correlated with foraged seed size and that this polymorphic ant is thus able to exploit a large range of seeds to increase its diet breadth.

The seeds foraged vary seasonally and from habitat to habitat. For most ant species very few collections have been made of the seeds

1. The first part of the report deals with the general situation of the country. It is a very interesting and informative study of the country's development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's development.

2. The second part of the report deals with the economic situation of the country. It is a very interesting and informative study of the country's economic development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's economic development.

3. The third part of the report deals with the social situation of the country. It is a very interesting and informative study of the country's social development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's social development.

4. The fourth part of the report deals with the political situation of the country. It is a very interesting and informative study of the country's political development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's political development.

5. The fifth part of the report deals with the cultural situation of the country. It is a very interesting and informative study of the country's cultural development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's cultural development.

6. The sixth part of the report deals with the environmental situation of the country. It is a very interesting and informative study of the country's environmental development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's environmental development.

7. The seventh part of the report deals with the international situation of the country. It is a very interesting and informative study of the country's international development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's international development.

8. The eighth part of the report deals with the future of the country. It is a very interesting and informative study of the country's future development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's future development.

which they gather, let alone identified. Table 1 lists the identified seeds of California desert plants utilized by V. pergandei. These are seeds which have been directly taken from returning foragers or recovered from seed caches within the nests; data are mostly from Rissing & Wheeler (1976).

Workers will climb plants and gnaw open seed capsules and extract both ripe and unripe seeds. Rissing & Wheeler noted that the ants respond to diminished preferred annuals seed production by increasing the amount of non-seed plant material or by increasing collections of less desirable seeds. Non-seed material gathered include leaves, stems, arthropod remains and fecal pellets.

This species is heavily preyed upon by the lizards Phrynosoma mcalli, P. coronatum and Uma sp. Dead workers have been collected from foraging ants such as Forelius foetidus, Myrmecocystus yuma and M. semirufus. The theridiid spider, Steatoda sp., also preys upon V. pergandei.

The ubiquitous thysanuran, Mirolepisma deserticola, is very common in nests. Other known nest associates are Notibius puberulus (Tenebrionidae) and Pseudomorpha sp. (Carabidae).

Mating flights occur in March and April.

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Table 1. SEEDS COLLECTED BY VEROMESSOR PERGANDEI.

Malvaceae	Polemoniaceae
<u>Malvastrum exile</u>	<u>Gilia filiformis</u>
<u>Malvastrum rotundifolium</u>	<u>Gilia latifolia</u>
Geraniaceae	<u>Gilia</u> sp.
<u>Erodium tridentata</u>	Hydrophyllaceae
Zygophyllaceae	<u>Phacelia calthifolia</u>
<u>Larrea tridentata</u>	<u>Phacelia crenulata</u>
Loasaceae	Boraginaceae
<u>Mentzelia albicaulis</u>	<u>Cryptantha angustifolia</u>
<u>Mentzelia veatchiana</u>	<u>Cryptantha holoptera</u>
Cruciferae	<u>Cryptantha nevadensis</u>
<u>Lepidium lasiocarpum</u>	<u>Pectocarya recurvata</u>
<u>Dithyrea californica</u>	Solanaceae
Polygonaceae	<u>Nicotiana trogonophylla</u>
<u>Chorizanthe brevicornu</u>	Scrophulariaceae
<u>Chorizanthe rigida</u>	<u>Mohavea breviflora</u>
<u>Eriogonum inflatum</u>	Acanthaceae
<u>Eriogonum pusillum</u>	<u>Beloperone californica</u>
<u>Eriogonum trichopes</u>	Leguminosae
Chenopodiaceae	<u>Cercidium floridum</u>
<u>Chenopodium pumilio</u>	<u>Dalea</u> sp.
<u>Atriplex hymenelytra</u>	Onagraceae
<u>Atriplex canescens</u>	<u>Oenothera clavaeformis</u>
Nyctaginaceae	Campanulaceae
<u>Abronia villosa</u>	<u>Nemocladus glanduliferus</u>
Plantaginaceae	Gramineae
<u>Plantago insularis fastigiata</u>	<u>Sporobolus</u> sp.

Table 1. SEEDS COLLECTED BY VEROMESSOR PERGANDEI (cont.)

Compositae

Bebbia juncea

Encelia farinosa

Hymenoclea salsola

Bidens sp.

Ambrosia dumosa

Geraea canescens

Chaenactis carphoclinia

Peucephyllum schottii

Chaenactis fremontii

Lygodesmia spinosa

Chaenactis stevioides

Calycoseris parryi

Monoptilon bellioides

Atrichoseris platyphylla

Psathyrotes ramosissima

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Genus PHEIDOLE Westwood

Pheidole is a cosmopolitan genus of great complexity and in most areas of the world the species are not well known. In many species workers are dimorphic so that there are two distinct subcastes: majors or "soldiers" with disproportionately large heads and the minors. Other species are polymorphic, with a full gamut of subtypes from minors to majors. Among the Southwestern forms many of those which are dimorphic are also graminivores. The polymorphic species tend to be omnivores, though often with a strong tendency to be predaceous. Some of these polymorphic species have a very disagreeable odor, reminiscent of ecitonine ants, when crushed.

The North American Pheidole, workers only, were keyed by Gregg (1958). The key works reasonably well for most of our forms. There are 12 described species known in our desert area; there is at least one undescribed species. The key which follows departs from tradition in dealing with the workers; for there are separate keys for major and minor subcastes. All previous keys have been based largely on majors which are not always available.

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. It begins with the first settlers, who came to the continent in search of a new life. They found a land of opportunity, but also of hardship. The early years were marked by conflict and struggle, as the settlers fought to establish their communities and defend themselves against the forces of nature and the native peoples. Over time, the United States grew from a small colony into a powerful nation, shaped by the ideals of liberty and democracy. The story of the United States is a testament to the resilience and spirit of its people, who have overcome countless challenges and built a nation of freedom and opportunity.

KEY TO SPECIES OF PHEIDOLE

minor workers

- 1a. Antennal club composed of three segments, antepenultimate segment clearly longer than preceeding segment; OMD usually less than EL; head usually smooth and shiny, with scattered punctures 2
- b. Antennal club composed of four segments, antepenultimate segment no longer than preceeding segment (Fig. 119); OMD more than EL; dorsum of head, except along midline, conspicuously and densely punctate clydei Gregg
- 2a. Head, in frontal view, much narrowed behind eyes and/or scape extending beyond occipital margin by more than one-third its length (Figs. 121-123); EL equal to OMD 3
- b. Head, in frontal view, not narrowed, occipital margin straight or concave; scape extending beyond occipital margin by no more than one-third its length; OMD usually less than EL 5
- 3a. Head sharply narrowed behind eyes to form a short neck at occipital margin (Figs. 122-123); HL about 1.3-1.4 time HW . . . 4
- b. Head weakly to moderately narrowed behind eyes, not forming neck at occipital margin (Fig. 121); HL about 1.2 times HW
. hyatti Emery
- 4a. Dorsum of head and thorax and basal half, or more, of first gastric tergum more or less distinctly reticulate-punctulate; propodeal spines short, slender, directed upward; occipital neck, exclusive of flange, equal to about 0.5 times interocular distance (Fig. 123) vistana Forel

THE HISTORY OF THE UNITED STATES

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- b. Dorsum of head, thorax and all of first gastric tergum mostly smooth and shiny, with limited areas of obscure reticulopunctation; propodeal spines short, triangular, oblique; occipital neck about 0.6 times interocular distance (Fig. 122)
. desertorum Wheeler
- 5a. Venter of head convex on either side of gular suture and without trace of fringing psammophore (Figs. 129-131); propodeal spines usually present and distinct (Figs. 129-131); eye ovoid 6
- b. Venter of head flattened and with a distinct psammophore of long curled setae (Fig. 134); propodeal spines absent (Fig. 134); eyes large, elongate psammophila Creighton & Gregg
- 6a. Dorsum of head and thorax (usually) largely smooth and shiny, punctulae, when present, obscure and limited in extent; mesonotum, in profile, often evenly curved or straight; scape exceeding occipital margin, if at all, by one-fifth its length or less 7
- b. Head and thorax closely and sharply punctulate with shiny areas along middle of head and promesonotum; mesonotum angulate in profile (Fig. 135); scape surpassing occipital margin by about one-fourth its length sciophila Wheeler
- 7a. Propodeum conspicuously punctulate, with short, but distinct, spines or teeth (Figs. 129-130); occipital margin usually distinctly concave (Figs. 125-127); postpetiole, in profile, more or less distinctly nodose 8

- b. Propodeum weakly punctulate or smooth and shiny, without spines or teeth, at most angulate at juncture of basal and posterior faces (Fig. 131); occipital margin flat or weakly convex (Fig. 128); postpetiole not nodose in profile barbata Wheeler
- 8a. EL at least 1.5 x OMD, interocular distance no more than 3.0 x EL, usually much less 9
- b. EL no more than 1.1 x OMD, interocular distance about 3.5 x EL micula Wheeler*
- 9a. EL not more than about 1.9 x OMD and usually less than 1.7; OI various but often less than 30; promesonotum usually smooth and shiny, without distinctly punctulate areas; if punctulae present, HW does not exceed 0.49 mm and occiput is not punctulate in middle 10
- b. EL 2 or more x OMD; OI 31-36; promesonotum extensively punctulate; HW more than 0.50 mm; occiput with a small punctulate area in middle tucsonica Wheeler
- 10a. Promesonotal hairs slender, flexuous, longest about equal to EL, clearly greater than MOD; tibial hairs decumbent to erect . . 11
- b. Promesonotal hairs stout, stiff, longest about equal to MOD (Fig. 129); tibial hairs appressed rugulosa Gregg
- 11a. Eye large, OI 30-35 12
- b. Eye small, OI 24-26 (middle of occiput smooth and shiny; anterior slope of pronotum smooth and shiny, a few weak punctulae on pronotal neck) paiute Gregg

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- 12a. Middle of occiput and anterior slope of pronotum usually weakly punctulate, rarely one only punctulate; occipital margin, in frontal view, broadly, shallowly concave (Fig. 125) gilvescens Wheeler
- b. Middle of occiput and anterior slope of pronotum both smooth and shiny; occipital margin deeply, often angularly, concave, often subcordate (Fig. 127) yagui Creighton & Gregg

major workers

- 1a. Antennal club three-segmented, segment 9 similar to preceeding segments; gular teeth present or absent 2
- b. Antennal club four-segmented, antennal segment 9 more similar to 10 than preceeding segments; one pair of gular teeth, mesial pair absent clydei Gregg
- 2a. Apex of antennal scape surpassing occipital margin (Figs. 137, 139); mesial pair of gular teeth slender, spiniform 3
- b. Apex of antennal scape not attaining occipital margin; when gular teeth present, mesial pair usually triangular 4
- 3a. Scape surpassing occipital margin by less than length of following segment (Fig. 139); first gastric tergum moderately shiny, lightly tessellate; clypeus shiny, flat or slightly raised : ng midline desertorum Wheeler
- b. Scape surpassing occipital margin by more than length of following segment (Fig. 137); first gastric tergum dull, closely punctulate; clypeus moderately shiny, with sharp longitudinal median carina vistana Forel

- 4a. Scape extending no more than two-thirds of distance to occipital margin, not flattened at basal bend; first gastric tergum smooth and shiny 5
- b. Scape extending three-fourths of distance to occipital margin, abruptly bent and flattened at base (Fig. 136); first gastric tergum distinctly roughened hyatti Emery
- 5a. Tops of occipital lobes distinctly transversely striate; mesial pair of gular teeth absent 6
- b. Tops of occipital lobes smooth and shiny, or variously sculptured, but not striate; gular teeth various 7
- 6a. Ventral mandibular carina not visible in frontal view; hairs of hind tibia appressed; OMD less than EL rugulosa Gregg
- b. Ventral mandibular carina visible, flange-like, in frontal view; hairs of hind tibia suberect to erect; OMD greater than EL micula Wheeler*
- 7a. Gular teeth absent; longest genal hairs at least 0.35 mm; OMD equal to, or less than, EL 8
- b. At least one pair of gular teeth; longest gular hairs no more than 0.25 mm, usually less than 0.20; OMD usually greater than EL 9
- 8a. Propodeal teeth absent or propodeum broadly triangular at junction of basal and posterior faces; postpetiole with broad, thin ventral process; longest genal hairs about 0.35 mm barbata Wheeler

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- b. Propodeal teeth distinct, sharp; postpetiole without ventral process; longest genal hairs about 0.60 mm
. psammophila Creighton & Gregg
- 9a. Dorsum of head mostly smooth and shiny with scattered coarse, piligerous punctures; promesonotal dorsum similar or with coarse transverse rugulae with moderately punctulate interspaces; mesial pair of gular teeth absent 10
- b. Dorsum of head and promesonotum densely granulopunctate; mesial pair of gular teeth present, spiniform . . . sciophila Wheeler
- 10a. Promesonotal dorsum smooth and shiny; when sculpturation present consisting of fine, transverse striae, usually restricted to anterior slope of pronotum, with shiny interspaces 11
- b. Promesonotal dorsum crossed by coarse, somewhat wavey, transverse rugulae, interspaces moderately punctulate . . tucsonica Wheeler
- 11a. Head, in profile, without flattened area extending posteriorly from antennal fossa; occipital lobes thick and evenly rounded in profile; anterior slope of pronotum smooth and shiny; HW less than 1.28 mm 12
- b. Head, in profile, with flattened area extending from antennal fossa toward occipital lobe; occipital lobe with dorsal and ventral surfaces notably convergent toward crest of lobe; anterior slope of pronotum usually crossed by a few fine, transverse striae; HW over 1.45 mm gilvescens Wheeler

- 12a. Mandible coarsely striate over basal one-half or more; head slightly flattened dorsomesad of eye, with coarse punctures and fine striae; HW 0.96-1.08 mm paiute Gregg
- b. Mandible usually without striae beyond basal one-third; head without flattened and coarsely punctate area dorsomesad of eye; HW 1.10-1.23 mm yaqui Creighton & Gregg

females

- 1a. Antennal club 3-segmented, ninth segment more similar to eighth than tenth; gula teeth various, one or two pairs or none . . 2
- b. Antennal club 4-segmented, ninth segment more similar to tenth than to eighth; one pair of gular teeth clydei Gregg
- 2a. Antennal scape surpassing occipital margin; first gastric segment conspicuously sculptured; two pairs of gular teeth, mesial pair often spiniform 3
- b. Antennal scape not reaching occipital margin; first gastric tergum usually smooth and shiny; median pair of gular teeth, when present, usually dentiform, rarely spiniform 4
- 3a. First gastric tergum moderately shiny, lightly tessellate; mesoscutum moderately shiny, with scattered coarse punctures over disc desertorum Wheeler
- b. First gastric tergum dull, densely punctulate; mesoscutum dull, densely punctate between close, very irregular rugulae
. vistana Forel
- 4a. Antennal scape cylindrical or slightly flattened at basal bend; apex of scape not extending beyond level of posterior ocelli; occipital area often smooth and shiny 5

- b. Antennal scape greatly flattened and broadened at basal bend; apex of scape reaching nearly to occipital margin; dorsum of head rugulose and reticulate, interspaces punctulate hyatti Emery
- 5a. Dorsum of head longitudinally striate or rugulose, or reticulate-rugose at least to level of anterior ocellus, interspaces more or less punctulate 6
- b. Dorsum of head coarsely rugose below, rugae not attaining level of anterior ocellus, most areas smooth and shiny, with scattered coarse, setigerous punctures
- 6a. Side of pronotum distinctly sculptured; IOD about twice OD; occiput, in frontal view, weakly concave; HW over 1.0 mm . . 7
- b. Side of pronotum smooth, shiny; IOD about 3 x OD; occiput, in frontal view, deeply concave; HW less than 1.0 mm paiute Gregg
- 7a. Dorsum of head with prominent, widely spaced longitudinal rugulae which break up to form reticulae at sides; interspaces somewhat shiny and lightly punctulate; occipital corners transversely rugulose and punctulate; one pair of gular teeth rugulosa Gregg
- b. Dorsum of head with fine, close, longitudinal striae, weaker at sides, interspaces dull, densely punctulate; occipital corners smooth, shiny between scattered coarse punctures; two pair of gular teeth sciophila Wheeler

- 8a. Venter of head with numerous long, slender, apically curled hairs, many at least 0.45 mm long; node of postpetiole dull, roughened and punctulate between irregular rugulae 9
- b. Venter of head with sparse hairs only, longest not over 0.25 mm; node of postpetiole moderately shiny, faintly punctulate between scattered coarse punctures 10
- 9a. Eye without erect hairs; lower gular area, on either side of midline with a large bare area surrounded by a fringe of long curled setae; most of area of frontal lobes and frons with coarse, longitudinal striae; HW 1.53-1.62 mm .. barbata Wheeler
- b. Eye with erect hairs; entire gular area with hairs, many long and curled, no defined bare areas; most of area of frontal lobes and frons smooth and shiny, with scattered coarse punctures; HW 1.80 mm psammophila Creighton & Gregg
- 10a. Side of pronotum weakly tessellate, moderately shiny, without distinct striae; ocellar area not notably darkened; infraspinal facet of propodeum punctulate but without coarse transverse striae gilvescens Wheeler
- b. Side of pronotum closely punctulate, roughened and with fine transverse rugules; ocellar area dark; infraspinal facet of propodeum densely punctulate between coarse, transverse, widely spaced rugules tucsonica Wheeler

males

- 1a. Mesoscutum either smooth and shiny between sparse coarse setigerous punctures or more or less finely lineopunctulate; scutellum smooth and shiny; mandibular dentition and scape length various 2
- b. Entire thorax dull and densely punctulate, occasionally with shiny areas on mesoscutum and mesopleura; mandible with apical tooth and broad basal tooth on margin; scape about 5 x longer than thick vistana Forel
- 2a. Scape short, no more than 3.5 x longer than thick; ocellocular distance no more than 1.3 x OD 3
- b. Scape long, slender, about 5 x longer than thick; OOD about 2 x OD barbata Wheeler
- 3a. SL at least 1.4 x OOD, usually more; scape at least 3 x longer than thick 4
- b. SL less than 1.25 x OOD; scape no more than 2.5 x longer than thick 5
- 4a. Greatest width of head (through eyes) about 1.4 x HL; rugae of infraspinal facel of propodeum, when transverse, not crossing segment but turning forward in middle tucsonica Wheeler
- b. Greatest HW (through eyes) no more than 1.3 x HL; infraspinal facet of propodeum with completely transverse rugulae
 gilvescens Wheeler

- 5a. Greatest HW at least 0.8 mm; occipital flange broad, translucent or transparent 6
- b. Greatest HW no more than 0.7 mm; occipital flange narrow, opaque 7
- 6a. Mandible with several short teeth basad of apical tooth; greatest HW more than 0.91 mm desertorum Wheeler
- b. Mandible usually with a single broad tooth basad of apical tooth; greatest HW less than 0.84 mm hyatti Emery
- 7a. Integument dark brown; mediobasal area of propodeum with a few transverse striae, those of side vertical, turning forward, toward base, along lateral angle paiute Gregg
- b. Integument yellowish brown; striae of median area of propodeum longitudinal, divergent behind, joining longitudinal striae of side rugulosa Gregg

* We have no records for this ant in our area; all so-called P. micula are misidentifications of P. rugulosa, but we have included it in the key to emphasize differences between these superficially similar ants.

NOTE: Females of P. micula and P. yaqui have not been available.

Males of P. clydei, P. micula, P. psammophila, P. sciophila and P. yaqui have not been available.

Pheidole barbata Wheeler

Figures 128, 131, 148

Pheidole barbata Wheeler, 1908c:448: ♀ . Creighton, 1950:170: ♀♂. Creighton & Gregg, 1955:1: ♀♂ ♀. Gregg, 1958:13, 17: ♀♂. Wheeler & Wheeler, 1973:74, 75: ♀♂.

RANGE: Western Arizona to southeastern California and southern Nevada.

DESERT RECORDS. Generally distributed through the Colorado Desert to southwestern Mojave Desert; 26 records. Map 4.

DISCUSSION. This species is distinct in all castes. Its nearest relative is P. psammophila, but the two are readily distinguished by the characters in the keys.

P. barbata nests in sand. It has been most frequently taken from nests in fine sand such as that of dunes, but may also nest in coarser sand at arroyo edges. Although Creighton & Gregg (1955) doubted that P. barbata nests in shifting sand, we now have records of nests in fine, windblown sand. Most of our collections are from Creosote Bush Scrub and dunes habitats, but we also have records from Joshua Tree Woodlands and Wash Woodlands. It has been found at elevations between -190 and 3500 feet.

Nests are surmounted by low sand craters 3.8-10 cm diameter. A chaff ring is sometimes present around the mound. Wheeler & Wheeler (1973) describe the nest architecture below the surface as consisting of chambers under the mound over an area twice the diameter of the crater to a depth of 18 cm in an interface between slightly damp and damp soil.

Creighton & Gregg (1955) cautiously noted that colonies of P.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation and the second section deals with the progress of the work.

2. The second part of the report deals with the specific work done during the year. It is divided into three main sections: the first section deals with the work done in the field, the second section deals with the work done in the laboratory, and the third section deals with the work done in the office.

3. The third part of the report deals with the results of the work done during the year. It is divided into three main sections: the first section deals with the results of the field work, the second section deals with the results of the laboratory work, and the third section deals with the results of the office work.

4. The fourth part of the report deals with the conclusions drawn from the work done during the year. It is divided into three main sections: the first section deals with the conclusions drawn from the field work, the second section deals with the conclusions drawn from the laboratory work, and the third section deals with the conclusions drawn from the office work.

5. The fifth part of the report deals with the recommendations made for the future work. It is divided into three main sections: the first section deals with the recommendations made for the field work, the second section deals with the recommendations made for the laboratory work, and the third section deals with the recommendations made for the office work.

barbata seem to be small. The largest nest encountered by Creighton consisted of 84 workers: 73 minors and 11 majors. Most nests yielded only a few majors and two or three dozen minors. Nests excavated at Pearblossom were much larger. Some were excavated to a depth of about 2 m and produced hundreds of minors and several dozen majors. In each nest only a single queen was found. It seems probable that proper excavation of nests of many other species with "small" colonies will produce similar results. A single nest may have several entrances and these must all be traced out.

P. barbata is a nocturnal forager and in Spring months workers can be found collecting seeds as late as 0830, at STs of 27°C. In some nests majors may form "repletes". These have not been analyzed, but they do not function for nectar storage; they are decidedly unpleasant to taste. Possibly they contain oils from seeds or insect hemolymph.

Males and females have been taken in nests in Spring and Fall months. A mating flight was observed in mid-February and deŕlated females have been collected in March. Flights may also take place during the Fall rainy season.

Pheidole clydei Gregg

Figures 119, 138

Pheidole (Ceratopheidole) clydei Gregg, 1950:89: ♀. Gregg, 1953:1-7; figs. 1-3: ♀. Creighton, 1964:169-174. Wheeler & Wheeler, 1973:84-86; fig. 32: ♀ ♀.

RANGE: New Mexico to southern Nevada and southeastern California.

DESERT RECORDS. Kern Co.: Last Chance Cyn., 2500', El Paso Mts., 16 Sept 1978 (RRS & CDG, #78-65j; LACM). Inyo Co.: Grapevine Ranger Sta., 2100-2300', DVNM, 1 Nov 1967, 7 July 1968, 4 Sept 1968, 25 May 1970 (GJW, #Cal. 215, 505b, 525, 527, 915a; GJW). Los Angeles Co.: Big Rock Cr., 4500', 30 Sept 1965 (RRS; LACM). River-side Co.: Deep Canyon, 1200', 19 Apr 1963 (WSC; LACM); same locality, 1000'-1225', various dates (GJW, #Cal. 365, 369, 470, 511, 513, 517; GJW); Painted Cyn., 15 Apr 1974 (F. G. Andrews, M. S. Wasbauer; CDA); 8 mi E Mecca, 3 May 1969 (R. J. Hamton; LACM). San Diego Co.: Split Mountain, 500', ABDF, 19 Apr 1952 (WSC; LACM). Map 4.

DISCUSSION. The four-segmented antennal club is diagnostic for worker and female among our Pheidole. This is one of the less commonly collected of our species, but it is probably more common than the above records would suggest.

P. clydei nests in canyon walls in crevices in rock or in cracks in large boulders (Fig. 281). The crevices themselves appear to contain no soil and so the nests are completely isolated from any contact with soil.

In our desert area this species occurs at elevations between 500 and 4500 feet.

DECLASSIFICATION AUTHORITY

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Minor workers, foraging individually, use scent trails but do not form columns. According to Wheeler & Wheeler (1973) foragers do not gather seeds, but collect arthropod remains, including whole or fragmentary flies, spiders, moth larvae and termites. Majors situated around the nest entrances assist with larger items. Using their powerful mandibles they dissect any booty too large for the nest opening.

Although Creighton (1964) observed P. clydei foraging from 0900 to 1400 in March and April, our records show that it is usually nocturnal and crepuscular, leaving the nest at about 1900 and continuing to forage until about 0930 at the latest.

Pheidole desertorum Wheeler

Figures 121, 133, 139

Pheidole desertorum Wheeler, 1906:337: ♀ ♀ ♂. Creighton, 1950:178: ♀ ♀. Gregg, 1958:9, 21: ♀ ♀. Gregg, 1963:417-419, map: ♀ ♀. Cole, 1966:14, 15: ♀ ♀.

Pheidole desertorum var. comanche Wheeler, 1906:339: ♀ ♀.

Pheidole desertorum var. maricopa Wheeler, 1906:339: ♀ ♀.

RANGE: Western Texas and Oklahoma to southern Nevada and southeastern California; northern Mexico.

DESERT RECORDS. Inyo Co.: Eureka Valley Canyon, 15 mi S Oasis, 23 May 1974 (M. S. & J. S. Wasbauer; CDA); above Deadman's Pass, 3400', Greenwater Range, 30 Sept 1978 (RRS; LACM); Townes Pass, 4956', 15 Sept 1975 (F. G. Andrews, A. R. Hardy; CDA). Kern Co.: Short Cyn., 3500', 7 mi NW Inyokern, 3 Nov 1967 (RRS; LACM); Last Chance Cyn., 2500', El Paso Mts., 10 July 1964 (RRS; LACM); same locality, 15-16 Sept 1978 (RRS & CDG, #78-65b; LACM); Lonetree

Cyn., 6.8 mi S jct Randsburg Rd. & Hwy 14, 15 June 1970 (F. Andrews, M. Wasbauer; CDA). Los Angeles Co.: 2 mi S Pearblossom, 3500', various dates (RRS; LACM). San Bernardino Co.: 0.5 mi S Red Mountain, 3500', 16 Sept 1978 (RRS & CDG, #78-72; LACM); Mescal Range, 4800', 5 Nov 1967 (RRS, #67-284; LACM); 9.5 mi NNE Cima, 4200'-4265', Ivanpah Mts., 14 Apr 1977 (RRS & CDG, #77-7; LACM); Cima, 4200', 7 June 1967 (Birdsall & Johnson; CDA); Cottonwood Spring, 4400', Granite Mts., 6 Nov 1967 (RRS, #67-285; LACM); Granite Pass, 4000', Granite Mts., 27 Apr 1968 (R. Hobza; LACM); 5 mi E Needles, 15 Aug 1956 (A. C. Cole, # 285; LACM); 23 mi S Needles, 475', 31 Jan 1967 (RRS; LACM); 1.3 mi S Vidal Jct., 800', 3 Oct 1978 (RRS, #78-118; LACM). Riverside Co.: Conejo Well, JTNM, 15 Oct 1961 (E. L. Sleeper; LACM); 2 mi E Cabazon, 13 Nov 1966 (R. J. Hamton; LACM); 24.5 rd mi WSW Wiley's Well, 2100', 24 Oct 1978 (RRS, #78-134; LACM); 0.6 mi SE Baunonk Mine, 2475', 25 Oct 1978 (RRS, #78-137; LACM). Imperial Co.: Hwy 78, 6.2 mi NNE jct Ogilby Rd., 500', 6 May 1978 (RRS & CDG, #78-26, 27; LACM); Indian Pass Rd., 380', 4 mi E Ogilby Rd, 7 May 1978 (RRS & CDG, #78-45; LACM). Map 4.

DISCUSSION. It seems odd that an ant as common and widely distributed as this one should not have been previously reported from California. In the field it can be confused only with P. hyatti and P. vistana. Both, however, are less common in the deserts than P. desertorum. Indeed, in many areas the presence of P. desertorum seems to preclude the existence of the others.

Our records for P. desertorum place it at elevations between 380 and 4956 feet. Collections are predominantly from coarse alluvial soils in Creosote Bush Scrub, Wash Woodlands and Joshua Tree Woodlands. Nests may be under stones or in fully exposed areas. Mounds are

usually small craters of sand and may be circular or very irregular and messy.

Cole (1966) found that "colonies were generally large and the occupants very active and pugnacious" in the region of the N vada Test Site. The pugnacity has possibly been overrated, for we found that when nests were disturbed, the ants ran about with considerable excitement, but few seemed inclined to attempt to defend the disturbed nest.

This is a primarily nocturnal forager. In southeastern Arizona Chew (1977) found P. desertorum at baits between 1910 and 0850 about 80% of the time and during the remaining daylight hours only 20% of the time. Whitford (1978a) notes that rain, in the area of Las Cruces, New Mexico, prompts foraging by this species. Workers would begin to forage a few hours after rainfall, but cease activity unless abundant forage was available. Our observations indicate that, in California, workers begin foraging around 2030 and may continue to be active until about 0930.

P. desertorum is a granivorous, individual forager. In a community study of desert seed eating ants Davidson (1977a) found P. desertorum workers at Rodeo, New Mexico, selecting native seeds ranging from 0.64 to 1.65 mm wide and that these sizes were positively correlated with worker body length. At one of our Imperial Valley sites we found numerous seeds of Datura discolor on P. desertorum chaff piles. The seeds, 4.25-5 mm long, had been transported to the nest and then discarded once the eliasomes had been removed.

Alate females and males have been collected in nests in August and September and deallated females on the ground in May.

1. The first of these is the fact that the population of the country is very small.

2. The second is the fact that the population is very small.

3. The third is the fact that the population is very small.

4. The fourth is the fact that the population is very small.

5. The fifth is the fact that the population is very small.

6. The sixth is the fact that the population is very small.

7. The seventh is the fact that the population is very small.

8. The eighth is the fact that the population is very small.

9. The ninth is the fact that the population is very small.

10. The tenth is the fact that the population is very small.

11. The eleventh is the fact that the population is very small.

12. The twelfth is the fact that the population is very small.

13. The thirteenth is the fact that the population is very small.

14. The fourteenth is the fact that the population is very small.

15. The fifteenth is the fact that the population is very small.

16. The sixteenth is the fact that the population is very small.

17. The seventeenth is the fact that the population is very small.

18. The eighteenth is the fact that the population is very small.

19. The nineteenth is the fact that the population is very small.

20. The twentieth is the fact that the population is very small.

21. The twenty-first is the fact that the population is very small.

22. The twenty-second is the fact that the population is very small.

23. The twenty-third is the fact that the population is very small.

24. The twenty-fourth is the fact that the population is very small.

25. The twenty-fifth is the fact that the population is very small.

26. The twenty-sixth is the fact that the population is very small.

27. The twenty-seventh is the fact that the population is very small.

28. The twenty-eighth is the fact that the population is very small.

29. The twenty-ninth is the fact that the population is very small.

30. The thirtieth is the fact that the population is very small.

Pheidole gilvescens Wheeler

Figures 125, 144, 145

Pheidole xerophila tucsonica var. gilvescens Wheeler, 1908c: 448: ♀♀.

Pheidole xerophila subsp. tucsonica, Creighton, 1950:102: ♀♀.
(in part)

Pheidole gilvescens, Creighton & Gregg, 1955:5: ♀♀. Gregg, 1958:15, 23: ♀♀. Wheeler & Wheeler, 1973:75, 76; fig. 27: ♀♀.

Pheidole xerophila, Wheeler & Wheeler, 1973:82 (in part).

RANGE: Arizona, southern Nevada, southeastern California.

DESERT RECORDS. General throughout both deserts, often very abundant locally: 53 records. Map 4.

DISCUSSION. Of the two samples recorded by Wheeler & Wheeler (1973) as P. xerophila from Deep Canyon, one (their #Cal.348) is P. gilvescens. The sample includes both worker subcastes and there is no doubt that these represent P. gilvescens.

This species is common, especially in the Mojave Desert. In many parts of the Colorado Desert it is replaced by P. tucsonica, though the two often exist side by side.

In our deserts found at elevations between 300 and 5000 feet, this species occupies a variety of habitats: Creosote Bush Scrub, Wash Woodlands, grasslands and Joshua Tree Woodlands. Nests are usually in sandy and gravelly soil, occasionally under stones.

Craters are usually composed of fine sand but may be entirely absent; chaff may be present around the tumulus. Crater diameter averages about 4 cm and entrances are very small (Fig. 305). One colony may have several entrances, usually clumped (Fig. 304).

THE UNITED STATES OF AMERICA
DO hereby certify that
[Name] is a citizen of the United States of America.

Witness my hand and seal of office this [Day] day of [Month], 19[Year].
[Signature]
[Title]

Given under my hand and seal of office this [Day] day of [Month], 19[Year].
[Signature]
[Title]

Attest my hand and seal of office this [Day] day of [Month], 19[Year].
[Signature]
[Title]

Attest my hand and seal of office this [Day] day of [Month], 19[Year].
[Signature]
[Title]

Creighton & Gregg (1955) state that colonies are small, noting that the largest nest had but 6 majors and up to 36 minors. We have excavated much larger colonies with up to 500 workers, to depths of 1.5 to 2 m.

This species is primarily granivorous but has been found carrying dead arthropods, probably scavenged. Repletes may be found in the nests. As with P. barbata, the stored liquid is certainly not nectar!

Group foraging is employed with workers following defined trails. Minors usually begin foraging around dusk, but have been seen out as early as 1515, and continue until morning. The end of foraging is usually followed by "housekeeping" and, finally, blocking of the nest entrance (usually between 0800 and 0900). According to Bernstein (1971) grass seeds are the primary forage. Seeds which we have recovered from the nests include many non-grasses, but these have not yet been identified.

Foragers of both Conomyrma bicolor and C. insana have been found carrying dead workers of P. gilvescens; whether as prey or scavenge is unknown. Wheeler & Wheeler (1973) recount interspecific aggression between P. gilvescens and P. tucsonica. The colonies were about 63 cm apart and dead or injured majors of both species were in the intervening area. A pair of majors was engaged in combat on the mound of the P. tucsonica colony.

Males have been found in nests in May and September. Alate females have been collected in nests in late May. No mating flights have been witnessed.

Pheidole hyatti Emery

Figures 122, 136

Pheidole hyatti Emery, 1895:295: ♀ 7. Wheeler, 1908c:462: ♀ 7 ♀. Creighton, 1950:180: ♀ 7. Gregg, 1955:10, 22: ♀ 7. Gregg, 1963:419; map: ♀ 7. Wheeler & Wheeler, 1973:74, 79-80: ♀ 7 ♀ ♂.

Pheidole hyatti var. ecitonodora Wheeler, 1908c:463: ♀ 7 ♀ ♂.

Pheidole hyatti subsp. solitanea Wheeler, 1915:409: ♀ 7 ♀. Creighton, 1950:181: ♀ 7. Gregg, 1958:10, 23: ♀ 7. NEW SYNONYMY.

RANGE: Western Oklahoma and Texas to southern Nevada and California; adjacent Mexico.

DESERT RECORDS. General throughout our region, though may be locally replaced by P. desertorum; 27 records. Map 4.

DISCUSSION. This species, like P. desertorum and P. vistana, has a rank, foetid odor when crushed, hence the name ecitonodora coined by Wheeler for one of the variant forms of P. hyatti. The subspecies solitanea was based on a series of specimens of smaller average size than what Wheeler regarded as normal. The difference is illusory and there is no reason to maintain solitanea.

The strongly curved and flattened scape base are distinctive of P. hyatti among the species in our area. The workers are similar to those of P. desertorum and P. vistana but have the posterior portion of the head broad and distinctly rounded (Fig. 122).

The elevation range for P. hyatti in our area is 0 to 4100 feet. Habitats in which it has been collected include Palm Oases, cottonwood groves, Wash Woodland, Joshua Tree Woodland and Piñon-juniper.

MEMORANDUM FOR THE RECORD

DATE: 10-10-61

TO: THE DIRECTOR, FBI (100-371091) FROM: SAC, NEW YORK (100-100000) (P)

SUBJECT: JAMES EARL RAY, AKA; ALLEGED ATTEMPT TO OBTAIN PASSPORT FOR TRIP TO AFRICA.

RE: NEW YORK TELETYPE TO BUREAU, 10-10-61.

FOR INFORMATION OF THE BUREAU, THE FOLLOWING IS A SUMMARY OF THE MATTER:

ON 10-10-61, JAMES EARL RAY, AKA, ADVISED THAT HE HAD BEEN ADVISED BY AN INDIVIDUAL WHO OFFERED HIM \$10,000 TO ASSIST HIM IN OBTAINING A PASSPORT FOR A TRIP TO AFRICA.

RAY STATED THAT HE HAD REFUSED THE OFFER AND WANTED TO REPORT THE MATTER TO THE FBI.

RAY STATED THAT THE INDIVIDUAL WHO OFFERED HIM THE \$10,000 WAS A MAN WHO IDENTIFIED HIMSELF AS "JOHN DOE".

RAY STATED THAT HE HAD NO OTHER INFORMATION CONCERNING THE MATTER.

RAY STATED THAT HE HAD NO OTHER INFORMATION CONCERNING THE MATTER.

RAY STATED THAT HE HAD NO OTHER INFORMATION CONCERNING THE MATTER.

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RAY STATED THAT HE HAD NO OTHER INFORMATION CONCERNING THE MATTER.

Nests are normally in soil under trees or other plants. They may also be situated in partially decayed logs of Yucca brevifolia on the ground. Wheeler (1915) found that this species makes large mound nests; craters may be regular, but, in our experience, more commonly they are messy and irregular piles of excavated soil (Fig. 303).

This ant is a nocturnal forager. The normal mode seems to be individual foraging until a rich resource is discovered; new foragers are quickly recruited and a distinct column may then result. Although Wheeler (1908c) considered this species to be a predatory carnivore, it is actually omnivorous. There is a preference for seeds with high oil content. One foraging column was observed in Wash Woodland; some of the workers were carrying eliosomes of Datura discolor and others were carrying the entire seed, but only those with eliosome still attached. Presumably the seed is ultimately discarded, as it is by P. desertorum. The ant may thus be a mechanism for dispersal of seeds of this plant.

Males have been taken at black lights in September. In other areas of southern California, males and females are present in the nests in both Spring and Fall.

Pheidole paiute Gregg

Figures 126, 130, 141

Pheidole bicarinata subsp. paiute Gregg, 1958:16, 17-18; ♀ 4.
Cole, 1966:15: ♀ 4.

Pheidole paiute, Wheeler & Wheeler, 1973:75, 80-81: ♀ 4.

RANGE: Southern Nevada to southeastern California and western Arizona.

DESERT RECORDS. Inyo Co.: Grapevine Ranger Sta., 2300', DVNM, 6 Mar. 1968 (GJW, #Cal.327; GJW); The Racetrack, 3700', DVNM, 26 Mar 1969 (GJW, #Cal.565, 566; GJW); 2 mi S the Racetrack, 3700', DVNM, 26 Mar 1969 (GJW, #Cal.569; GJW); 4 mi S Badwater, DVNM, 27 Mar 1969 (GJW, #Cal.573; GJW). Riverside Co.: Deep Canyon, 800', 3 Dec 1967, 12 Apr 1969 (GJW, #Cal.243, 600a; GJW). Map 4.

DISCUSSION. We are here following Wheeler & Wheeler (1973) in treating P. paiute as a species, not a subspecies of P. bicarinata.

This is primarily a Great Basin Sagebrush Desert form. Our records reflect this, for most are from sagebrush areas of Inyo County. The Deep Canyon records are surprising since both samples were taken in Larrea-Palo Verde Community of the desert biome. The Wheelers also record one nest in the Ecotone at 3000'.

Cole (1966) found that "colonies were numerous at the Test Site in areas of Grayia-Lycium, Larrea-Franseria, Coleogyne and Atriplex-Kochia." The nests on which we have data were all in soil under stones. Small craters, 9-13 cm diameter, are present; entrances are very small.

Seeds of Oenothera claviformis were found in a nest at Deep Canyon by Wheeler & Wheeler (1973).

Sexual brood were in the nest 4 mi S Badwater at the end of March.

Pheidole psammophila Creighton & Gregg

Figure 134

Pheidole psammophila Creighton & Gregg, 1955:15: ♀ 7. Gregg,
1958:12, 25: ♀ 7. Wheeler & Wheeler, 1973:74, 81: ♀ 7.

RANGE: Southeastern California and adjacent Mexico.

DESERT RECORDS. Colorado Desert and southern Mojave Desert in
areas of fine drift or dune sand; 21 records. Map 4.

DISCUSSION. The minor worker is easily recognized among our
Pheidole by the presence of a psammophore, unique in the North American fauna. The major is similar to that of P. barbata but has longer hairs on the gena and lacks a subpostpetiolar process.

This ant is found primarily in association with sand dunes in
Creosote Bush Scrub, at elevations ranging from 100 to 2950 feet.

Nests are in very fine sand; when in shifting sands, as in
dunes, excavated material is blown away and nests are difficult to
locate. In stabilized dunes, nests will have a crater with a chaff
pile, indicating that the ant is a harvester. Foraging is crepuscular and nocturnal.

Reproductives of both sexes have been found in nests in mid-April and females in nests on 12 October.

Pheidole rugulosa Gregg

Figures 129, 140

Pheidole rugulosa Gregg, 1958:12, 26-29: ♀ 4 ♀ ♂.

Pheidole micula, Wheeler & Wheeler, 1973:74, 80: ♀ 4.

(misident.)

RANGE: Southern Arizona to southeastern California.

DESERT RECORDS. Los Angeles Co.: 2 mi S Pearblossom, 3500', 28 July 1978 (CDG; LACM). San Bernardino Co.: Morongo Valley, 2500', 7 Apr 1963 (RRS; LACM). Riverside Co.: Deep Canyon, 1000', 16 Mar 1968 (GJW, #Cal.374; GJW). Map 4.

DISCUSSION. The Deep Canyon specimens, recorded as P. micula by Wheeler & Wheeler (1973), have been examined and prove to be P. rugulosa. Both worker subcastes were available and in characters of pilosity and mandibular structure they agree with the present form.

An important feature of P. micula is a peculiarity of mandibular structure. The lower mandibular carina is normally not visible in our Pheidole when the head is in full frontal view, for it lies behind the lower margin of the external face, or is coincident with it. In P. micula, however, the carina is clearly visible as a distinct semitransparent flange. In lateral view it is even more evident. This feature is clearly present in all Arizona material of P. micula and absent from all Arizona P. rugulosa. It is likewise absent from our California samples.

In most of the major workers seen from California the occipital sculpture does not agree with either species as described by Gregg (1958). Across the occiput, the striations are fine and dense, much as in paratypes of P. rugulosa in the LACM. However, they do

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not extend along the gena to the base of the mandible. In this they are more similar to P. micula. In all other features, mandibular structure, eye size and pilosity, they agree with typical P. rugulosa.

Although California records are few, collections of this species show an elevation range from 1000 to 3500 feet. Nests have been found in Creosote Bush Scrub, Wash Woodlands and Joshua Tree Woodlands and are usually under stones.

According to Whitford (1978a) foraging by this species "will exhibit peak activity within a few hours after rainfall." In southeastern Arizona, Chew (1977) found that 52% of the foraging activity occurs between 0850 and 1910 during the month of August.

There is considerable confusion about the food preferences of this ant. Creighton (1966) was of the opinion that it is not granivorous and stated that "it is only by stretching the point that [this] species can be considered [a harvester], since their main reliance is on insect food." The workers "bring in insect remains during most of the year and gather seeds only at intervals." On the other hand, Chew (1977) found that returning foragers brought in seeds 89% of the time and vegetative parts the remainder--no arthropods. In California, Wheeler & Wheeler (1973) list seeds of Oenothera elavaeformis, Sporobolus sp., Atriplex sp. and Cryptantha sp. in one nest.

not known. The first record of the disease in the United States was in 1911, when it was reported from the State of New York.

The disease is caused by a virus which is transmitted by the house fly, *Musca domestica*, and the stable fly, *Stomoxys calcitrans*.

The disease is characterized by a high fever, headache, and a general feeling of malaise. The fever is usually accompanied by a rash which is most prominent on the face and neck.

The disease is usually self-limiting and the patient recovers within a few days. However, in some cases, the disease can be fatal.

The disease is most common in the summer months, and is especially prevalent in areas where there is a large population of house flies and stable flies.

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Pheidole sciophila Wheeler

Figures 120, 135

Pheidole sciophila Wheeler, 1908c:443: ♀ ♀ ♂. Creighton, 1950:
188: ♀ ♀. Creighton & Gregg, 1955:19: ♀ ♀. Gregg, 1958:13, 29-30:
♀ ♀.

Pheidole proserpina Wheeler, 1908c:437: ♀ ♀. Creighton, 1950:
188: ♀ ♀. Creighton & Gregg, 1955:19: ♀ ♀.

Pheidole sciophila var. semilaevicephala M. Smith, 1934:385: ♀.

Pheidole sciophila subsp. semilaevicephala, Creighton, 1950:
188: ♀.

RANGE: Western Texas to southeastern California.

DESERT RECORDS. Riverside Co.: 4 mi N Wiley's Well, 500', 24
Oct 1978 (RRS, #78-125; LACM). Imperial Co.: Brawley, -113', 8
July 1964 (Taylor & Gammon; CDA); same locality, 14 Aug 1967 (R. A.
Flock, L. Pineda; CDA); Holtville, -15', June 1956 (RRS; LACM);
Indian Pass, 500', 7 rd mi E Ogilby Rd., 7 May 1978 (RRS & CDG,
#78-43a; LACM). Map 4.

DISCUSSION. This distinctive species has not been previously
recorded from California. In the workers the head and thoracic
dorsum and closely punctulate, though usually with more or less
impunctate areas along the midline. Workers of both subcastes are
typically blackish brown.

In California this ant has been taken at elevations between
-113 and 500 feet. Habitats include Wash Woodland and cultivated
areas in former Saltbush Scrub. In Arizona "all of the colonies
Wheeler took came from shady areas near stream . . . but this
species is capable of utilizing fully exposed nest sites well removed
from any source of water. The ant prefers areas of desert grassland

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY

REPORT OF THE
COMMISSIONER OF PLANT INDUSTRY
FOR THE YEAR 1907
CONTAINING
A SUMMARY OF THE WORK OF THE BUREAU
DURING THE YEAR
AND
A LIST OF THE PLANTS INTRODUCED
DURING THE YEAR

1907
The year 1907 was a successful one for the Bureau of Plant Industry. The work of the Bureau was carried on in accordance with the plan of work for the year, and the results were most satisfactory. The following is a summary of the work of the Bureau during the year:
1. The Bureau received 1,234 applications for introductions of plants, and 1,045 of these were accepted for introduction. The total number of plants introduced during the year was 1,045.
2. The Bureau received 1,234 applications for introductions of plants, and 1,045 of these were accepted for introduction. The total number of plants introduced during the year was 1,045.
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a fact that casts some doubt on Wheeler's supposition that sciophila is carnivorous and not a harvester." (Creighton, 1966) We can add little to the above. Stray workers have been collected under iron-wood trees during daylight hours (1400-1445) in October.

Remains of workers have been found in scats of Phrynosoma mcalli.

Pheidole tucsonica Wheeler

Figures 124, 147

Pheidole xerophila subsp. tucsonica Wheeler, 1908c:448: ♀ 7.
Creighton, 1950:167, 192: ♀ 7. Creighton & Gregg, 1955:40: ♀ 7.
Gregg, 1958:15, 32: ♀ 7. Wheeler & Wheeler, 1973:75, 82-83; fig. 31:
♀ 7.

Pheidole xerophila, Wheeler & Wheeler, 1973:82 (in part, misident.)

RANGE: New Mexico to southern California.

DESERT RECORDS. Mojave Desert and western margins of Colorado Desert, apparently originating from Ecotone populations; 34 records.
Map 4.

DISCUSSION. Wheeler & Wheeler (1973) recorded two samples as P. xerophila. One was P. gilvescens; the other (#Cal.750) is P. tucsonica. The specimens have been examined and they are quite typical of P. tucsonica.

P. tucsonica has long been regarded as a form of P. xerophila. While there is no denying that the two are close, evidence for this treatment is remarkably difficult to come by. If it were truly a form of P. xerophila, then somewhere in the eastern part of its range P. tucsonica should begin to assume some of the characteristics of P. xerophila, which it does not. Quite the contrary, it remains very consistent in its characters. The presumed hybrids studied by

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Creighton & Gregg (1955) have been available. They do appear to be hybrids, but these few do not prove that xerophila and tucsonica are conspecific. The rarity of such hybrids suggests that these are species that are not fully reproductively isolated and do occasionally hybridize.

This species occurs at California desert elevations ranging from 500 to 5000 feet. It has been collected in Creosote Bush Scrub, Wash Woodland, Joshua Tree Woodland and Pinon-juniper Woodland.

Nests generally have small, low sand craters 2.5-8 cm in diameter and may be surrounded by chaff from seed husks. Aggregated mounds may represent a single colony. Seed chambers may be as little as 5 cm below the surface. Colony size is variable, but may consist of 30-40 majors and 200-300 minors. This species forms foraging columns and majors are usually present in these columns.

Seeds of Tridens pulchellus, Bouteloua aristoides and Eriogonum Parishii have been identified from nests (Wheeler & Wheeler, 1973).

In Arizona mating flights have been observed in July.

Pheidole vistana Forel

Figures 123, 132, 137

Pheidole susannae subsp. longipes Pergande, 1895:885: ♀ ♀.
(preocc.)

Pheidole longipes, Forel, 1899:65. Wheeler, 1915:397: ♀.

Pheidole longipes var. vistana Forel, 1914a:272: ♀.

Pheidole grallipes Wheeler, 1916:40 (new name for longipes Perg.).
Creighton, 1950:180. Gregg, 1958:9, 22: ♀ ♀. Pullen, 1961:93-96.
Wheeler & Wheeler, 1973:74, 77-78; figs. 28-30: ♀ ♀ ♂.

RANGE: Southern California, Arizona, Lower California.

DESERT RECORDS. San Bernardino Co.: Ft. Piute, Piute Range, 7 Oct 1973 (J. P & K. E. Donahue; LACM); Morongo Valley, 2500', Apr. 1957 (RRS & M. D. Stage; LACM); Pisgah Crater, 14 Jan 1962 & 7 Oct 1961 (Norris & Heath; LACM). Riverside Co.: Deep Canyon, 800'-1200', 24 samples, numerous dates & collectors (GJW, LACM, UCB); Palm Desert, 350', 2 June 1970 & 2 Sept 1969 (GJW, #Cal.944, 814; GJW); 2 mi S Palm Desert, 450', 10 May 1968 & 31 Aug 1969 (GJW, #Cal.465, 802a; GJW); 3 mi W Shaver's Well, 8 Mar 1964 (RRS; LACM). San Diego Co.: Palm Canyon, 850', ABDP, 17 Apr 1952 (WSC; LACM). Map 4.

DISCUSSION. This is the ant long known as P. grallipes. However, Forel's P. vistana has priority by two years and there is no good reason why that name should be disregarded. It is adopted here.

The nearest relative to P. vistana appears to be P. desertorum which replaces it over much of the desert area. Minor workers of the two are quite similar, but those of P. vistana have the dorsum of the head and thorax more or less dull and punctulate; the occipital margin is also slightly narrower than in P. desertorum. Major workers may be recognized by the longer scape and punctulate first gastric tergum.

A primarily chaparral and ecotonal species, P. vistana enters the desert along the western margins. Samples from such localities as Pisgah Crater and Fort Piute may represent isolated relict populations.

Our records for this species in the California deserts show it ranging between 350 and 2500 feet. Colonies generally inhabit washes or canyons and are mostly limited to Wash Woodlands, though we do have a few records from Creosote Bush Scrub and Joshua Tree Woodland.

Pullen (1961) states that P. vistana colonies are larger than those of other Pheidole, but this is questionable, for those of such species as P. desertorum and P. hyatti are quite populous. And, it must also be pointed out that nests of very few Pheidole have been fully excavated and that existing estimates for many species are much too low. Craters or messy irregular mounds are constructed, often situated at the base of a shrub or tree or under a stone.

This is a nocturnal species becoming active at dusk. The workers possess the long legs and long sharp mandibles characteristic of many carnivorous ants. Primarily entomophagous, they are especially fond of termites according to Pullen (1961). However, much the same is true for most of our predaceous ants. "Prey is overcome primarily with the aid of the mandibles, since the sting is degenerate and nonfunctional in this genus. A sticky substance with a rank, fecal odor is exuded from the tip of the gaster and daubed on the prey or enemy" (Pullen, 1961) Pullen further noted that larger prey is stretched between several workers and eventually overcome or cut up.

Colonies of this species are polygynous, as surmised by Pullen (1961). This seems also to be true of such species as P. desertorum and P. hyatti.

Pheidole yaqui Creighton & Gregg

Figures 127, 142, 143, 146

Pheidole yaqui Creighton & Gregg, 1955:43: ♀ 4. Gregg, 1958: 15, 33: ♀ 4. Wheeler & Wheeler, 19 3:75, 83-84: ♀ 4.

RANGE: Southeastern California, northeastern Baja California.

DESERT RECORDS. Invo Co.: Scotty's Ranch, 2100', DVNM, 30 Mar 1968 (GJW, #Cal.3 ; GJW). Riverside Co.: Palm Desert, 240'-300', 15 Mar 1968 & 13 May 1968 (GJW, #Cal.362, 363, 481, 482: GJW); Deep Canyon, eight samples, various dates (GJW; GJW). San Diego Co.: Yaqui Well, 1300', ABDP, 15 Apr 1952 (WSC; LACM); Borrego Wells, 300', ABDP, 22 Apr 1952 (WSC; LACM); Palm Canyon, 800', ABDP, 17 Apr 1952 WSC; LACM); The Narrows, 1200', Vallecito Mts., ABDP, 17 Apr 1952 (WSC; LACM). Map 4.

DISCUSSION. Creighton & Gregg placed P. yaqui in the xerophila complex but noted that the major worker differed rather sharply from the other species in matters of cephalic and thoracic sculpture. It is our belief that P. yaqui is actually much closer to P. paiute than to members of the xerophila complex.

Gregg (1958) described P. paiute as a subspecies of P. bicarinata (Mayr), but we are treating it as a separate species. Couplet 56 of the key in Gregg's paper utilized the number of eye facets to separate P. xerophila and allies from P. bicarinata and other species. This is not a very good character, since it is never clear whether one is to count all facets (including the colorless, marginal ones) or just the pigmented ones.

The first group (the xerophila group) is said to have 60 or more facets and the second group to have 40 or fewer facts. For P.

UNITED STATES DEPARTMENT OF AGRICULTURE

WASHINGTON, D. C. 20250

OFFICE OF THE ASSISTANT SECRETARY FOR AFFAIRS

WASHINGTON, D. C. 20250

MEMORANDUM FOR THE ASSISTANT SECRETARY FOR AFFAIRS

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SUBJECT: [Subject]

DATE: [Date]

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yaqui this works fairly well, for the eye has from 57 to 63 fully pigmented facets. Unfortunately, P. paiute has almost exactly the same range: 55-62 facets. It is not possible to key P. paiute to the proper place in Gregg's key. In fact, a series in the LACM, determined by Creighton as P. yaqui is actually P. paiute; these are from the Kofa Mountains, Arizona. P. bicarinata and its relatives with fewer than 40 eye facets key out properly.

We believe that P. yaqui and P. paiute are possibly more closely allied to each other than either is to members of the xerophila complex or the bicarinata complex. The characters given in the key above should readily distinguish between the two species.

P. yaqui has been collected in the California deserts at elevations between 240 and 2500 feet. Nests are generally in sandy-gravelly soil in Wash Woodlands.

According to Creighton & Gregg (1955) colonies are always small, about 12-20 majors and up to 50 minors. Our experience with other species has not borne out such statements and we would urge caution in this case also. Craters range from 2.5-9 cm across and may be regular or eccentric. Multiple, clumped craters may represent a single colony. Although no chaff piles have been seen around nests, seeds of Euphorbia micromera and Oenothera clavaeformis have been found in the nests by Wheeler & Wheeler (1973)

Genus CARDIOCONDYLA Emery

A small Old World genus of mostly minute ants, Cardiocondyla may be immediately recognized by the lack of erect hairs on the cephalic and thoracic dorsa. The postpetiole is swollen and much broader, as a rule, than the petiole when viewed from above. Several of the species have been widely distributed as "tramps" and at least five have been introduced and established in the United States. One is evidently now established in our desert area. Others occur in coastal southern California and will likely be transported into urban areas of the desert.

Cardiocondyla ectopia Snelling

Figures 149-152

Cardiocondyla ectopia Snelling, 1974:76-81; figs. 1-5: ♀ ♂.
Creighton & Snelling, 1974:87-92.

RANGE: Presently known only from southern California.

DESERT RECORDS. Imperial Co.: El Centro, Aug 1974.

DISCUSSION. We have seen a number of females taken at lights in El Centro. These would indicate that the species is established there.

This species was described from specimens collected at Seal Beach, Orange Co. and several localities in Los Angeles Co. It is apparently most closely allied to certain North African forms but has not yet been matched with any of these. The male is wingless and worker-like in appearance (Fig. 151).

Nests of this species found in coastal areas were located in an urban setting between bricks set into soil or under concrete sidewalks. The tiny (1 mm) nest entrances were surrounded by piles of debris.

As observed on the coast, little surface activity took place between November and March. In the remaining months, the ants foraged diurnally when the ambient temperature was between 19°C and 23°C. (Creighton & Snelling, 1974) They traveled at least 6 m in search of food and were observed taking nectar from Euphorbia serpens, collecting bits of plant fiber and fragments of dead arthropods.

When recruiting additional foragers these ants use tandem running rather than laying a chemical trail. Once a large food source is located, a returning forager will recruit another worker and lead it in tandem back to the food. The leader of the pair apparently releases a highly volatile pheromone which must be followed very closely.

Colonies of C. ectopia are polygynous (have multiple queens). Mating occurs within the nest since males are wingless. Females may emerge singly for flight to another nest to promote outcrossing. Flights of females have been observed in February, July and August.

Genus CREMATOGASTER Lund

Recognition of the genus Crematogaster is no difficult matter; the gaster of the worker, viewed from above, is cordate and the attachment of the postpetiole is dorsal rather than anterior as in all our other ants. In side view the dorsal surface is rather flat and the ventral surface is strongly convex. In the sexual forms the attachment of the postpetiole to the gaster is similar, but in the females the gaster is elongate rather than cordate.

The North American representatives of Crematogaster have been treated by Buren (1968) who recognized 26 species in America north of Mexico, 16 in the Southwest. Of these, six occur in our area and only one is at all common. The difficulties encountered with these few species are quite disproportionate to the number of forms and the treatment here is not wholly satisfactory. A more comprehensive study of the entire Southwestern fauna is necessary and must include the sexual forms.

There are large numbers of females and males available since they are commonly attracted to lights. But, until they are matched to their workers they are not much help. In the present study the sexual forms are ignored because we have not enough material matched to workers.

Colonies of Crematogaster are usually in soil or in decaying roots of desert plants, but are uncommonly difficult to locate.

KEY TO SPECIES OF CREMATOGASTER

workers only

- 1a. Thoracic dorsum without erect hairs; thoracic integument closely and uniformly punctate, rugulae obscure or absent on promesonotum and promesopleura 2
- b. Thoracic dorsum with at least a single long erect hair on each pronotal humerus; thoracic integument, especially promesonotum, distinctly rugulose or striate, interspaces punctate or not . 3
- 2a. Head and thorax dark brown to blackish, little, if any, lighter than gaster larreae Buren
- b. Head and thorax yellowish to reddish, distinctly lighter than gaster depilis Wheeler
- 3a. A single erect hair on each pronotal humerus, none elsewhere on thoracic dorsum; spaces between rugulae densely punctulate, rugulae often more or less effaced 4
- b. At least two erect hairs on each pronotal humerus and usually a few shorter hairs at rear of mesonotum; spaces between rugulae of thoracic dorsum more or less shiny and indistinctly punctulate 5
- 4a. Pubescence suberect on scape and head, suberect and long on body californica Emery
- b. Pubescence on scape and head appressed, that of body short and appressed opuntiae Buren

- 5a. Lower mesopleura distinctly striate; mesonotal declivity abrupt, angular in profile mormonum Emery
- b. Lower mesopleura densely punctate; mesonotal declivity, in profile, evenly rounded hespera Buren

Crematogaster californica Emery

Figure 155

Crematogaster lineolata laeviuscula var. californica Emery, 1895:

285: ♀.

Crematogaster californica, Buren, 1968:94: ♀. Wheeler & Wheeler, 1973:87-88; fig. 33: ♀.

RANGE: Southern California, Baja California.

DESERT RECORDS. Los Angeles Co.: Big Rock Creek, 3600', Valyermo, 11 Apr 1952 (WSC; LACM). Imperial Co.: Mountain Spring, 21 June 1964 (D. R. Miller; LACMO. Map 5.

DISCUSSION. This a common species in southern California, entering the deserts only marginally. The Wheelers found it in the ecotone between chaparral and desert at Deep Canyon, 3400-3600'. The two localities cited here are also ecotonal, not true desert. In the desert it is largely replaced by the closely related C. opuntiae.

According to Buren (1968) this species is "found at bases and on roots of various plants cultivating aphids and coccids." Wheeler & Wheeler describe nests they found in Deep Canyon: "one was in a cottonwood grove along a flowing stream; the nest was in a buried rotten log 4 inches in diameter. Three were exposed on steep rocky slopes; one of these colonies had constructed messy earthworks among the stones covering an area of one square foot."

Crematogaster depilis Wheeler

Figures 153, 154

Crematogaster lineolata opaca var. depilis Wheeler, 1908c:478: ♀.

Crematogaster (Acrocoelia) depilis, Creighton, 1950:204, 209: ♀.

Crematogaster depilis, Cole, 1966:16: ♀. Buren, 1968:93: ♀.

Wheeler & Wheeler, 1973:87, 88: ♀.

RANGE: Western Texas to southern Nevada and southeastern California, south into Mexico.

DESERT RECORDS. Inyo Co.: e. side Owens Lake, 3600', 17 Sept 1977 (F. G. Andrews, A. R. Hardy; CDA); Lone Pine, 3700', 8 June 1973 (E. L. Paddock; CDA); Eureka Valley, Apr 1978 (DG et al.; CDA); Grapevine Ranger Sta., 2100'-3000', DVNM, various dates (GJW, numerous samples; GJW); Mesquite Spg., 1400'-1760', various dates and collectors; GJW, LACM); sand dunes, 1150', Saline Valley, 30 Mar 1976 (DG; LACM). Kern Co.: Last Chance Cyn., 2500', El Paso Mts., 15-16 Sept 1978 (RRS & CDG, #78-65c; LACM); Lonetree Cyn., 6.8 mi S jct Randsburg Rd. & Hwy 14, 15 June 1970 (F. G. Andrews, M. S. Wasbauer; CDA). Los Angeles Co.: 2 mi S Pearblossom, 3500', 22 May 1978 (RRS & CDG, #78-53; LACM). San Bernardino Co.: Saratoga Spgs., 0', DVNM, 6 Apr 1968 (GJW, #Cal.387; GJW); nr. Piute Spgs., 3000', Piute Range, 1 Oct 1978 (RRS, #78-108; LACM); Bonanza King Mine, 4700', Providence Mts., 8 May 1965 (RRS; LACM); 5 mi N Adelanto, 23 July 1963 (D. R. Miller; LACM); 1 mi W Phelan, 24 Apr 1967 (R. P. Allen; CDA); 3 mi W Morongo Valley, 9 June 1963 (D. R. Miller; LACM). Riverside Co.: Deep Canyon, 1000'-2500', numerous collections (GJW; GJW); 3 mi W Blythe, 27 May 1971 (M. S. Wasbauer; CDA). Imperial Co.: 6 mi W Coyote Wells, 27 May 1956 (RRS; LACM). Map 5.

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey in the different regions.

3. The third part of the report deals with the results of the survey in the different districts.

4. The fourth part of the report deals with the results of the survey in the different villages.

5. The fifth part of the report deals with the results of the survey in the different households.

6. The sixth part of the report deals with the results of the survey in the different families.

7. The seventh part of the report deals with the results of the survey in the different groups.

8. The eighth part of the report deals with the results of the survey in the different communities.

9. The ninth part of the report deals with the results of the survey in the different regions.

DISCUSSION. This ant is easily recognized by characters given in the key and is the only Crematogaster at all common in our deserts. It seems to be generally distributed in the Mojave, though usually associated with mountain ranges. Its distribution on the Colorado appears to be marginal.

In the California deserts C. depilis occurs at elevations between 0 and 4700 feet. This ant occupies assorted habitats: Creosote Bush Scrub on the desert floor, gravelly washes of canyons, Joshua Tree Woodland and in Riparian community along Deep Creek in Deep Canyon.

Nests have been found in soil at the bases of Larrea, Ambrosia and Ephedra plants, under rocks, in pores or crevices of stones and in soil in exposed area.

Although these ants are nocturnal, stray foragers have occasionally been collected during morning hours (0900 in May and July). Foragers tend homopterans for honeydew, especially mealybugs situated on plant roots. Workers also visit the extrafloral glands of cholla (Opuntia bigelovii). C. depilis readily comes to honey bait.

Scats of the flat-tailed horned lizard Phrynosoma mcalli indicate that this species is a predator of C. depilis.

Crematogaster hespera Buren

Figure 157

Crematogaster hespera Buren, 1968:94, 98-99: ♀ ♀.

RANGE: Southern New Mexico to southern California; Sonora, Baja California.

DESERT RECORDS. Inyo Co.: Deep Springs, Deep Springs Valley, Jan 1971 (DG; CAS). Imperial Co.: Calipatria, -184', 19 May 1956 (RRS; LACM); El Centro, -45', 8 Jan 1940 (B. A. Harrigan; CDA). Map 5.

DISCUSSION. C. hespera "seems largely arboreal. The favored habitat seems to be the large cottonwood trees growing along streams." (Buren, 1968). The specimens from Imperial Co. are from areas of former Saltbush Scrub; the Calipatria series consists of a female and two very small workers taken from a hollow stem of Atriplex sp. The Deep Springs site is in Great Basin Sagebrush Desert.

Crematogaster larreae Buren

Crematogaster larreae Buren, 1968:94, 117-120: ♀ ♀ ♂.

RANGE: Western Texas to southeastern California.

DESERT RECORDS. San Bernardino Co.: Yucca Grove (recorded by Buren, 1968; not seen) Map 5.

DISCUSSION. This species is closely related to C. depilis and it is possible that the record from Yucca Grove is based on that species, which occurs in the area. According to Buren (1968) the only difference between workers of the two species is one of color: in C. depilis the head and thorax are lighter than the gaster, reddish or reddish brown. They are described as dark brownish in C. larreae.

THE HISTORY OF THE UNITED STATES

(1776-1863)

THE HISTORY OF THE UNITED STATES, 1776-1863

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Since males and females of the two are quite different, there is no question that two species are involved. On the other hand, the distinction between workers is slight, and it seems that certain identification requires that the sexual forms be available. We consider the Yucca Grove record to be unverified at this time.

The Yucca Grove habitat is, as its name implies, Joshua Tree Woodland. In other areas of its range, beyond California, C. larreae commonly nests at the roots of Larrea bushes, at elevations below 5000 feet. The species is nocturnal according to Buren (1968).

Crematogaster mormonum Emery

Figure 156

Crematogaster lineolata coarctata vsr. mormonum Emery, 1895:

284: ♀. Wheeler, 1908c:482: ♀ ♀ ♂.

Crematogaster (Acrocoelia) mormonum, Creighton, 1950:204, 215-216; ♀.

Crematogaster mormonum, Buren, 1968:94: ♀. Wheeler & Wheeler, 1973:87, 88-89; fig. 34: ♀.

RANGE: Southern Oregon, Idaho, Utah, to southern California and northern Baja California.

DESERT RECORDS. Inyo Co.: Willow Creek, 4500', Inyo Mts., 16 Sept 1976 (DG; LACM); Deep Springs, Deep Springs Valley, Jan 1971 (DG; CAS). San Bernardino Co.: Granite Pass, 3800'-4320', Granite Mts., 27 Apr 1968 (E. I. Schlinger; LACM). Note: San Bernardino Co. is blessed with two ranges named Granite Mts., each with a Granite Pass! The first Granite Pass, summit elevation 4050', is located about 49 air mi NE of Barstow, in Fort Irwin Military Reservation. The second, summit elevation 4024', is about 19.5 air mi

NNE of Amboy on the road to Kelso. Map 5.

DISCUSSION. This is a primarily Great Basin Sagebrush Desert species and seems to occur marginally in our area. Thus, while Wheeler & Wheeler (1973) made 13 collections of C. mormonum in Deep Canyon, all were in the chaparral biome, 4600'-6000'. It has also been taken in Piñon-juniper Woodlands at higher elevations of such desert ranges as the Panamints.

Nests may be under stones or other covering objects, such as logs (Cole, 1942). Buren (1968) has speculated that the closely related C. mutans Buren may be a temporary social parasite of C. mormonum.

Crematogaster opuntiae Buren

Crematogaster opuntiae Buren, 1968:94, 120-121: ♀.

RANGE: Southern Arizona to southeastern California.

DESERT RECORDS. Inyo Co.: Eureka Valley, 7-9 Apr 1978 (DG et al.; CDA); Grapevine Ranger Sta., 2100'-2400', DVNM, various dates (GJW, #Cal. 553, 884, 885, 945a; GJW). San Bernardino Co.: Cadiz Dunes, 25 Apr 1978 (A. R. Hardy, F. G. Andrews; CDA). Riverside Co.: 1 mi E Mecca, -190', 5 Nov 1978 (RRS & CDG, #78-152, 153; LACM). Map 5.

DISCUSSION. These California specimens were at first thought to represent a new species allied to C. californica. However, comparison with many specimens of C. opuntiae from Arizona indicated few tangible differences but emphasized their similarities. The eyes of the specimens from the California deserts are slightly larger, but the difference is neither impressive nor consistent. For the time being we regard the California form as a variant of C. opuntiae.

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 1, 1861. It is a very important document, as it sets out the President's policy for the new year. The President states that he is pleased to see the Congress assembled, and that he is confident that the country is in a good position to meet the challenges of the future. He also mentions the recent election of Abraham Lincoln as President, and expresses his confidence in Lincoln's ability to lead the country.

2. The second part of the document is a report from the Secretary of the Treasury, dated January 1, 1861. It provides a detailed account of the country's financial situation at the beginning of the year. The report states that the country's finances are in a sound position, and that the government is able to meet its obligations. It also mentions the recent election of Abraham Lincoln as President, and expresses confidence in Lincoln's ability to lead the country.

3. The third part of the document is a report from the Secretary of the Interior, dated January 1, 1861. It provides a detailed account of the country's natural resources and land management. The report states that the country's natural resources are abundant, and that the government is able to manage them in a responsible manner. It also mentions the recent election of Abraham Lincoln as President, and expresses confidence in Lincoln's ability to lead the country.

4. The fourth part of the document is a report from the Secretary of the War, dated January 1, 1861. It provides a detailed account of the country's military situation at the beginning of the year. The report states that the country's military is in a strong position, and that the government is able to meet its obligations. It also mentions the recent election of Abraham Lincoln as President, and expresses confidence in Lincoln's ability to lead the country.

5. The fifth part of the document is a report from the Secretary of the Navy, dated January 1, 1861. It provides a detailed account of the country's naval situation at the beginning of the year. The report states that the country's navy is in a strong position, and that the government is able to meet its obligations. It also mentions the recent election of Abraham Lincoln as President, and expresses confidence in Lincoln's ability to lead the country.

The separation of C. opuntiae, as here interpreted, from C. californica is also a problem. Buren (1968) noted in his key that in C. californica the pubescence of the head and scape is suberect and on other parts of the body rather long. The pubescence of the head and scape is stated to be appressed in C. opuntiae and elsewhere rather short. In general, this distinction holds, but some samples of C. opuntiae are variable. While most specimens in these samples are clearly C. opuntiae there are some which would, if their locality data were removed, be unhesitatingly placed with C. californica. The specimens from our deserts are especially prone to exhibit this sort of variation. It seems likely that C. opuntiae will prove to be a synonym of C. californica but more material, especially the sexual forms, will have to be studied before a decision is possible.

Specimens have been collected in sandy soil at elevations from -190' to 2400'. Vegetation at these sites has ranged from Larrea-Ambrosia associations to Larrea-Atriplex-Haplopappus communities.

Nests have been in soil at the base of Atriplex (Fig. 306) or under rocks. The tumulus is a low, irregular pile of scattered sand.

At the Mecca site, workers were found in association with pseudococcids at the base and crown of Atriplex. In Arizona this ant was commonly found foraging on Opuntia fulgida.

Genus MONOMORIUM Mayr

Our only species of this genus is a minute, shiny black ant. The only ants likely to be confused with it are workers of some of the small Pheidole, such as P. barbata, P. sciophila or P. tucsonica. These have a quadrate head, angulate or bispinose propodeum and the clypeus is not bicarinate.

Like the minute Solenopsis which it resembles, except for the black color and 12-segmented antenna, M. minimum may be a thief in the nests of other ants. But, at least as frequently, workers may be found foraging in the evening on and under shrubs and trees.

Monomorium minimum (Buckley)

Figures 158, 159, 170

Monomorium minutum Mayr, 1866:506: ♀ (not M. minutum Mayr, 1855).

Myrmica minimum Buckley, 1866:338. ♀ ♀.

Monomorium minutum var. minimum, Emery, 1895:274: ♀ ♀ ♂.

Monomorium minutum subsp. ergatogyna Wheeler, 1904:269: ♀ ♀.

Monomorium minutum subsp. minimum, Wheeler, 1908c:423.

Monomorium minimum, Wheeler, 1914c:42. M. Smith, 1947:564;

pl.8 fig.31: ♀. Creighton, 1950:218, 219; pl. 25; ♀ ♀ ♂. Wheeler

& Wheeler, 1963:133-135; fig.IV-8; map 16; ♀ ♀ ♂. Gregg, 1963:366-

368: ♀. M. Smith, 1965:33-34; fig. 16: ♀. Cole, 1966:16: ♀.

Wheeler & Wheeler, 1973:89-90: ♀ ♀ ♂.

Monomorium minutum subsp. emersoni Gregg, 1945:66: ♀ ♀.

RANGE: Southeastern Canada and northeastern United States to the Pacific Coast, south to Mexico; rare in Pacific Northwest.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation of the country and the progress of the work during the year, and the second section deals with the specific work done during the year.

2. The second part of the report deals with the specific work done during the year. It is divided into three main sections: the first section deals with the work done in the field, the second section deals with the work done in the laboratory, and the third section deals with the work done in the office.

3. The third part of the report deals with the conclusions drawn from the work done during the year. It is divided into two main sections: the first section deals with the conclusions drawn from the work done in the field, and the second section deals with the conclusions drawn from the work done in the laboratory and the office.

4. The fourth part of the report deals with the recommendations made for the future work. It is divided into two main sections: the first section deals with the recommendations made for the work done in the field, and the second section deals with the recommendations made for the work done in the laboratory and the office.

5. The fifth part of the report deals with the summary of the work done during the year. It is divided into two main sections: the first section deals with the summary of the work done in the field, and the second section deals with the summary of the work done in the laboratory and the office.

6. The sixth part of the report deals with the bibliography. It is divided into two main sections: the first section deals with the bibliography of the work done in the field, and the second section deals with the bibliography of the work done in the laboratory and the office.

7. The seventh part of the report deals with the index. It is divided into two main sections: the first section deals with the index of the work done in the field, and the second section deals with the index of the work done in the laboratory and the office.

DESERT RECORDS. San Bernardino Co.: Cronise Station, 29 Apr 1956 (M. Wasbauer; UCB); Kramer Hills, 30 Mar 1963 (M. E. Irwin; UCD); Morongo Valley, 2600', 11 Apr 1958, 9 June 1963 (RRS; LACM). River-side Co.: Thousand Palms Cyn., 21 Mar 1954 (W. A. McDonald; LACM); Pushawalla Palms, 6 Dec 1967 (GJW, #Cal.265; GJW); Palm Springs, 475', 10-11 July 1967 (A. E. Lewis; LACM); Andreas Cyn., 28 Oct 1943 (P. H. Timberlake; LACM); Palm Desert, 2 June 1970 (GJW, #Cal.944a; GJW); 2 mi S Palm Desert, 31 Aug, 14 Nov 1969 (GJW, #Cal.802b, 821a; GJW); Deep Canyon, 825'-1000', various dates (GJW, #Cal.715a, 755, 954; GJW); Palm Canyon, 1000', 20 Nov 1969 (GJW, #Cal.846; GJW). Imperial Co.: Indian Pass, 500', 7 rd mi E Ogilby Rd., 7 May 1978 (RRS & CDG, #78-43b, 44; LACM). Map 5.

DISCUSSION. This species has been taken in our deserts at elevations between 475 and 3500 feet, generally in Wash Woodlands, but occasionally in Palm Oases and Joshua Tree Woodlands, less commonly in Creosote Bush Scrub.

Nests may be in open areas with irregular mounds or none at all; craters may be 5-8 cm in diameter (Wheeler & Wheeler, 1973). Often nests are under stones or in decaying wood. Colonies are populous and polygynous.

M. minimum is omnivorous. Workers feed on honeydew, collect nectar from flowers and extrafloral nectaries and feed on insects, usually dead ones. Like the minute Solenopsis which it resembles, M. minimum may occasionally practice cleptobiosis. It is also an occasional house-pest, attracted especially to meat scraps.

1. The first part of the report deals with the general situation of the country and the progress of the work of the Commission.

2. The second part of the report deals with the work of the Commission in the field of human rights.

3. The third part of the report deals with the work of the Commission in the field of economic, social and cultural rights.

4. The fourth part of the report deals with the work of the Commission in the field of international law.

5. The fifth part of the report deals with the work of the Commission in the field of international cooperation.

6. The sixth part of the report deals with the work of the Commission in the field of international relations.

7. The seventh part of the report deals with the work of the Commission in the field of international law.

8. The eighth part of the report deals with the work of the Commission in the field of international cooperation.

9. The ninth part of the report deals with the work of the Commission in the field of international relations.

10. The tenth part of the report deals with the work of the Commission in the field of international law.

Genus SOLENOPSIS Westwood

To this genus belong the "fire ants" and their smaller, less conspicuous relatives, the "thief ants." Solenopsis is a worldwide genus with many complexes of closely allied forms which are often very difficult to separate. Within our area there are two quite different groups or subgenera, Solenopsis s. str. and Diplophoptrum, each with two species. There are almost certainly additional species in the latter group, but since they are normally hypogaedic, their discovery will be a matter of accident.

The taxonomy of the North American species of Solenopsis is in a very unsatisfactory state. Creighton (1930) revised some groups of New World Solenopsis, but did not study the minute species. These were included 20 years later in the Ants of North America, but that portion of the key does not work at all well. There are evidently a number of fairly common, undescribed forms which will run out in the key to various names, but which do not belong to the species indicated.

Recent studies of venoms of Solenopsis suggest the presence of more species than currently recognized. The sometimes striking differences in venom chemistry are seldom reflected in external morphology. The genus is very much in need of a modern study utilizing all possible methods, including the unconventional.

KEY TO SPECIES OF SOLENOPSIS

workers

- 1a. Eye large, with 20 or more facets (Figs. 160, 163); third, and usually fourth, antennal segment at least 1.5 x longer than wide (Fig. 160); polymorphic 2
- b. Eye minute, consisting of three to six facets (Figs. 166-169); third and fourth antennal segments no longer than broad (Fig. 167); monomorphic or weakly polymorphic 3
- 2a. Eye of major with 70-80 facets (about 50 in minor), OMD 1.0-1.5 x EL (Figs. 163-165); head and thorax light to dark red, gaster largely blackish maniosa Wheeler
- b. Eye of major with 40-50 facets (about 20 in minor), OMD 1.6-2.0 x EL (Figs. 160-162); entirely yellowish, gastric segments margined with brownish aurea Wheeler
- 3a. Cephalic punctures 3 or 4 x diameter of hairs arising from them; mandible four-toothed (Fig. 169); propodeum, in profile, with distinct basal and apical faces joined through an abrupt curve (Fig. 168) new species
- b. Cephalic punctures no more than twice diameter of hairs arising from them, usually less; mandible three-toothed or, if four-toothed, inner tooth is on basal margin and distinctly separated from other (Fig. 167); propodeum, in profile, evenly curved from base to apex, without discrete basal and apical faces (Fig. 166) molesta (Say)

females*

- 1a. Larger species, HW more than 1.1 mm; cephalic punctures sparse, no more than twice diameter of hairs arising from them; third and fourth antennal segments longer than broad 2
- b. Small species, HW less than 0.9 mm; cephalic punctures close, several times diameter of hairs arising from them; third and fourth antennal segments broader than long . . . molesta (Say)
- 2a. EL at least 2.5 x OMD; head, thorax and much of gaster yellow; outer face of mandible usually not evenly striate, often with extensive smooth areas aurea Wheeler
- b. EL less than 2.2 x OMD; head and thorax red, gaster more or less blackish; outer face of mandible coarsely and evenly longitudinally striate maniosa Wheeler

* Female of new species will key to molesta. It may differ from that of molesta in mandibular structure.

Solenopsis aurea Wheeler

Figures 160-162

Solenopsis geminata var. aurea Wheeler, 1906:336: ♀ ♀. Wheeler, 1908c:425: ♀ ♂.

Solenopsis aurea, Forel, 1909:269. Creighton, 1950:228, 230; pl. 27: ♀ ♀ ♂. Cole, 1953b:299. Snelling, 1963:3, 5, 6-7; fig. 7; ♀ ♀ ♂. Cole, 1966:16, 17: ♀.

Solenopsis aurea subsp. amblychila Wheeler, 1915:394: ♀. Creighton, 1950:228, 230: ♀.

Solenopsis xyloni subsp. aurea, Creighton, 1930:103; pl.2 fig.2: ♀.

Solenopsis xyloni subsp. amblychila, Creighton, 1930:104; pl.3 fig.3: ♀ ♀ ♂.

RANGE: Western Texas to southern Nevada and southeastern California; south to central Mexico.

DESERT RECORDS. San Bernardino Co.: Needles, 16 Aug 1956 (A. C. Cole; LACM). Riverside Co.: Thousand Palms, 10 Oct 1961 (W. H. Ewart; LACM); Pushawalla Palms, 6 Dec 1967 (GJW, #Cal.268, 274; GJW); Rancho Mirage, 230', 25 Apr 1969 (GJW, #Cal.627, 628, 636; GJW); Deep Canyon, 800'-1225', various dates (GJW, 10 samples; GJW); Indio, -22' 5 Nov 1978 (RRS & CDG, #78-149; LACM); Thermal, 24 Aug 1965 (S. Frommer; LACM); 1 mi E Mecca, -190', 5 Nov 1978 (RRS & CDG, #78-151; LACM); Corn Springs, 1350', 6 Nov 1978 (RRS & CDG, #78-161; LACM). Imperial Co.: Salton Beach, 12 Nov 1945 (LACM); 10 mi N Niland, 4 Feb 1960 (S. Brown; LACM); 12.2 mi W Glamis, 18 Nov 1963 (E. I. Schlinger; LACM); Indian Pass, 500', 7 mi E Ogilby Rd., 7 May 1978 (RRS & CDG; LACM); Calexico, 10 Dec 1957 & 16 Dec 1968 (E. I. Schlinger; LACM).

San Diego Co.: Borrego Springs, 26 June 1968 (E. I. Schlinger; LACM).
Map 5.

DISCUSSION. This species and S. maniosa are closely related and difficult to separate. As a rule, S. aurea is light, golden yellow with pale brown bands at the margins of the gastric segments, while S. maniosa is light to dark red with mostly black gaster. Each of these species is sufficiently variable, however, that no reliance may be placed on color.

The eyes of S. aurea are smaller. In the largest workers, there are 40-50 pigmented facets while the minor workers have about 20-25 fully pigmented facets. Eye length relative to length of the oculo-mandibular distance is, fortunately, easier to determine than the number of eye facets: in S. aurea, the OMD is 1.6 to 2.0 times the EL. In S. maniosa the OMD is 1.0 to 1.5 times the EL, but in some exceptional specimens may be as much as 1.7 times the EL. It is therefore necessary to measure a number of specimens from each series in order to establish the range.

S. aurea appears to be largely limited to the Colorado Desert in California, but extends north along the eastern Mojave into southern Nevada. This and S. maniosa often occur at the same site, though as a rule S. maniosa is the more abundant of the two.

Our subjective impression is that colonies of S. aurea are less populous than those of S. maniosa and the workers perhaps less aggressive when disturbed. The sting of S. aurea is less severe, at least to RRS, than that of S. maniosa. The venom chemistry of S. aurea has been reported by Blum et al. (1973).

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18. The eighteenth is the fact that the

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25. The twenty-fifth is the fact that the

26. The twenty-sixth is the fact that the

27. The twenty-seventh is the fact that the

28. The twenty-eighth is the fact that the

29. The twenty-ninth is the fact that the

30. The thirtieth is the fact that the

This polymorphic species has been collected at elevations ranging from -190' to 1350' in California deserts. It is most commonly encountered in Wash Woodlands and to a lesser extent in Palm Oases, Creosote Bush Scrub, alfalfa fields and date palm groves. In the cultivated areas it seems to be subject to displacement by S. maniosa. Nests are usually constructed in coarse, gravelly soil, often under stones. Tumuli, when present, consist of irregular piles of sand, usually without a clearly defined entrance.

Creighton (1950) considered this species to be nocturnal or crepuscular. This is normally true, but we did take it foraging at Indio on 5 Nov at midday. Although dietary preferences are unknown this species is probably typical of the fire ants, a generally omnivorous scavenger-predator with preferences for oily or fatty meats and seeds.

Alates were taken in flight in December at Pushawalla Palms.

Solenopsis maniosa Wheeler

Figures 163-165, 171-173

Solenopsis geminata var. diabola Wheeler, 1908c:424-426; ♀ ♂ (in part).

Solenopsis geminata subsp. maniosa Wheeler 1915:396-397; ♀ ♂.

Solenopsis xyloni var. maniosa, Creighton, 1930:102; ♀ ♂.
Eckert & Mallis, 1937:8, 20-22; fig. 15-16; ♀. Mallis, 1941:12-13.

Solenopsis (S.) geminata rufa, Mallis, 1941:11-12 (misident.)

Solenopsis (S.) xyloni, Mallis, 1941:12.

Solenopsis xyloni, Creighton, 1950: 228, 232-233; ♀ (in part).

Snelling, 1963:4-6, 9; fig. 2, 3, 6, 8, 11, 12 (in part). Cole, 1966: 16, 17. Wheeler & Wheeler, 1973:91, 92-94; fig. 35: ♀ ♂.

RANGE: California east to New Mexico, southern Utah; Sonora, Lower California.

DESERT RECORDS. Generally distributed through Mojave and Colorado Deserts; apparently may be displaced by S. aurea in some areas of Colorado Desert; 91 records. Map 5.

DISCUSSION. For more than 25 years the western form allied to S. xyloni, S. xyloni maniosa, has been in synonymy and it appeared that some nomenclatural stability had been attained. This is not the case. According to W. F. Buren (pers. comm. to RRS) S. maniosa should be regarded as a separate species, a western counterpart of S. xyloni. The venom chemistry of the two is different, but morphological differences are less obvious; we know of none at this time. S. xyloni does lack the largely black gaster of S. maniosa, but how well this will hold up remains to be determined.

This species has been taken in our desert areas at elevations ranging from -22 to 4320 feet in a wide range of habitats. Colonies have been found in Wash Woodland, Alkali Sinks, Saltbush Scrub, Creosote Bush Scrub, Palm Oases, Shadscale Scrub, Joshua Tree Woodlands, in grasslands, date palm groves, alfalfa fields, citrus orchards and in urban area lawns and gardens.

Nests are populous and usually situated under stones or other covering objects or in soil at the bases of shrubs, trees or in clumps of grass. Mounds are irregular, consisting of scattered soil with obscure, multiple entrances. These mounds may be "several inches high and several feet long" (Wheeler & Wheeler, 1973), but more often are less than 3 cm high and only 10-15 cm long. Rarely, small, crateriform tumuli, up to 5 cm in diameter, may be constructed.

1. The first part of the report is a summary of the work done during the year.

2. The second part is a detailed account of the work done during the year.

3. The third part is a summary of the work done during the year.

4. The fourth part is a summary of the work done during the year.

5. The fifth part is a summary of the work done during the year.

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26. The twenty-sixth part is a summary of the work done during the year.

27. The twenty-seventh part is a summary of the work done during the year.

During the warm Spring and summer months most of the foraging occurs in the morning, late afternoon and evenings. In cooler fall and winter months we have observed the ants foraging throughout the day.

This species is omnivorous, but with a marked predilection for oily meats and nuts. Workers forage at floral and extrafloral nectaries of Tamarix, Cercidium floridum, Asclepias albicans, Helianthus sp., Euphorbia micromera, E. albomarginata, E. polycarpa hirtella, Cleomella obtusifolia, Opuntia bigelovii and Ferocactus acanthodes. They are readily attracted to honey and wheat germ baits. The workers also tend aphids and pseudococcids for honeydew.

As an economically important pest, S. maniosa feeds on seeds, buds and stems of crop plants, and on household foods such as fruits, nuts, cereals, bakery goods, butter, oil, grease and meats. Hatchlings of ground nesting birds and chicks on poultry farms may also be attacked and killed (Eckert & Mallis, 1937). As a predator, S. maniosa readily attacks other insects. Dead insects are scavenged.

Debris collected around nest tumuli included workers of the ants Solenopsis aurea and Forelius foetidus; termites (Heterotermes aureus); insect fragments of various groups (mostly beetles); isopods; arachnids; seed capsules from a variety of local plants. This was a single sample from Corn Springs, Chuckwalla Mts.

S. maniosa workers have been taken as prey by other ants (Conomyrma bicolor, Myrmecocystus flaviceps) and the flat-tailed horned lizard, Phrynosoma mcalli.

Mating flights occur from May through October in the afternoon or early evening of warm days. The alate sexual forms are often attracted to lights.

The sting of this pugnacious ant may be quite painful, but the severity of the reaction by humans is quite variable. Most commonly a severe burning sensation is felt which may persist for several hours. Less commonly, large pustules may develop and pain, usually as intense itching, may last for several days. Secondary infection may ensue once the pustules have ruptured.

Solenopsis molesta (Say) s. lat.

Figures 166-167

Myrmica molesta Say, 1836:293: ♀.

Myrmica minuta Say, 1836:294: ♀ ♀ ♂.

Myrmica exigua Buckley, 1866:342: ♀ ♀.

Solenopsis fugax, Mayr, 1870:996: ♀ (in part)

Solenopsis debilis Mayr, 1886b:461: ♀ ♀ ♂.

Solenopsis molesta, Emery, 1895:277: ♀ ♀ ♂. Wheeler, 1908c:

430. Wheeler & Wheeler, 1963:136-138; map 17: ♀ ♀ ♂. M. Smith, 1965:43-45; fig. 23: ♀. Wheeler & Wheeler, 1973:91-92: ♀ ♀ ♂.

Solenopsis molesta var. validiuscula Emery, 1895:278: ♀.

Wheeler, 1908c:430.

Solenopsis (Diplorhoptrum) molesta, Creighton, 1950:230, 237: ♀. Gregg, 1963:370, 373-375: ♀.

Solenopsis (Diplorhoptrum) molesta subsp. validiuscula, Creighton, 1950:230, 237: ♀. Gregg, 1963:370, 375-377: ♀. Cole, 1966:17: ♀.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year.

2. The second part of the report deals with the results of the work done during the year and the progress of the work during the year.

3. The third part of the report deals with the results of the work done during the year and the progress of the work during the year.

4. The fourth part of the report deals with the results of the work done during the year and the progress of the work during the year.

5. The fifth part of the report deals with the results of the work done during the year and the progress of the work during the year.

6. The sixth part of the report deals with the results of the work done during the year and the progress of the work during the year.

7. The seventh part of the report deals with the results of the work done during the year and the progress of the work during the year.

8. The eighth part of the report deals with the results of the work done during the year and the progress of the work during the year.

9. The ninth part of the report deals with the results of the work done during the year and the progress of the work during the year.

10. The tenth part of the report deals with the results of the work done during the year and the progress of the work during the year.

RANGE: Transcontinental, southern Canada, entire United States, northern Mexico.

DESERT RECORDS. Inyo Co.: sand dunes, 1150', Saline Valley, 30 Mar 1976 (DG; LACM); Upper Warm Spg., Saline Valley, 5 Apr 1976 (DG; LACM); McElvoy Canyon, 2400', Inyo Mts., 22 May 1976 (DG; LACM). San Bernardino Co.: Bonanza King Mine, 4700', Providence Mts., 8 May 1965 (RRS; LACM). Riverside Co.: Palm Desert, 350', 30 Aug 1969 (GJW, #Cal.794; GJW); Deep Canyon, 800', 20 Apr & 4 May 1969 (GJW, #Cal.614, 721b; GJW); Coon Hollow, 525', Mule Mts., 1 Feb 1967 (RRS; LACM). Imperial Co.: Hwy 198, 20 mi W Calexico, 1 Jan 1977 (P. Rude; UCB). San Diego Co.: Hell Hole Canyon, ABDP, 25 Mar 1959 (LACM). Map 5.

DISCUSSION. It is difficult to deal with the minute species of Solenopsis and this is particularly true of the forms allied to S. molesta. The present specimens all run to S. molesta in Creighton's (1950) key. However, it appears that a number of quite disparate elements will come to this same point, with the result that the current concept of S. molesta is bankrupt. But, for the time being, the present course seems least disruptive. Eventually, all these forms can be studied and straightened out.

In California desert this species has been collected in Creosote Bush Scrub, Wash Woodland, Cottonwood Groves and Joshua Tree Woodland at elevations ranging from 0 to 4700 feet. It nests "in exposed soil or under cover of stones and other objects, in rotting wood, and in the woodwork and masonry of houses." (Smith, 1965) Most of our desert nests were found under stones. This minute ant is also known to nest in the walls of nest chambers of other ant species, or in close proximity, with passages communicating to those nests. Workers of S.

molesta enter the chambers and steal food and prey upon the brood.

This ant, like most Solenopsis, is omnivorous. The workers forage for dead and living insects, honeydew from aphids and other homopterans, germinating grain, and such crops as corn, milo and sorghum. They also infest houses and feed upon a broad spectrum of foods there, hence are economically important as pests.

Remains of S. molesta workers have been found in debris piles of Forelius foetidus. Whether these represent predation by F. foetidus, or are scavenged, is not known. They might also be intruders slain while attempting to pilfer the Forelius nest.

Mating flights have been recorded from late July to early fall. "A single fertile female (which may be many times larger than the worker) is capable of establishing her nest alone but she may not always do so; one observer noted a nuptial flight in which some females carried at least one worker attached to her body." (Smith, 1965) Since colonies are polygynous, it seems likely that some mated females may return to their nests.

Solenopsis new species

Figures 168-169

RANGE: Known only from Death Valley.

DESERT RECORDS. Inyo Co.: Tule Spring, -250', DVNM, 5 Mar 1968 (GJW, #Cal.321; GJW); Scotty's Ranch, 2100', DVNM, 30 Mar 1968 (GJW, #Cal.383; GJW). San Bernardino Co.: Saratoga Springs, 0', DVNM, 6 Apr 1968 (GJW, #Cal.387a, 389; GJW). Map 5.

DISCUSSION. This species is allied to S. salina Wheeler, S. krockowi Wheeler and S. pilosula Wheeler and in Creighton's (1950) key will run to S. salina. From that species it differs immediately in the profile of the thoracic dorsum which is gently, but distinctly convex in S. salina but definitely flat in our species. In S. salina and S. krockowi the erect hairs of the front of the head are widely spaced and quite variable in length, with many long hairs interspersed among much shorter hairs. S. krockowi also has a rather compressed, blunt, subpetiolar tooth. The flattened thoracic dorsum is similar in S. pilosula and the new species; S. pilosula differs in that the node of the petiole is slightly, but definitely wider than that of the postpetiole when viewed from above. In the new species the two nodes are equal in width. The pilosity of the head is similar in the two species: for the most part, the cephalic dorsum is covered with numerous short hairs which are quite even in length; there are a few longer hairs on the occiput and between the frontal lobes. This is most evident when the head is viewed from the side. Finally, our new species is a much smaller ant than S. pilosula, HW 0.36-0.42 mm, contrasting with a HW in excess of 0.55 mm in S. pilosula.

Genus LEPTOTHORAX Mayr

The genus Leptothorax is large and complex; although largely Holarctic, there is a small Neotropical element. Species are small, mostly more or less cryptic in their habits. While many nest in soil, other nest in preformed cavities of plants. Some forms are socially parasitic in the nests of other ants, a few are dulotic, but most seem to be more normal.

As a whole, the genus is badly in need of revision; the relationships between Nearctic and Palearctic elements, in particular, need study. Those species which occur in America north of Mexico are not especially difficult to identify by means of Creighton's (1950) key. A few new species have been subsequently described and some changes made, but the key is generally good, but does need to be updated.

Leptothorax is a genus of forested habitats and our species are rare. There are apparently three species in our area, only one of which can now be identified. One species is known from a few stray workers. The third is known from a short series of workers; a small collection of one female and several males is tentatively assumed to be conspecific.

KEY TO SPECIES OF LEPTOTHORAX

workers and females

- 1a. Base of first gastric tergum smooth and shiny; apex of scape not reaching occipital margin; propodeal spines short, triangular 2

- b. Base of first gastric tergum reticulate-punctate, moderately shiny; apex of scape reaching occipital margin; propodeal spines much longer than interbasal distance species A
- 2a. Erect hairs of cephalic and thoracic dorsum short (longest pronotal hair of worker less than width of scape), clavate, or at least stout and with blunt tips; worker EL = OMD; node of petiole, in profile, cuneate species B
- b. Erect hairs of cephalic and thoracic dorsum longer (longest pronotal hair of worker at least equal to greatest width of scape) slender, not at all spatulate (but with blunt tips); worker EL less than OMD; node of petiole, in profile, thick, blunt at summit andrei Emery

Leptothorax andrei Emery

Figures 175, 178

Leptothorax andrei Emery, 1895:322; pl.8 fig.15: ♀. Wheeler, 1903a:256; pl.12 fig.22: ♀. Creighton, 1950:254, 263: ♀. Cole, 1958: 537, 538: ♀ & ♂. Cole, 1966:17: ♀. Wheeler & Wheeler, 1973:95: ♀.

RANGE: California, Nevada, northern Arizona, northern New Mexico, Baja California.

DESERT RECORDS, Riverside Co.: Whitewater Canyon, 8 May 1977 (F. G. Andrews & K. W. Cooper; CDA); Lower Covington Flat, JTNM, 8 July 1961 (E. L. Sleeper; LACM). San Diego Co.: Hell Hole Canyon, ABDP, 29 Mar 1954 (LACM). Map 5.

DISCUSSION. This is a common soil nesting species in chaparral and higher zones. Often found nesting in close proximity to other ants, such as Camponotus and Formica, L. andrei may sometimes be an inquiline.

Male and female reproductives have been collected at black lights during July.

This species usually nests under stones. The colonies are small, usually consisting of fewer than 100 workers.

Leptothorax species A

Figures 176, 177

A few stray workers, all from Joshua Tree National Monument, represent a distinctive species closely related to L. silvestrii (Santschi) of southern Arizona. Santschi's species has been redescribed and figured by Creighton (1953b). Workers of our species differ from L. silvestrii as follows: clypeus lacks median carina; ventral surface of head with numerous short, erect hairs (restricted to oral region in L. silvestrii); propodeal spines longer, curved when viewed from above; petiolar node lower, more rectangular. Other differences exist, but are more subtle and may well be an artifact of the limited material available.

L. silvestrii is arboreal; Creighton found colonies in limbs of the evergreen oak, Quercus emoryi. Probably the present species will be found in similar situations.

Leptothorax species B

Figures 174, 179-181

Two samples are included here. One consists of a single alate female and several males: Inyo Co.: Resting Springs, 29-30 May 1955 (J. N. Belkin et al.; LACM). The other is a series of workers: Imperial Co.: Bard, 17 Mar. 1964 (G. Beevor & J. Johnson; CDA), under bark of desert willow (Chilopsis linearis).

We presume these to be conspecific. Both samples are clearly related to L. andrei and the females and workers differ from those of L. andrei females and workers in much the same manner. No males of L. andrei have been available for comparison. Since L. andrei nests in soil, an additional difference may exist, for the Bard specimens were taken under bark. However, since the circumstances of the collection are unknown this datum is accepted with reservation. Cole (1958) notes that he has never found nests of members of the nitens-carinatus complex under bark or in decaying logs.

Genus CYPHOMYRMEX Mayr

This and the following genus, Acromyrmex, include our only fungus-growing ants. Fungi are cultivated within the nests on a substrate of vegetative material, often comminuted bits of leaves which the workers harvest from plants. Some fungus-growers utilize caterpillar droppings. Those which harvest leaves are known as "leaf-cutter ants". The fungus-growers are almost exclusively confined to tropical America.

Cypomyrmex is a moderate-sized Neotropical genus of minute species. Because the ants are small, cryptically colored and feign death when disturbed, they are very difficult to locate. Two species of Cyphomyrmex are known to occur in the United States; both are found in California.

KEY TO SPECIES OF CYPHOMYRMEX

workers & females

- 1a. Antennal scape not surpassing posterior corner of head; node of petiole with a pair of teeth on dorsal surface; worker length 2.0 - 2.5 mm wheeleri Forel
- b. Antennal scape distinctly surpassing posterior corner of head; node of petiole without teeth on dorsal surface; worker length 1.7 - 2.1 mm rimosus (Spinola)

males

- 1a. Scrobal carina extending to occipital margin (Fig. 188)
..... wheeleri Forel
b. Scrobal carina not extending beyond level of anterior ocellus
(Fig. 189) rimosus (Spinola)

Cyphomyrmex rimosus (Spinola)

Figures 182-183, 188, 190

Cryptocerus ? rimosus Spinola, 1851:65: ♀ ♂.

Meranoplus difformis F. Smith, 1862:413: ♀.

Cyphomyrmex minutus Mayr, 1862:691: ♀.

Cataulacus deformis Roger, 1863:210: ♀ ♂.

Cyphomyrmex rimosus, Dalla Torre, 1893:150. Emery, 1894:224.

Wheeler, 1907:719. Kempf, 1965:165, 198.

Cyphomyrmex rimosus subsp. minutus Emery, 1894:225: ♀ ♂. Wheeler,
1905:106. Wheeler, 1907:722: ♀ ♂. Creighton, 1950:316.

Cyphomyrmex rimosus var. comalensis Wheeler, 1907:719; pl.49
fig. 1: ♀ ♂.

RANGE: In the United States: southern Florida to Texas, southern
Arizona, southeastern California. South through the Caribbean and
Central America to Peru and Argentina.

DESERT RECORDS. Imperial Co.: Indian Pass, 500', 7 mi E Ogilby
Rd., 7 May 1978 (RRS & CDG, #78-44; LACM). Map 6

1. The first part of the report is devoted to a general survey of the situation in the country.

2. The second part of the report is devoted to a detailed analysis of the economic situation.

3. The third part of the report is devoted to a detailed analysis of the social situation.

4. The fourth part of the report is devoted to a detailed analysis of the political situation.

5. The fifth part of the report is devoted to a detailed analysis of the cultural situation.

6. The sixth part of the report is devoted to a detailed analysis of the environmental situation.

7. The seventh part of the report is devoted to a detailed analysis of the international situation.

8. The eighth part of the report is devoted to a detailed analysis of the future prospects.

9. The ninth part of the report is devoted to a detailed analysis of the conclusions.

10. The tenth part of the report is devoted to a detailed analysis of the recommendations.

11. The eleventh part of the report is devoted to a detailed analysis of the annexes.

12. The twelfth part of the report is devoted to a detailed analysis of the bibliography.

13. The thirteenth part of the report is devoted to a detailed analysis of the index.

14. The fourteenth part of the report is devoted to a detailed analysis of the appendices.

15. The fifteenth part of the report is devoted to a detailed analysis of the conclusions.

16. The sixteenth part of the report is devoted to a detailed analysis of the recommendations.

17. The seventeenth part of the report is devoted to a detailed analysis of the annexes.

18. The eighteenth part of the report is devoted to a detailed analysis of the bibliography.

19. The nineteenth part of the report is devoted to a detailed analysis of the index.

20. The twentieth part of the report is devoted to a detailed analysis of the appendices.

21. The twenty-first part of the report is devoted to a detailed analysis of the conclusions.

22. The twenty-second part of the report is devoted to a detailed analysis of the recommendations.

23. The twenty-third part of the report is devoted to a detailed analysis of the annexes.

24. The twenty-fourth part of the report is devoted to a detailed analysis of the bibliography.

25. The twenty-fifth part of the report is devoted to a detailed analysis of the index.

26. The twenty-sixth part of the report is devoted to a detailed analysis of the appendices.

27. The twenty-seventh part of the report is devoted to a detailed analysis of the conclusions.

28. The twenty-eighth part of the report is devoted to a detailed analysis of the recommendations.

29. The twenty-ninth part of the report is devoted to a detailed analysis of the annexes.

30. The thirtieth part of the report is devoted to a detailed analysis of the bibliography.

DISCUSSION. In addition to the above listed synonyms, there are a dozen more names for Neotropical forms which probably are synonyms also.

These are the first California specimens we have seen. The characters given in the key will readily separate this from C. wheeleri. Our specimens are from a shallow sandy wash with ironwood and palo verde. Encelia farinosa was plentiful on the wash periphery and graded into Creosote Bush Scrub on rocky slopes.

No nests were found. The specimens were taken from debris around the nest of Forelius foetidus. In tropical areas this ant constructs irregular cavities which "may be in soil, under the bark of rotted wood, in humus about roots of epiphytes . . . high in rain forest trees, or even in a snail shell on the ground. The entrance may be but a bare hole or a crack in rotted wood." (Weber, 1972)

Tropical records indicate colonies are small. The more populous nests have less than 300 workers.

In Florida, the lower limit of activity for this species outside the nest is reached when soil temperatures at 2.5 cm below the surface reached 18.3°C. The ants remained below ground, retiring to the fungus gardens, when temperatures became colder.

In the tropics, C. rimosus cultured cheese-like masses of yeast cells which are placed on pellets of insect excrement.

Mating flights have been observed in tropical localities in March, April, August and December. In all probability in the desert the mating flights are synchronized with the spring and/or fall rains. Before taking flight, the females collect a bit of fungus from the garden and secure it in the infrabuccal pouch. Once mated and settled

in a chamber, she must culture a new fungus garden from the bit which she took with her.

Cyphomyrmex wheeleri Forel

Figures 184-185, 189

Cyphomyrmex wheeleri Forel, 1900:282-284: ♀ ♀. Wheeler, 1907: 725, 726, 765-768; fig. 30; pl. 49 fig. 2: ♀ ♀ ♂. Woodworth, 1910: 74, 75; fig. 18-19: ♀. Weber, 1940:409: ♀. Creighton, 1950:315-317; pl. 40: ♀ ♀ ♂. Kempf, 1965:14, 167-172; figs. 7, 25, 37, 49: ♀ ♀ ♂. Wheeler & Wheeler, 1973:97-98; ♀ ♀ ♂.

RANGE: Central and southwestern Texas, California and northern Mexico.

DESERT RECORDS. Inyo Co.: Grapevine Ranger Sta., DVNM, 21 June 1973 (GJW, #Cal.1007; GJW); Hunter Canyon, 1600'-3000', Inyo Mts., 30 June 1976 (DG; LACM). Riverside Co.: Deep Canyon, 25 Apr 1969;(GJW, #Cal.638; GJW). Imperial Co.: Indian Pass, 500', 7 mi E Ogilby Rd., 7 May 1978 (RRS & CDG, #78-44; LACM). Map 6.

DISCUSSION. The characters given in the key are sufficient for recognition of this fungus-growing ant. Although apparently rare in our area, it may be more common than now seems the case. The diversity of habitats indicated by the above records suggest that concerted efforts to locate additional records would be productive. The small size, cryptic coloration and the habit of remaining motionless when disturbed render this ant inconspicuous.

Since records for this species are few, it is difficult to ascertain elevational range. It has been collected at elevations ranging from 500 to about 2100 feet. Desert washes with ironwood and palo verde are the characteristic collection sites.

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey in the different regions.

3. The third part of the report deals with the results of the survey in the different districts.

4. The fourth part of the report deals with the results of the survey in the different villages.

5. The fifth part of the report deals with the results of the survey in the different households.

6. The sixth part of the report deals with the results of the survey in the different families.

7. The seventh part of the report deals with the results of the survey in the different groups.

8. The eighth part of the report deals with the results of the survey in the different communities.

9. The ninth part of the report deals with the results of the survey in the different regions.

10. The tenth part of the report deals with the results of the survey in the different districts.

11. The eleventh part of the report deals with the results of the survey in the different villages.

Colonies are small, with a few dozen workers and one queen. They are usually situated under stones where moisture is more readily retained. A small crater near the edge of the stone may be present.

A nest may have several chambers, but a fungus garden is present in only one of these. The garden is comprised of dense mycelia growing on triturerated plant fragments. The brood is implanted in the garden and eggs and larvae are coated with a thin film of mycelium. Larvae are frequently licked by the adults. The salivary coating probably enables the fungus to grow over the integument, helping to imbibe the larvae in the gardens.

Weber's (1972) account of larval feeding technique in tropical fungus-growing ants probably applies to our local species as well: the larger larvae have mouthparts which are out of range of the fungus and therefore are not able to feed themselves. They "pout" (extrude their mouthparts) to notify the adult workers of their hunger. The workers respond by placing a fungal mass on them, within reach of their mouthparts. Larvae possess ventral hairs which aid in keeping the mass of fungus within reach. Adults feed independently on the fungus.

Wheeler (1907) observed that the workers are nocturnal under warm weather conditions.

Males were taken in pit traps at Deep Canyon 20-27 June; a single male was taken at Hunter Canyon on 30 June. On 23 September a winged female was collected at Deep Canyon.

Remains of workers have been found in debris around nests of Veromessor pergandei, Forelius foetidus and Myrmecocystus sp.

Genus ACROMYRMEX Mayr

Acromyrmex is a moderate-sized Neotropical genus. The one California representative is the only species to extend into the Nearctic Region. There is nothing in our fauna that can be confused with it.

The mounds are usually in a wash and form conspicuous clusters of crateriform tumuli, often composed of coarse pebbles. Conditions suitable to A. versicolor seem to be similar to those of the ironwood tree, Olneya tesota, and the two are often associated in our area.

Acromyrmex versicolor (Pergande)

Figures 186-187

Atta versicolor Pergande, 1893:31-32: ♀. Emery, 1905:108, 111. Wheeler, 1907:703, 743-746: ♀ ♀ ♂. Wheeler, 1917:179-180.

Acromyrmex (Moellerius) versicolor, Emery, 1922:351. Creighton, 1950:326-327.

Atta (M.) versicolor subsp. chisosensis Wheeler, 1907:705: ♀.

Acromyrmex (M.) versicolor subsp. chisosensis, Creighton, 1950: 326-327.

RANGE: Big Bend area of Texas to southeastern California, Sonora, Lower California.

DESERT RECORDS. Limited to dry stream courses of southeastern California, commonly associated with ironwood trees (Olneya tesota); 27 records. Map 6.

DISCUSSION. The dull, spinose body with numerous stout bristles are diagnostic for this unusual ant.

A. versicolor has been collected at elevations ranging from 335

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey and the conclusions drawn from them.

3. The third part of the report deals with the results of the survey and the conclusions drawn from them.

4. The fourth part of the report deals with the results of the survey and the conclusions drawn from them.

5. The fifth part of the report deals with the results of the survey and the conclusions drawn from them.

to 2475 feet. Although it ^{generally} nests in sandy regions of desert washes under or near ironwood trees, we have found it nesting at the edge of a palm oasis under Tamarix sp. and Prosopis glandulosa. The characteristic nest tumuli consist of a regular crater 10-30 cm in diameter with a central entrance 2-3 cm across. The crater is usually constricted of coarse sand and is broad-based. As a rule colonies, when mature, have a cluster of such cones (Fig. 307). "Single large, central galleries penetrate the craters and lead into numerous and irregularly-shaped brood and fungus chambers." (Cole, 1934a)

Colonies consist of a few thousand workers who forage and cultivate the fungus gardens. Deplete females have been seen foraging along along with the workers.

We have seen foraging workers collecting creosote bush (Larrea tridentata) leaves, stems and flowers, ironwood (Olneya tesota) leaves, mesquite (Prosopis glandulosa) leaves, seed capsules and pod fragments, and leaves and stems from desert thorn (Lycium andersonii). They systematically strip a plant of foliage, moving from one side to the other. In cutting leaves the ants work from the periphery of the leaf, facing inward. With tarsal claws firmly attached, the ant cuts an arc with its sharp mandibles, using the body as a radius and turning. The size of the arc cut thus tends to vary with the size of the ant.

Wheeler (1907) states that these ants do not leave the nest during midday heat, but towards evening will begin foraging. We have observed workers in May foraging in morning hours until 1100.

In October and November they were seen foraging from 0845 (ST 29°C) to 1100 (ST 37°C), nest cleaning from 1445 to 1645; foraging resumed at 1530 and continued to 1730 (ST 20°C). During the hot summer months there is no surface activity.

Mating flights of this species have not been observed in the California deserts. Wheeler (1917a) described a flight of A. versicolor which he observed in Arizona. It occurred at dawn (0530) on 30 July after a heavy rain on the previous day. The ants were in numerous well defined swarms about 100 feet apart, extending for miles over the desert floor. Individual males and females would join the swarms and writhing pairs in copulo would fall to the ground beneath.

We found females which had just flown at Wiley's Well, Riverside County, on 6 November. Most had excavated chambers in soil beneath ironwood trees. These were surmounted by a semicircular tumulus of large sand pellets; the entrance was closed. The individual females were in small chambers about 70-125 cm below the surface.

SUBFAMILY DOLICHODERINAE

The subfamily Dolichoderinae is best represented in tropical areas, where there are many genera and species. Relatively few have penetrated into temperate zones and fewer still into the arid desert. The species which do occur in our area include two which are present only marginally, one introduced species and several wide-ranging forms tolerant of diverse conditions.

Dolichoderines share with the subfamily Formicinae a one-segmented petiole. The most conspicuous morphological difference between the two groups is the presence of an acidopore among the formicines. Instead of an acidopore, the dolichoderines possess only an anal slit. Both groups lack a sting so defense of colonies and individuals must rely upon other deterrent methods. These two subfamilies employ chemical defenses. Formicines, as a whole, utilize a chemical defense which is partially, or entirely, formic acid. Female castes of our species of formicines will, when their gasters are crushed, yield the characteristic sharp odor of formic acid.

In the dolichoderine ants the compounds of defense are centered around butyric acid. These compounds are quite aromatic and, to humans anyway, very disagreeable. The odor has been variously compared to rancid butter, rotting coconuts and scorched rubber. Whatever the comparison, these compounds are convincingly repugnant and provide an excellent field identification characteristic.

Colonies of Liometopum, Tapinoma and Forelius are usually quite large and numerous females are present. Those of Conomyrma are evidently smaller and may have only a single female. With the

exception of Tapinoma, however, none of these has been extensively studied. The dolichoderines asaa group are quite aggressive omnivores. Liometopum, Tapinoma and Forelius are all trail foragers. In Conomyrma trails are less consistent and when they do occur, do not receive the heavy traffic so characteristic of the others.

Since our fauna includes so few species of Dolichoderinae, the following keys are for both genera and species, except that in the key to males no effort is made to separate those of the two Forelius species or the two Conomyrma.

KEY TO GENERA AND SPECIES OF DOLICHODERINAE

workers & females

- 1a. Juncture of basal and posterior faces of worker propodeum rounded, not at all produced upward as a conical process when viewed from side (Figs. 196, 198, 200); third segment of maxillary palp distinctly shorter than following three combined 2
- b. Juncture of basal and posterior faces of worker propodeum, in profile, conically produced upward (Fig. 202); third segment of maxillary palp longer than following three combined (Fig. 6) (Conomyrma) 6
- 2a. Worker monomorphic; gastric terga without appressed dense, long grayish pubescence; gap between lateral margin of clypeus and base of mandible very narrow (Fig. 195a) 3
- b. Worker polymorphic; gastric terga with appressed dense, long grayish pubescence; gap between lateral margin of clypeus and mandibular base large (Fig. 191a)
. Liometopum occidentale Wheeler

- 3a. Dorsal surface of head and thorax with at least a few long erect setae; petiolar scale small, distinct, erect or sub-erect (Figs. 198, 200) 4
- b. Dorsal surface of head and thorax without erect setae (a few present on clypeus); petiolar scale very small, strongly inclined forward, adnate to anterior peduncle (Fig. 196) Tapinoma sessile (Say)
- 4a. Apical margin of clypeus thin, not at all beveled in middle; mandible with four distinct, close teeth and a weak basal tooth, denticles present only between basal and subbasal teeth; worker metanotum not depressed below base of propodeum, latter flat (Forelius) 5
- b. Apical margin of clypeus thick, with median, triangular beveled area; mandible with four or five widely spaced teeth, with several minute denticles between each (except apical and pre-apical teeth); metanotum of worker sharply depressed below level of anterior margin of propodeal base, latter strongly convex Iridomyrmex humilis (Mayr)
- 5a. Antennal scape and all tibiae with at least a few suberect to erect hairs; occipital corner with a few short erect hairs; worker pronotum with 6 or more erect hairs (Figs. 198, 199) F. foetidus (Buckley)
- b. Scape, tibiae and occipital corner without erect hairs; worker pronotum with 2 or 4 erect hairs (Figs. 200, 201) F. pruinus (Roger)

- 6a. Head and thorax ferruginous, gaster brownish black. Worker:
interocular distance more than 1.5 time EL; CI over 95
(Fig. 203) C. bicolor (Wheeler)
- b. Head, thorax and gaster concolorous, from light brownish to
blackish brown. Worker: interocular distance less than 1.5
times EL; CI less than 95 (Fig. 204) . . . C. insana (Buckley)

males

- 1a. Scape much longer than second flagellar segment (Figs. 197,
205) 2
- b. Second flagellar segment distinctly longer than scape
. Iridomyrmex humilis (Mayr)
- 2a. Third segment of maxillary palp about as long as second, much
shorter than combined lengths of last three; head dorso-
ventrally flattened or not 3
- b. Third segment of maxillary palp much longer than second, about
equal to combined lengths of last three; head dorso-ventrally
flattened (Fig. 205) Conomyrma spp.
- 3a. Scape shorter than combined lengths of next four segments; base
of gaster without impressed area for reception of petiole;
erect body hairs often abundant 4
- b. Scape about as long as combined lengths of next five segments
(fig. 197); base of gaster with impressed area for reception
of petiole; erect body hairs sparse .. Tapinoma sessile (Say)

- 4a. Head distinctly flattened, more or less concave beneath;
body hairs sparse; length less than 4 mm . . . Forelius spp.
- b. Head convex dorsally and ventrally (Fig. 194); body hairs
abundant; length 7-11 mm . . . Liometopum occidentale Wheeler

Genus LIOMETOPUM Mayr

Liometopum is a small Holarctic genus of arboreal ants. The two or three New World species are limited to western North America. One species is found along the western margins of both the Mojave and Colorado Deserts. All of our records for this species are apparently incursions along water courses.

These ants are commonly associated with cottonwood and oak trees. Colonies are very populous and in late afternoon long, dense files of the workers may be seen moving between trees. When disturbed, the ants are quite aggressive and spray attackers with an especially disagreeable secretion. They are effective foragers and, while apparently omnivorous, do capture insects. Aphids and pseudococcids are tended for their secretions.

Liometopum occidentale Emery

Figures 191-194

Liometopum microcephalum var. occidentale Emery, 1895:330:

♀ ♂.

Liometopum apiculatum var. occidentale, Wheeler, 1905:324: ♀.

Liometopum occidentale, Wheeler, 1917:522: ♀ ♂. M. Smith, 1947:590; pl.16 fig.61: ♀. Creighton, 1950:339: ♀. Wheeler & Wheeler, 1973:100: ♀.

RANGE: Northern Oregon, California at low to moderate elevations; Baja California.

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DESERT RECORDS. Inyo Co.: Eureka Valley, Feb. 1978 (DG; CDA); Paiute Canyon, 3500'-5000', Inyo Mts., 17 June 1976 (DG; LACM); Willow Creek, 2400', Inyo Mts., 3 May 1976 (DG; LACM); Willow Creek, 4500', Inyo Mts., 16 Sept 1976 (DG; LACM). Los Angeles Co.: Big Rock Wash at Palmdale Blvd., 1 Apr 1972 (J. P. & K. E. Donahue; LACM). San Bernardino Co.: Victorville, 2700', 8 Apr 1949 (W. D. Pierce; LACM); same locality, 28 May 1938 (C. M. Dammers; LACM); Yermo, 1935', 7 Sept 1952 (RRS; LACM). Riverside Co.: Smithwater Wash, JTNM, 6 Aug 1960 (M. Knox, E. L. Sleeper; LACM); Palm Canyon, 3 Apr 1925 (P. H. Timberlake; LACM). Map 6.

DISCUSSION. This species enters the desert from adjacent chaparral zones along stream courses. It is commonly associated with oaks and cottonwoods. The Mojave River bottom in the vicinity of Victorville, with an extensive grove of cottonwood trees, supports a large population of L. occidentale.

L. occidentale is generally taken at elevations ranging from sea level to about 4800 feet in California where it nests in the ground under stones. It may occasionally be found nesting in hollow trees or under roots of trees. Nest chambers are often subdivided by a network of paper-like material which the ants make by mixing soil, plant detritus and a mandibular secretion (Creighton, 1950).

The closely related L. apiculatum Mayr seems to tolerate a number of myrmecophiles, but so far none are known for this species.

Reproductive females of L. occidentale have been found in the nests and collected at lights in May. We also have seen an alate female taken at black light during August.

Genus IRIDOMYRMEX Mayr

With the removal of pruinusosus from Iridomyrmex to Forelius we are left with but one species of Iridomyrmex in California, I. humilis (Mayr), the Argentine ant. This introduced species seems to be unable to establish itself in natural habitats, consequently it is an urban ant. In the deserts it does not seem to do at all well, however. We have seen occasional specimens from Palm Springs, Indio, Brawley and El Centro. During our own visits to these and other desert communities we have not seen the ant and consider that it is not firmly established. In all probability it is repeatedly introduced from coastal populations.

Genus TAPINOMA Foerster

Tapinoma sessile (Say)

Figures 195-197

Formica sessilis Say, 1836:287: ♀.

Tapinoma sessilis, F. Smith, 1858:57

Tapinoma boreale Roger, 1863:165: ♀ ♀. Mayr, 1866:497: ♀.

Formica gracilis Buckley, 1866:158: ♀ ♀.

Formica parva Buckley, 1866:159: ♀.

Tapinoma sessile, Mayr, 1886b:434. Emery, 1895:332: ♀ ♂.

M. Smith, 1928:309; pl.18 figs 1-3; ♀ ♀ ♂. M. Smith, 1947:596; pl.17 fig.65: ♀. Creighton, 1950:352, 353; pl. 48: ♀ ♀ ♂. Gregg, 1963:443-447; map: ♀. Wheeler & Wheeler, 1963:157-160; map 28: ♀ ♀ ♂. Wheeler & Wheeler, 1973:106-107: ♀ ♀ ♂.

RANGE: Southern Canada and entire United States; Lower California.

DESERT RECORDS. Inyo Co.: S. end Owen's Lake, 26 May 1974 (M. S. & J. S. Wasbauer; CDA); sand dunes, 1150', Saline Valley, 8 July 1976 (DG; LACM); Salt Lake, 1060', Saline Valley, 23 Mar 1976 (DG; LACM); 3/4 mi N, 3/4 mi W Badwater Spg., 2200', Inyo Mts. 15 June 1976 (DG; LACM); Willow Creek, 2400', Inyo Mts., Mar-Sept 1976 (DG; LACM); Pat Keyes Cyn., 3000', Inyo Mts., 14 June 1976 (DG; LACM); Craig Cyn., 3400', Inyo Mts., 18 Sept 1976 (DG; LACM); Hunter Cyn., 2000'-2800', Inyo Mts., 2 Apr 1976 (DG; LACM); Paiute Cyn., 3500'-5000', Inyo Mts., 17 June 1976 (DG; LACM). San Bernardino Co.: Saratoga Spg., 0', DVNM, 28 May 1955 (J. N. Belkin, et al.; LACM). Riverside Co.: Andreas Cyn., 1500', 4 mi S Palm Springs, 20 Nov 1969 (GJW, #Cal.842; GJW); Deep Canyon, 1000'-1100', various dates (GJW; #Cal.472, 473, 718, 765, 824; GJW); Whitewater Canyon, 26 July 1963 (E. I. Schlinger; LACM). San Diego Co.: Sentenac Canyon, 2400', 23 Apr 1952 (WSC; LACM). Map 6.

DISCUSSION. The record from Saratoga Spring might seem questionable were there not records of Hypoconera and Brachymyrmex from the same site. These are evidently relict populations dating from the Tertiary. At least some of the samples from the Inyo Mts. might represent similar populations.

Widespread in North America, T. sessile is an easily recognized ant which can be confused only with I. humilis. The strongly convex propodeum and less pungent odor when crushed will distinguish I. humilis. Since it is often a house pest, T. sessile has been fairly well studied, especially by M. Smith (1928, 1965).

This species is extremely adaptable and therefore can be found in a broad range of habitats. In the California desert it has been collected at elevations from 0' to 6300' in streamside habitats with cottonwood, along desert washes with palo verde, catsclaw, etc. and

in Piñon-juniper communities. Although nests are predominantly found under stones, this species is also known to locate under loose bark, in cavities of plant stems, in wasp galls, in bird and mammal nests and under leaves and rubbish piles.

Colony size is variable depending on age, but may range from 2000 to 10,000 ants, with numerous queens. Mating usually takes place within the nest between siblings with occasional mating flights outside. Alate females have been collected from desert localities during the month of May.

This species is primarily aphidicolous and coccoidicolous and an extensive list of aphid and coccoid associations is presented by M. R. Smith (1928). Workers also collect nectar from floral and extrafloral nectaries of plants and occasionally take living and dead insects as food. They forage singly from trails and are active during both day and night.

Predators of T. sessile include birds (crows, red-shafted flickers) and toads (Bufo).

Various myrmecophiles have been found in nests of this ant. They include: Myrmecophila spp. (Orthoptera), Zygras, Myrmoecia, Nototaphra, Connophron and Myrmedonia (Coleoptera).

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Forelius foetida, Wheeler, 1902c:14. Emery, 1912:35; pl.1 fig.18: ♀. Creighton, 1950:345; pl. 46: ♀ ♂.

Forelius Maccooki race Andreii Forel, 1912:44: ♀.

Forelius foetidus, Gregg, 1963:434-436; map: ♀. Wheeler & Wheeler, 1973:102-103: ♀.

RANGE: Arkansas, Kansas, southeastern Colorado, Texas west to southern California; south to central Mexico.

DESERT RECORDS. Sporadic through much of our area, most abundant in Colorado Desert; 26 records. Map 6.

DISCUSSION. The only ant with which this species can be confused is F. pruinus. Both ants are similar in size, color and habits. In the field, the two cannot be distinguished from one another.

The pattern of erect hairs in F. foetidus is quite variable and in some samples the number may be greatly reduced. Such could be mistakenly identified as F. pruinus. There always are at least a few erect hairs along the side of the head, on the occipital corner and at least 6 on the pronotum of F. foetidus. The pronotum of F. pruinus has 2 or 4 erect hairs and there are none on the side of the head or on the occipital corner. The average size of F. foetidus is a little smaller than that of F. pruinus.

This species has been collected at desert localities at elevations ranging from -22' to 3500'. It can be found in a variety of situations and exhibits a tolerance for all sorts of soil types, from fine sand of dune areas to the coarse gravel of desert washes and to powdery soil in alkali flats. Plant community associations include Palm Oases, Wash Woodlands, Saltbush Scrub, Alkali Sink

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Forelius Maccooki race Andreii Forel, 1912:44: ♀.

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Creosote Bush Scrub and Joshua Tree Woodlands.

Nest tumuli generally consist of scattered or irregular piles of fine sand (Fig. 313). However, there may be a cluster of fairly well defined small (usually no more than 8 cm diameter) craters. This species also nests under stones. In this situation comminuted sand from the nest may be detectable at the base of the stones.

The workers have been observed foraging on the deserts from as early as 0830 to as late as 1730. They are capable of moving very rapidly and thus are found foraging at high surface temperatures (up to 66°C) when other ants have ceased such activity.

Their debris piles indicate that they apparently scavenge dead individuals of other ant species, such as: Pheidole barbata, P. hyatti, P. sciophila, Solenopsis maniosa, S. molesta, S. aurea, Veromessor pergandei, Cyphomyrmex rimosus, C. wheeleri, Pogonomyrmex spp., Monomorium minimum, Forelius pruinus, Neivamyrmex californicus and Myrmecocystus flaviceps. Other arthropods taken include Hemiptera (Miridae), Diptera (Muscidae) and Homoptera (Cicadellidae, Membracidae). They have also been commonly observed on road kill vertebrates. Other workers are quickly recruited when a new resource is discovered and by virtue of large numbers may exclude other ant species.

This species has been observed foraging for nectar on Euphorbia albomarginata, E. polycarpa hirtella, Cleomella obtusifolia, Sal-sola iberica, Sphaeralcea ambigua, Encelia farinosa and Opuntia bigelovii.

Forelius pruinosus (Roger)

Figures 200-201

Tapinoma pruinosum Roger, 1863:16: ♀. Emery, 1895:333: ♀.
Wheeler, 1905a:110. Wheeler, 1905c:389.

Tapinoma boreale Mayr, 1886b:434: ♀. (nec Roger, nec Mayr,
1866)

Tapinoma anale Andre, 1893:148: ♀.

Tapinoma pruinosum var. anale, Emery, 1895:333.

Iridomyrmex analis, Wheeler, 1906:342. Forel, 1908:62.
Emery, 1912:26. Eckert & Mallis, 1941:7; fig. 8: ♀.

Iridomyrmex pruinosus, M. Smith, 1924:83: ♀. M. Smith, 1929:
241: ♀. M. Smith, 1965:54-55; fig. 29: ♀. Wheeler & Wheeler,
1973:101-102; fig. 36: ♀ ♀ ♂.

Iridomyrmex pruinosum var. testaceus Cole, 1936:121: ♀.

Iridomyrmex pruinosum, Creighton, 1950:341, 342-343: ♀.

Iridomyrmex pruinosum analis, Creighton, 1950:34, 343; pl.
45; ♀ ♀ ♂. Gregg, 1963:436-438; map: ♀. Cole, 1966:18: ♀.

RANGE: Cuba, Bahamas; New Jersey to Florida, west to Idaho,
Oregon, south to central Mexico.

DESERT RECORDS. Throughout the desert areas but sporadic;
86 records. Map 6.

DISCUSSION. The western populations of F. pruinosus have
usually been recognized as a separate subspecies, analis. This
form differs from the nominate in reduced pubescence, especially
on the head and gaster. The difference is a slight one of degree
and is very difficult to assess; there seems to be no practical

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value in retaining this name.

This widely distributed ant is common over much of our area, from elevations between -190' and 4300'. It occupies the same sort of habitats as those described for F. foetidus, and has similar nesting habits. Foraging files may be seen going over rocky areas and along plant stems lying on the ground. It seems to exhibit the same tolerance for high temperatures as does F. foetidus.

Workers have been observed foraging from 1000 until 1900. Nest debris indicates that flies, beetles and ants are taken. Of the samples we have studied, Solenopsis maniosa is most commonly taken, Monomorium minimum to a lesser extent. The foragers have been observed taking nectar on Encelia farinosa, Euphorbia albomarginata, E. polycarpa, Bebbia juncea, Eriogonum inflatum and Larrea tridentata. We have also observed this species soliciting aphids on Dalea and mealybugs on roots of Ambrosia dumosa.

Known predators include the flat-tailed horned lizard, Phrynosoma mcalli and the western blind snake, Leptotyphlops humilis.

Mating flights have been observed in April and in August.

Genus CONOMYRMA Forel

This is the genus long known in North American literature as Dorymyrmex. As shown by Snelling (1967) Dorymyrmex is limited to a small group of very different South American ants. Conomyrma ranges from Argentina and Chile to the United States. The South American genus Araucomyrmex is almost certainly to be considered a synonym of Conomyrma. All of the species of Araucomyrmex, as defined by Snelling and Hunt (1976) should now be placed in Conomyrma.

Nominally, there are but two species of Conomyrma in our desert area. One of these, C. bicolor, is an easily recognized ant and presents no serious taxonomic difficulties. The ant here called C. insana is quite another matter. This species has long been known as Dorymyrmex pyramicus in North American literature, but the true pyramicus is a South American species, according to Snelling (1967)

The next available name for the North American ant is Buckley's Formica insana, described from Texas. Unfortunately there is now reason to suspect the existence of a complex of several closely allied species. If this proves to be the case, then all of the prior literature on "Dorymyrmex pyramicus" in North America will be virtually worthless for there will be little certainty as to the identity of the ant involved in each case. Until such a time as this entire complex is revised, and a specific identity is established for C. insana, there can be no real stability in our forms. Such a study is beyond the scope of this project. For our purposes we have chosen to use the name C. insana, but with the realization that revision will almost certainly give our form another name.

Genus FORELIUS Emery

There are two species of Forelius in our area. Both are small ants, workers less than 3 mm long and monomorphic. They vary in color from sordid yellowish to blackish, but commonly are reddish with the posterior half or more of the gaster brownish. Colonies may possess many females. Workers forage in dense trails and characteristically move in a rapid, frenzied fashion. These ants evidently have a high thermal tolerance for the workers may be seen foraging when larger ants have given up.

One of our species, F. pruinosis, has traditionally been placed in the related genus Iridomyrmex. This assignment is one of long standing even though the ant bears little resemblance to others placed there. Indeed, it had been consistently confused with F. foetidus, for it much more closely resembled that ant than any of its presumed congeners. The habitus of F. pruinosis and the structure of the proventriculus are consistent with Forelius rather than Iridomyrmex and so the ant must be transferred from Iridomyrmex to its present placement. With this accomplished, it is now an easy matter to separate the two genera on external characters.

Forelius foetidus (Buckley)

Figurees 198-199

Formica foetida Buckley, 1866:167: ♀.

Iridomyrmex maccooki Forel, 1878:382 (Nomen nudum). McCook, 1879:187: ♀. Forel, 1886:39: ♀. Mayr, 1886b:432: ♀ ♂.

Forelius maccooki, Emery, 1888:389: ♀. M. Smith, 1947:595; pl.17 Fig.63: ♀.

Conomyrma bicolor (Wheeler)

Figures 202-203

Dorymyrmex pyramicus subsp. bicolor Wheeler, 1906:342: ♀.

Dorymyrmex pyramicus var. bicolor, Cole, 1942:371, 372: ♀.

Dorymyrmex pyramicus bicolor, Creighton, 1950:348, 349: ♀.

Conomyrma (Biconomyrma) bicolor, Kusnezov, 1952:430: ♀.

Dorymyrmex bicolor, Cole, 1957:130. Cole, 1966:18: ♀.

Wheeler & Wheeler, 1973:103-104; figs. 37, 38: ♀.

Conomyrma bicolor, Snelling, 1973: 4-5: ♀ ♂.

RANGE: Western Texas to southern California; Nevada, Utah; northern Mexico.

DESERT RECORDS. Generally distributed throughout our area; 89 records. Map 6.

DISCUSSION. This ant is easily recognized, though in the field it can be confused with some bicolored Myrmecocystus. The characteristic tapinomine odor, when crushed, will readily identify C. bicolor. Nests of this aggressive little ant often have very regular circular craters 5-7.5 cm in diameter, but may also have a very irregular tumulus. Nests appear to be clumped; these may be multiple entrances of a single colony.

C. bicolor is found in open areas in habitats such as Creosote Bush Scrub and Saltbush Scrub on the desert floor, Palm Oases, near sand dunes, on alkali flats and in Joshua Tree Woodlands, but is most commonly encountered in sandy Wash Woodlands. It occurs at elevations between -190 and 4300 feet.

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THE HISTORY OF THE UNITED STATES OF AMERICA, FROM THE FIRST SETTLEMENTS TO THE PRESENT TIME. BY JAMES M. SMITH, LL.D. VOL. I. NEW YORK: PUBLISHED BY J. B. LIPPINCOTT, 150 NASSAU ST. 1854.

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Foragers move rapidly and generally leave their nests to search for food in the late afternoon (1600 - 1700). They forage throughout the night and into the morning hours until about 0900. During cooler months, such as October and November, they may be found foraging from 1200 until 1500.

Workers have been found on several different plants collecting nectar, resins and honeydew from homopterans. Records include: Encelia farinosa, Ambrosia dumosa, Larrea tridentata, Chrysothamnus nauseosus, Peucephyllum schottii, Stanleya pinnata, Asclepias erosa, Datura bicolor and Euphorbia spp.

Returning foragers have been intercepted with the following items: other ant species (Pogonomyrmex maricopa, Solenopsis maniosa, Pheidole gilvescens, etc.), flies (especially Ceratopogonidae), Hemiptera (Lygaeidae, Miridae) and Homoptera (Cicadellidae). C. bicolor has been observed attacking Pogonomyrmex californicus at the entrance to the Pogonomyrmex nest. Remains of Solenopsis maniosa have often been found in great numbers at the base of C. bicolor craters.

Alate females have been collected at lights during the months of April and May.

This species is preyed upon by the flat-tailed horned lizard, Phrynosoma mcalli.

Conomyrma insana (Buckley)

Figures 204-206

Formica insana Buckley, 1866:165: ♀ ♀.

Dorymyrmex flavus McCook, 1879:188: ♀.

Dorymyrmex pyramicus subsp. flavus, Forel, 1899:103: ♀.

Dorymyrmex pyramicus var. nigra Pergande, 1895:871: ♀.

Dorymyrmex pyramicus var. smithi Cole, 1936:120: ♀.

Dorymyrmex pyramicus, Cole, 1942:371: ♀. Creighton, 1950: 348-349; pl. 47: ♀ ♀ ♂. Cole, 1957:130: ♀. Wheeler & Wheeler, 1963:155-157; map 27: ♀ ♀ ♂. Cole, 1966:18. Wheeler & Wheeler, 1973:103, 105-106; fig. 39; ♀ ♀ ♂.

Conomyrma (C.) pyramica, Kusnezov, 1952: 430 (in part).

Wilson, 1964:10.

Conomyrma (? Biconomyrma) wheeleri Kusnezov, 1952:438-439: ♀.

Dorymyrmex (Conomyrma) pyramicus, Gregg, 1963:432-434; map. ♀.

Conomyrma insana, Snelling, 1973:4-5: ♀ ♀. Wheeler & Wheeler, 1977: 2, 3.

RANGE: Southern United States, northern Mexico.

DESERT RECORDS. Ubiquitous, but sometimes displaced locally by C. bicolor; 99 records. Map 6.

DISCUSSION. It is sufficient here to reiterate that the name C. insana is applied to a complex of forms which appear to be separate species. The untangling of this problem is beyond the scope of this project. No obviously different behavior exists among the various populations and the present approach has been adopted.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation and the second section deals with the progress of the work.

2. The second part of the report deals with the results of the work during the year. It is divided into two main sections: the first section deals with the results of the work in the field of research and the second section deals with the results of the work in the field of education.

3. The third part of the report deals with the conclusions of the work during the year. It is divided into two main sections: the first section deals with the conclusions of the work in the field of research and the second section deals with the conclusions of the work in the field of education.

4. The fourth part of the report deals with the recommendations of the work during the year. It is divided into two main sections: the first section deals with the recommendations of the work in the field of research and the second section deals with the recommendations of the work in the field of education.

5. The fifth part of the report deals with the summary of the work during the year. It is divided into two main sections: the first section deals with the summary of the work in the field of research and the second section deals with the summary of the work in the field of education.

In the field this ant can be confused only with the small, monochromatic Myrmecocystus. The two have very different ways of running, however. The Conomyrma tend to be quite direct and even-gaited, in contrast to the usually erratic and "jerky" running of Myrmecocystus. Of course, too, Conomyrma, when crushed is easily identified by its pungent and disagreeable odor.

Habitats for this ant are similar to those for C. bicolor. Nests of C. insana occur at elevations between -190 and 5800 feet in exposed areas. The craters are small, 5-10 cm in diameter, circular to irregular in shape, often much higher on one side (Fig. 312).

This species moves rapidly while foraging. Workers were observed foraging in afternoon hours during the Spring, evening hours during the warmer months of July - September and during early afternoon in October and November. They appear to estivate during winter months, at least on the Mojave.

Honeydew is collected from aphids, mealybugs and other scale insects, which the ants tend, and workers have been noted taking nectar from Cercidium floridum, Sphaeralcea ambigua, Chrysothamnus paniculatus and Opuntia bigelovii. Highly predaceous, workers have been found to take a wide array of arthropods, such as termites, larval Lepidoptera, syrphid flies, small beetles, chalcidoid wasps and other species of ants. This species has been observed to attack much larger ants (Novomessor cockerelli) that trespass near their foraging column (Cazier and Statham, 1962). Debris from one nest alone consisted of fragments of 732 ants representing five different genera: Pheidole, Crematogaster, Monomorium, Solenopsis

and Nylanderia (= Paratrechina) (Hung, 1974). It is not known whether these were scavenged from other nests or represent freshly killed prey.

Alate females have been collected at black lights during the month of May.

The lizard, Phrynosoma mcalli, is know to be predaceous upon C. insana.

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research. It also provides a brief overview of the methodology used in the study.

2. The second part of the report is a detailed description of the study area. It includes information about the location of the study area, the population of the study area, and the characteristics of the study area. It also discusses the data sources used in the study.

3. The third part of the report is a detailed description of the study results. It includes information about the findings of the study, the conclusions drawn from the findings, and the implications of the findings. It also discusses the limitations of the study and the need for further research.

4. The fourth part of the report is a conclusion and recommendations section. It summarizes the findings of the study and provides recommendations for future research and policy. It also discusses the overall impact of the study and the need for further research.

SUBFAMILY FORMICINAE

This is a large, cosmopolitan subfamily with many genera, only a few of which extend into the deserts. As a group the formicines do not seem to be as successful in arid habitats as are the myrmicines. Of those genera present in the area of this project only Myrmecocystus is common and predictably present.

The formicines share with the dolichoderines a one-segmented petiole. They differ from dolichoderines in that they possess an acidopore at the gastric apex. In our species this is a conspicuous, somewhat tubiform, projection, around the periphery of which is a conspicuous fringe of long hairs (Fig. 19). By means of this acidopore the ant sprays the primary defensive compound of the formicine ants, formic acid, an irritant in respiratory systems and on surface wounds; as an insecticide it is lethal.

The taxonomy of the desert inhabiting formicines is not especially difficult, if for no other reason than that there are so few of them. Several of the genera, such as Camponotus, Formica and Paratrechina, are very much in need of revisionary study but our species are few and reasonably well known (except Paratrechina). The genus Myrmecocystus has more species within the study area than any other ant genus, but was revised by Snelling (1976) and the species are now mostly well known.

KEY TO GENERA OF FORMICINAE

workers

- 1a. Antenna twelve-segmented 2
- b. Antenna nine-segmented (Fig. 208) Brachymyrmex
- 2a. Thoracic dorsum, in profile, with propodeum distinctly depressed below level of promesonotum; metanotal impression usually distinct; antennal socket at or near margin of clypeus . . 3
- b. Propodeum in profile not depressed below level of promesonotum; metanotal impression absent or very weak; antennal socket well removed from margin of clypeus (Figs. 214, 216, 218) Camponotus
- 3a. Maxillary palp no longer than head, third and fourth segments not unusually long; psammophore absent 4
- b. Maxillary palp longer than head, third and fourth segments very long; psammophore present but weak (Fig. 5) Myrmecocystus
- 4a. Frontal carinae weak, rounded into antennal fossa; ocelli absent or indistinct; body and appendages with coarse, dark erect setae (Figs. 226-231) Paratrechina
- b. Frontal carinae prominent, lateral margins slightly reflected upward; ocelli present, distinct; body and appendages without coarse, dark erect setae (Figs. 268-273) Formica

males

- 1a. Antenna 13-segmented; mandible well developed, with masticatory margin 2
- b. Antenna 10-segmented; mandible vestigial, narrow and pointed, without masticatory margin Brachymyrmex

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- 2a. Antennal socket not, or very narrowly, separated from margin
of clypeus 3
- b. Antennal socket separated from clypeal margin by about one-
half its minimum diameter Camponotus
- 3a. Maxillary palp of normal length, fourth segment shorter than
combined lengths of fifth and sixth 4
- b. Maxillary palp unusually long, fourth segment longer than com-
bined lengths of fifth and sixth Myrmecocystus
- 4a. Tibiae and scape with coarse, dark erect hairs; cerci absent .
. Paratrechina
- b. Tibiae and scape without coarse, dark erect hairs; cerci
present Formica

Genus BRACHYMYRMEX Mayr

Brachymyrmex is a small, exclusively New World genus of minute and nondescript ants. Most of the species are tropical; one occurs naturally in America north of Mexico. Two or three others are introduced, and apparently established, in the southeastern United States. The genus was revised by Santschi (1923). One species is found in our desert area.

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29. twenty-ninth is the fact that the

30. thirtieth is the fact that the

Brachymyrmex depilis Emery

Figures 207-208

Brachymyrmex heeri subsp. depilis Emery, 1893:635: ♀ ♀ ♂.
Wheeler, 1903b:103; fig. 7a: ♀.

Brachymyrmex nanellus Wheeler, 1903b:102-103; fig. 7b: ♀ ♂.
Santschi, 1923:664: ♀.

Brachymyrmex depilis, Santschi, 1923:653; fig. 22: ♀.
Creighton, 1950:359; pl. 48: ♀ ♀ ♂. Cole, 1953a:266: ♀. Wheeler
& Wheeler, 1963:161-163; map 29: ♀ ♀. Gregg, 1963:447-449; map:
♀. Wheeler, 1973:108-109: ♀ ♀. Wheeler & Wheeler, 1978:189: ♀.

Brachymyrmex depilis flavescens Grundmann, 1952:117: ♀.

RANGE: Nova Scotia to British Columbia, south to central
Mexico.

DESERT RECORDS. Inyo Co.: Paiute Canyon, 3500'-5000', Inyo
Mts., 17 June 1976 (DG; LACM); Willow Creek, 2400', Inyo Mts., 3
May 1976 (DG; LACM); Pat Keyes Canyon, 2000'-3000', Inyo Mts., 14
June 1976 (DG; LACM); nr. Grapevine Ranger Sta., 3000', DVNM, 22
Jan 1968 (GJW, #Cal.286; GJW). San Bernardino Co.: Saratoga
Spring, 0', DVNM, 10 Nov 1968 (RRS, #68-126; LACM). Riverside
Co.: Pushawalla Palms, 200', 6 Dec 1967 (GJW, #Cal.281; GJW);
Deep Canyon, 825', 9 May 1969 (GJW, #Cal.755; GJW). Map 7.

DISCUSSION. This tiny, pale ant is easily recognized, for
it is our only formicine in which the worker and female antenna
is nine-segmented. Colonies are apparently small, usually located
in soil beneath stones or in rotting wood in a wide variety of
habitats. The species is largely subterranean in our area, but
workers may occasionally forage on the surface during warm nights.

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Over its entire range this species occupies an astounding variety of habitats. Within our area it has been found in Salt-bush Scrub, Sagebrush Scrub and Wash Woodlands, at elevations ranging from 0 to about 3500 feet.

Feeding habits in the desert are unknown, but elsewhere B. depilis feeds on honeydew secreted by aphids and mealybugs. It likely also takes nectar from floral and extrafloral nectaries. At Saratoga Spring workers were found walking about the surface of the soil at about 2330.

Genus CAMPONOTUS Mayr

Camponotus is a huge, worldwide genus of bewildering complexity. Many species are quite variable and most of the variants have been named, resulting in a welter of inadequately described, poorly understood forms whose relationships are often obscured by superficial differences which have little or no taxonomic value. This genus is an excellent example of taxonomic chaos.

Fortunately, the forms in the United States are, for the most part, in a relatively stable taxonomic condition. The major exception is that group of species which comprise the subgenus Myrmecotoma. We have but two species of Myrmecotoma in the desert and their separation presents no problems.

The remaining species are fairly easy to separate. The key includes C. papago Creighton, an arboreal species not known to occur in our area. Since it has been taken in Arizona near the Colorado River it seemed well to include it as a potential member of our fauna.

KEY TO SPECIES OF CAMPONOTUS

workers

- 1a. Head of major, in profile, evenly arched from clypeal apex to occiput, lower area not sharply contrastingly sculptured .. 2
- b. Head of major, in profile, obliquely truncate below, truncation marginate and involving most of clypeus and adjacent side of face, truncated portion vermiculate-rugose or reticulate, sharply contrasting with sculpture elsewhere on head papago Creighton
- 2a. Median lobe of clypeus with apical margin thickened, either transverse or slightly convex and irregularly eroded or subdentate (Figs. 210, 212, 218) 3
- b. Median lobe of clypeus thin, weakly convex and semicircularly depressed and incised in middle of apical margin (Figs. 214, 216) 7
- 3a. Malar area without erect hairs or with no more than two or three; apical margin of clypeus slightly convex, irregular; scape without erect hairs except a few near tip 4
- b. Malar area with 15+ erect hairs; median lobe of clypeus set off on each side by distinct angulation, its margin transverse, even; scape with scattered erect hairs (Fig. 210) festinatus (Buckley)

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- 4a. Hind tibia usually not contrastingly darker than femur; median carina of clypeus not terminating in blunt tooth; pronotum usually with at least ten erect hairs and node of petiole with five or six on each side; scape usually flattened at base 5
- b. Hind tibia blackish, contrasting with femur; median carina of clypeus ending in blunt tooth; pronotum with fewer than ten, often no, erect hairs and scale of petiole with no more than two or three, often no, erect hairs on each side; scape not flattened at base (Fig. 212) ocreatus Emery
- 5a. Base of scape flattened, at least slightly broader at base than immediately beyond; pubescence of second tergum usually shorter than distance between individual hairs 6
- b. Scape narrowest at base, weakly flattened (Fig. 220); discal pubescence of second tergum longer than distance between individual hairs vicinus Mayr
- 6a. Head of major, in frontal view, with margins distinctly convergent toward mandibular bases; scape with a small lateral lobule at base; apex of scape of major exceeding occipital corner by at least its apical breadth (Fig. 219)
 semitestaceus Emery
- b. Head of major quadrate, margins strongly convergent immediately above mandibular base; scape base broad, flattened, not lobulate; apex of scape of major exceeding occipital corner, if at all, by less than its apical breadth (Fig. 218)
 sansabeanus (Buckley)

- 7a. Metanotum, in profile, distinctly depressed below adjacent mesonotum and propodeum; outer face of mandible with round punctures, interspaces often polished; clypeus of major distinctly flattened and shiny (Figs. 213, 214) . . . hyatti Emery
- b. Metanotum, in profile, little, if any, depressed; outer face of mandible with elongate punctures, interspaces dull; clypeus of major convex, dull (Figs. 215, 216) . . . savi Emery

females

- 1a. Head, in profile, evenly arched from clypeal apex to occiput; lower portions not vermiculate-rugose or reticulose 2
- b. Head, in profile, obliquely truncate below, truncation marginate and involving most of clypeus and adjacent sides of face, vermiculate-rugose or reticulose . . . papago Creighton
- 2a. Median lobe of clypeus with apical margin thickened, either transverse or slightly convex and irregularly eroded or subdentate 3
- b. Median lobe of clypeus with apical margin thin, weakly convex and semicircularly depressed and incised in middle 7
- 3a. Malar area without erect hairs, or with fewer than three; apical margin of median lobe slightly convex, irregular 4
- b. Malar area with 6-15 erect hairs; median lobe angulate at sides, margin transverse; scape with scattered erect hairs festinatus (Buckley)

- 4a. Median carina of clypeus, if present, not terminating as a tooth; base of scape flattened; summit of petiolar scale usually entire; tibiae no darker than femora 5
- b. Median carina of clypeus ending as a distinct apical tooth; scape cylindrical at base; petiolar scale incised at summit; tibiae darker than femora ocreatus Emery
- 5a. Scape surpassing occipital corner by more than length of second antennomere; dorsum of head contiguously micropunctate, subgranulose, or finely and closely tessellate, punctures sparse fine and obscure; thoracic side slightly to moderately shiny, surface distinctly tessellate 6
- b. Scape surpassing occipital corner by less than length of second antennomere; dorsum of head moderately shiny, with sparse sharply defined small punctures and scattered coarse punctures; thoracic side shiny, surface weakly tessellate in most areas sansabeanus (Buckley)
- 6a. Scape base flattened, with small lateral lobule; dorsum of head finely, densely tessellate, usually not appearing granulose semitestaceus Emery
- b. Scape base flattened, without lobule; dorsum of head contiguously micropunctate, subgranulose vicinus Mayr
- 7a. Head and thorax reddish; ocelli large, IOD about 3 x OD, OOD no more than 4x OD savi Emery
- b. Head and thorax brownish; ocelli small, IOD at least 4.5 x OD, OOD about 6.5 x OD hyatti Emery

Camponotus festinatus (Buckley)

Figures 209-210, 222, 225

Formica festinatus Buckley, 1866:164: ♀ ♀.

Camponotus (Camponotus) fumidus pubicornis Emery, 1893:668,
670: ♀.

Camponotus fragilis Pergande, 1893:26: ♀.

Camponotus fumidus var. fragilis, Emery, 1895:336: ♀. Wheeler,
1910a:315: ♀.

Camponotus fumidus var. festinatus, Wheeler, 1902c:22: ♀.
Wheeler, 1910a:312-314: ♀.

Camponotus fumidus var. spurcus Wheeler, 1910a:315: ♀ ♀.

Camponotus fumidus subsp. festinatus, Creighton, 1950:376: ♀.

Camponotus (Tanaemyrmex) festinatus, Snelling, 1968:350-355:
figs. 1-3: ♀ ♀ ♂.

RANGE: Central Texas to southern California; adjacent Mexico.

DESERT RECORDS. San Bernardino Co.: 1 mi S Sunflower Spring,
3100', Old Woman Mts., 8 May 1965 (RRS; LACM); Twentynine Palms,
1855', 3 Aug 1933 (P. H. Timberlake; LACM). Riverside Co.: 7 mi S
Squaw Tank, JTNM, 20 Mar 1965 (E. L. Sleeper, S. L. Jenkins; LACM);
Thousand Palms Canyon, 21 June 1954 (W. A. McDonald; LACM); Palm
Springs, 475', 7 June 1946 (LACM); Indian Wells, 24 Mar 1938 (R.
D. Cowles; LACM); Indio, -22', Sept 1963 (H. T. Reynolds; LACM);
2 mi S Coachella, 0', 22 Feb 1963 (WSC; LACM); Valerie Jean's, 29
Jan 1962, 22 Feb 1963 (W. H. Ewart, C. H. Musgrove; LACM); Blythe,
266', various dates (L. A. Stange, R. M. Hardman; LACM); 1 mi E
Mecca, -190', 5 Nov 1978 (RRS & CDG, #78-155; LACM). Imperial Co.:
Niland, -124', 25 June 1962 (D. A. Killgore; LACM); Calipatria, -184'

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4. The fourth part of the report deals with the recommendations made for the future work.

5. The fifth part of the report deals with the summary of the work done during the year.

6. The sixth part of the report deals with the appendixes.

7. The seventh part of the report deals with the references.

8. The eighth part of the report deals with the index.

9. The ninth part of the report deals with the list of figures.

10. The tenth part of the report deals with the list of tables.

1-11 June 1962 (J. D. Tison; CDA); Brawley, -118', 11 June 1962 (Dr. A. Killgore; CDA); 3 mi E Imperial, -70', 4 May 1956 (RRS; LACM); El Centro, -45', various dates & collectors (CDA, LACM); 8 mi E Holtville, 22 June 1963 (R. L. Westcott; LACM); Calexico, 1', various dates and collectors (CDA, LACM); 0.5 mi S Seeley, 8 May 1970 (E. L. Paddock et al.; CDA); 3 mi N Glamis, 15-16 Sept 1972 (M. S. Wasbauer, A. R. Hardy; CDA); campgr., Picacho St. Recr. Area, 300', 6 May 1978 (RRS & CDG, #78-35; LACM); Bard, 150', 12 June 1962 (W. J. Akins; CDA); Winterhaven, 131', various dates & collectors (CDA, LACM). Map 7.

DISCUSSION. The yellow to pale brownish color of this ant render it one of the easily recognized species of Camponotus in the desert area. These desert populations differ rather substantially, especially in the distribution of erect hairs, from those of other areas of the Southwest. They may represent a hitherto undescribed species, but considerably more material must be studied before this is clear.

C. festinatus has been collected in California at elevations from -190 to 3100 feet. Habitats on record are variable and include Creosote Bush Scrub, Alkali Sink, Saltbush Scrub and Joshua Tree Woodland. In Arizona, it inhabits the higher desert plateaus, according to Cole (1934a), but our records from California, as well as many from Arizona, Sonora and Lower California, do not support this view.

This species, like most in the subgenus Tanaemyrmex, is one which nests in the ground. The nests commonly are situated beneath a covering object such as a log, stone or dried cow dung. Often,

too, the nests are associated with shrubby plants, such as Atriplex and Ambrosia, and they are situated among the root systems of the plant.

C. festinatus is a crepuscular/nocturnal species and the workers may be seen wandering about individually. The food habits are little known, but workers have been seen at night on Opuntia bigelovii at extrafloral glands. They have also been noted to pick up dead arthropods.

Males and females have been taken at light traps from June through September.

Camponotus hyatti Emery

Figures 213-214, 224

Camponotus hyatti Emery, 1893:680; pl.22 fig.25, 26: ♀. Wheeler, 1910a:345: ♀.

Camponotus (Myrmentoma) hyatti, Creighton, 1950:384, 387: ♀. Cole, 1966:19: ♀.

RANGE: southern Oregon and southwestern Idaho, south to southwestern Nevada and Baja California.

DESERT RECORDS. Inyo Co.: Lone Pine, 3700', 8 June 1973 (E. L. Paddock; CDA); Hunter Canyon, 2800', Inyo Mts., 2 Apr 1976 (DG; LACM). Map 7.

DISCUSSION. Our two records are clearly intrusions via the Great Basin Sagebrush Desert. Since these are "arboreal" ants in a habitat not noted for a high incidence of arboreal ants, they are understandably difficult to locate. This species has been found nesting in large stems of sagebrush (Artemisia).

1. The first part of the report deals with the general situation of the country and the results of the survey.

2. The second part of the report deals with the results of the survey in the different regions of the country.

3. The third part of the report deals with the results of the survey in the different sectors of the economy.

4. The fourth part of the report deals with the results of the survey in the different social groups.

5. The fifth part of the report deals with the results of the survey in the different administrative regions.

6. The sixth part of the report deals with the results of the survey in the different economic sectors.

7. The seventh part of the report deals with the results of the survey in the different social groups.

8. The eighth part of the report deals with the results of the survey in the different administrative regions.

9. The ninth part of the report deals with the results of the survey in the different economic sectors.

10. The tenth part of the report deals with the results of the survey in the different social groups.

11. The eleventh part of the report deals with the results of the survey in the different administrative regions.

12. The twelfth part of the report deals with the results of the survey in the different economic sectors.

13. The thirteenth part of the report deals with the results of the survey in the different social groups.

The peculiar structure of the clypeus and the profile are definitive for this ant. Unlike C. sayi, another desert member of the same subgenus, C. hyatti has the head and thorax distinctly brownish, rather than clear red. Thus, the two are easily separated in the field.

Camponotus ocreatus Emery

Figures 211-212

Camponotus maculatus subsp. ocreatus Emery, 1893:637: ♀
Wheeler, 1910a:309: ♀.

Camponotus ocreatus, Wheeler, 1917:561.

Camponotus acutirostris subsp. primipilaris Wheeler, 1910a:
319: ♀.

Camponotus ocreatus subsp. primipilaris, Wheeler, 1917:562.

Camponotus (Tanaemyrmex) ocreatus, Creighton, 1950:374, 378:
♀. Cole, 1966:19, 20: ♀. Wheeler & Wheeler, 1973:111: ♀.

RANGE: Desert mountains, southern California to New Mexico,
south to Baja California, Sonora and Chihuahua.

DESERT RECORDS. Inyo Co.: Panamint Mts., 19 Apr 1891 (co-
type; LACM). San Bernardino Co.: nr. Piute Springs, 3000', Piute
Range, 1 Oct 1978 (RRS, #78-109; LACM); Keystone Canyon, New York
Mts., 21 Apr 1977 (J. Doyen; UCB); New York Mts., 23 Sept 1940
(C. Henne; LACM); nr. Sunflower Springs, 3100', Old Woman Mts.,
22 May 1965 (RRS; LACM); Pisgah Crater, 12 Apr 1961 (Norris &
Heath; LACM); Willis Well, Ord Mts., 10 Nov. 1937 (E. Jaeger; LACM);
Morongo Valley, 2500'-2600', various dates & collectors (UCD, LACM).
Riverside Co.: Bell's Camp, JTNM, 9 July 1959 (F. C. Raney; UCD);

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Palm Springs, 475', 5 Apr 1925 (A. C. Cole; LACM); Palm Canyon, 3 Apr 1925 (P. H. Timberlake; LACM). San Diego Co.: Anza-Borrego State Park, 10 Dec. 1953 (LACM). Map 7.

DISCUSSION. This rather large species cannot be easily confused with any other of the Camponotus in the Mojave and Colorado Deserts. It seems always to have the head and thorax dark reddish brown with gaster blackish; the tibiae are always blackish, or at least conspicuously darker than the remainder of the legs.

This is an ant primarily of desert mountain ranges; within the hot desert it ranges in elevation from 475' to 4300'. However, it extends well into the Piñon-juniper Woodland at elevation up to about 6600 feet.

Nests are in soil, usually on rocky slopes and are most often located beneath stones. This is a crepuscular/nocturnal species, foraging individually. We have seen foragers on cholla (Opuntia bigelovii).

Camponotus papago Creighton

Camponotus (Colobopsis) cerberulus, Wheeler, 1934:214: ♀ only (misident.).

Camponotus (Colobopsis) papago Creighton, 1952:153-159: ♀ & ♂.

RANGE: Southern Arizona west to Yuma Co.; Sonora.

DESERT RECORDS. We have no records from our area, but since C. papago has been taken near Quartzsite, Arizona, there seems a good possibility it may occur in southeastern California.

Nests taken in Arizona were in stubs of broken off limbs of evergreen oaks and mesquite trees. Workers have never been seen foraging, but it is presumed they do so at night (Creighton, 1952b). Nuptial flights take place throughout July, alates attracted to lights.

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research.

2. The second part of the report is a detailed description of the methodology used in the study. It includes information about the sample, the data collection methods, and the statistical analysis.

3. The third part of the report is a discussion of the results of the study. It compares the findings with previous research and discusses the implications of the study.

4. The fourth part of the report is a conclusion and a list of references. The conclusion summarizes the main findings of the study, and the references list the sources of information used in the study.

5. The fifth part of the report is a list of appendices. These include additional data, tables, and figures that are not included in the main body of the report.

6. The sixth part of the report is a list of footnotes. These provide additional information about the study and the sources of information used in the study.

7. The seventh part of the report is a list of acknowledgments. These thank the individuals and organizations that provided support and assistance during the study.

Camponotus sansabeanus (Buckley)

Figures 217-218, 223

Formica sansabeana Buckley, 1866:167: ♀ ♀ ♂.

Camponotus maculatus subsp. maccooki var. sansabeanus Emery,
1893:672: ♀ ♀.

Camponotus maculatus subsp. sansabeanus, Wheeler, 1910a:307:
♀ ♀ ♂.

Camponotus maculatus subsp. bulimosus Wheeler, 1910a:308:

♀ ♂. NEW SYNONYMY.

Camponotus maculatus subsp. torrefactus Wheeler, 1910a:308:

♀ ♂. NEW SYNONYMY.

Camponotus (Tanaemyrmex) sansabeanus, Creighton, 1950:375,
378-379; pl. 50: ♀ ♀ ♂. Gregg, 1963:669-671; map: ♀. Wheeler &
Wheeler, 1973:110, 111: ♀.

Camponotus sansabeanus subsp. bulimosus, Creighton, 1950:375,
379: ♀.

Camponotus sansabeanus subsp. torrefactus, Creighton, 1950:
375, 379: ♀.

RANGE: Central Texas to southern California; Utah; southern
Colorado.

DESERT RECORDS. Inyo Co.: Charcoal Kilns, 6300', Panamint
Range, DVNM, 4 May 1968 (GJW, #Cal.439; GJW). San Bernardino Co.:
2.8 mi NW Desert Springs, 14 Mar 1955 (P. H. Timberlake; LACM).
Los Angeles Co.: 2 mi S Pearblossom, 3500', 7 May 1965 (RRS; LACM);
4 mi SE Pearblossom, 4300', 20 Mar 1966 (RRS; LACM). Riverside Co.:
Shaver's Well, 500', 7 Apr 1935 (LACM); Deep Canyon, 3400'-5500',
various dates (Wheeler & Wheeler, 1973:111). Map 7.

General Information (Continued)

1. Name: [illegible]

2. Date of Birth: [illegible]

3. Place of Birth: [illegible]

4. Date of Arrival: [illegible]

5. Date of Departure: [illegible]

6. Date of Return: [illegible]

7. Date of Re-entry: [illegible]

8. Date of Exit: [illegible]

9. Date of Entry: [illegible]

10. Date of Departure: [illegible]

11. Date of Return: [illegible]

12. Date of Re-entry: [illegible]

13. Date of Exit: [illegible]

14. Date of Entry: [illegible]

15. Date of Departure: [illegible]

16. Date of Return: [illegible]

17. Date of Re-entry: [illegible]

18. Date of Exit: [illegible]

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20. Date of Departure: [illegible]

21. Date of Return: [illegible]

22. Date of Re-entry: [illegible]

23. Date of Exit: [illegible]

24. Date of Entry: [illegible]

25. Date of Departure: [illegible]

DISCUSSION. As noted by Wheeler & Wheeler (1973) this species is quite variable. They found that their material was about equally divided between the nominate form and the color variant torrefactus. Much the same situation is true of samples from other areas as well. Long series of specimens from the mountains of southern Arizona and adjacent Mexico exhibit so much variation that these populations, the so-called subspecies bulimosus, cannot be satisfactorily separated from the nominate form. Many species in this group are extremely variable and local color forms may be quite striking, but intensive sampling of an area usually discloses that these forms are part of a continuously variable population. Such forms, once named, can only burden the systematist with more names and more problems, to little profit. At this point, I see no value to recognizing either bulimosus or torrefactus.

Since this ant and C. vicinus both have the base of the scape flattened, it is possible to confuse the two. Major workers are necessary, as a rule, before one can distinguish between them. In C. sansabeanus the scape is short, barely surpassing the occipital corner. The apex of the scape exceeds the occipital corner by more than the length of the second antennal segment in C. vicinus. The major of C. sansabeanus has a distinctly quadrate head which is usually broader than long and the margin, in frontal view, distinctly bowed. The head of major workers of C. vicinus is longer than broad, conspicuously narrowed toward the mandibular insertions through straight margins when seen in frontal view.

C. sansabeanus desert collections have been from elevations between 500 and 6300 feet, the latter in Piñon-juniper Woodland.

Nests may be under stones or at the base of a woody shrub. In addition to Pinon-juniper Woodland, we have records from Joshua Tree Woodland and Wash Woodland.

As with most of our other Camponotus, this species is primarily nocturnal and an omnivorous scavenger with a strong predilection for carbohydrates.

Reproductives have been found in nests in March and April.

Camponotus sayi Emery

Figures 215-216, 221

Camponotus sayi Emery, 1893:679: ♀. Wheeler, 1910a:343: ♀.

Camponotus sayi var. bicolor Pergande, 1894:161: ♀ ♀ ♂.

(preoccupied)

Camponotus fallax subsp. rasilis Wheeler, 1910b:227: ♀ ♀ ♂.

(in part)

Camponotus sayi californica Emery, 1925:118 (new name for C. sayi bicolor Perg.).

Camponotus (Myrmentoma) sayi, Creighton, 1950:390: ♀. Snelling, 1968:354-358: ♀ (in part).

RANGE: Utah and Arizona to southeastern California, south to Cape Region of Lower California.

DESERT RECORDS. Los Angeles Co.: Lovejoy Buttes, 15 Apr 1946 (L. M. Martin; LACM). San Bernardino Co.: Victorville, 2715', Oct 1972 (LACM). Riverside Co.: Indian Wells, 1 Apr 1938 (R. B. Cowles; LACM); Blythe, various dates & collectors (CDA, LACM, UCD). Imperial Co.: Calipatria, -182', 2 Aug. 1962 (R. S. Deal; LACM); Imperial, -60', 19 Oct 1959 (C. R. Waegner; CDA); El Centro, -45', 25 Aug & 11 Sept 1959 (C. R. Waegner; CDA); Calexico, 1', various dates & collectors (CDA, LACM); Bsd, 150', 17 Mar 1964 (G. Beever & J.

Johnson; CDA) & 9 Aug 1961 (R. Maxwell; LACM). San Diego Co.:
Borrego Valley, 20 Jan 1949 (R. Harper; CDA). Map 7.

DISCUSSION. The clear red head and thorax and black gaster, together with the notched clypeal apex, are sufficient for recognition of this species. The only other species in our area with a notched clypeus is C. hvatti, which is quite different in color and with a very different thoracic profile.

As with most other species of subgenus Myrmentoma, C. sayi nests in wood, usually dead limbs of cottonwood, willow, desert willow, mesquite, etc. Apparently the ant rarely excavates its own galleries but utilizes old galleries of termites or wood-boring beetles. We have collections from "under Chilopsis bark" and "in date palms".

Elevation range in our area is from -182 to 2715 feet in Saltbush Scrub, Wash Woodlands and Alkali Sink.

Camponotus semitestaceus Emery

Figures 4, 219

Camponotus maculatus subsp. vicinus var. semitestaceus Emery, 1893:672: ♀. Wheeler, 1910a:304: ♀.

Camponotus maculatus subsp. maccooki, Emery, 1893:672: ♀ (in part). Wheeler, 1910a:306: ♀ ♂. (in part)

Camponotus (Tanaemyrmex) maccooki, Creighton, 1950:374, 377-378: ♀ (in part).

Camponotus (Tanaemyrmex) semitestaceus, Snelling, 1970:390-397; fig. 1B, 1E, 2C: ♀ ♂. Wheeler & Wheeler, 1973:111, 112-113; figs. 40, 41: ♀.

RANGE: Washington and Idaho south to Baja California. NOTE: the range given by Wheeler & Wheeler (1973:113) is evidently incorrect; no material has been seen from Oklahoma and Texas, and these records may be based on C. sansabeanus.

DESERT RECORDS. Marginal in our area: 24 records. Map 7.

DISCUSSION. This common ant is usually associated with chaparral and Pinon-juniper habitats, but follows stream courses into true desert areas. In earlier literature, this is the ant commonly known as C. maccooki. That name, however, belongs to a quite different species. There has also been much confusion with C. dumentorum, a very distinct species which Creighton(1950) treated as a synonym of C. "maccooki" (i. e., C. semitestaceus); for fuller discussion, see Snelling (1970).

Among the species in our area, C. semitestaceus can be confused with C. sansabeanus and C. vicinus. In both of these species the base of the scape is flattened, but it is not broadened to form a weak lobule. The only other superficially similar form is C. ocreatus, but that species has the base of the scape cylindrical.

Our desert collections, between 550 and 5400 feet, are from Sagebrush Scrub and Joshua Tree Woodland.

Nests are often under stones or at the base of shrubs such as Artemisia, Eriogonum and Chrysothamnus.

Our records reflect the fondness of this ant for carbohydrates. We have found foragers associated with aphids on roots of Gutierrezia microcephala and at nectaries of Yucca whipplei and Eriogonum fasciculatum. Since they are omnivores, they occasionally manage to take prey (Fig. 314). This species is nocturnal.

Reproductive castes have been collected from nests in February, March and April. Mating flights in chaparral areas are in the spring months, following a rain.

Camponotus vicinus Mayr

Figure 220

Camponotus vicinus Mayr, 1870:940: ♀. Forel, 1879:60.

Camponotus maculatus subsp. vicinus, Emery, 1893:671: ♀ ♀.

Wheeler, 1910a:301: ♀ ♀ ♂.

Camponotus maculatus subsp. vicinus var. nitidiventris Emery, 1893:672: ♀. Wheeler, 1910a:304: ♀ ♂.

Camponotus maculatus subsp. vicinus var. infernalis Wheeler, 1910a:305: ♀ ♂.

Camponotus maculatus subsp. vicinus var. luteangulus Wheeler, 1910a:304: ♀ ♂.

Camponotus maculatus subsp. vicinus var. maritimus Wheeler, 1910a:305: ♀ ♀ ♂.

Camponotus maculatus subsp. vicinus var. plorabilis Wheeler, 1910a:303: ♀ ♀ ♂.

Camponotus maculatus subsp. maccooki var. berkleyensis Forel, 1914b:619: ♀.

Camponotus maculatus subsp. vicinus var. subrostratus Forel, 1914b:620: ♀.

Camponotus (Tanaemyrmex) vicinus, Creighton, 1950:375, 381-382: ♀. Gregg, 1963:655, 671-675; ♀. Wheeler & Wheeler, 1963:170-171; map 33: ♀ ♀ ♂. Cole, 1966:19, 20: ♀. Snelling, 1970:396: ♀. Wheeler & Wheeler, 1973:111, 113-114: ♀ ♀ ♂.

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RANGE: British Columbia, Alberta and southwestern North Dakota, southward to the central highlands of Mexico; Lower California.

DESERT RECORDS. Northern and western margins of Mojave and Colorado, from adjacent Sagebrush Scrub and Chaparral. Inyo Co.: Charcoal Kilns, 6300', DVNM, Panamint Range, 4 May 1968 (GJW, #Cal.442, 444; GJW). Kern Co.: 3 mi NW Indian Wells, 12 Apr 1954 (J. Linsley; UCB). Los Angeles Co.: Lovejoy Buttes, 15 Apr 1946 (L. M. Martin; LACM); Juniper Hills, 4800', 12 Apr 1952 (WSC; LACM); Palmdale, 2655', 1 May 1968 (J. Powell; UCB); Little Rock Dam, 3270', 30 Apr 1968 (J. Powell; UCB). Riverside Co.: Deep Canyon, 6 Apr 1963 (W. A. Steffan, D. E. Bright; UCB). San Diego Co.: Hell Hole Canyon, ABDP, 13 Apr 1946 (LACM). Map 7.

DISCUSSION. As should be evident from the above synonymic listing, this widely distributed species is quite variable. Creighton (1950) and Snelling (1970) have discussed the variation of this species and there is no need to repeat those comments here. Suffice to say merely that these forms are all minor variations which occur sporadically through the range of this species.

The flattened, but not broadened, base of the antennal scape will serve to separate this from the superficially similar C. semitestaceus. Differences between C. vicinus and C. sansabeanus have been discussed under the latter species. Since C. ocreatus occurs principally to the east of C. vicinus, in our area, there should be no difficulties involved, but C. ocreatus is easily recognized by clypeal structure and the color of the tibiae.

Cole

Within the desert area, C. vicinus has been taken at elevations between 2655 and 6300 feet. More common in Sagebrush Scrub and Piñon-juniper Woodlands, we do have records from Joshua Tree Woodland and Creosote Bush Scrub.

In the Chaparral biome, where the species is common, mating flights occur during the spring, especially after rains. No mating flights have been observed in desert areas, but a deflated female has been taken on the ground in April and males have been found in nests in the same month.

Nests are in soil as a rule, commonly situated at the base of a shrub or under a stone. Tumuli are messy mounds of soil or very irregular craters.

Foraging is primarily crepuscular and nocturnal. Although the ant is an omnivore, it is especially fond of nectar and honeydew which it secures from plants and various homopterans.

Genus PARATRECHINA Motschulsky

Paratrechina is a moderate-sized genus of ants with a characteristic habitus. Especially unusual are the long, stout, usually dark brown, somewhat flattened bristles of the head and body. Most of the species are tropical, but many have been transported by commerce to various parts of the world where they have become established. Especially notorious among these tramp species is P. longicornis, the "crazy ant."

In this report we are using Paratrechina in its broad sense to include those species traditionally placed in the subgenus or genus Nylanderia. The differences between Nylanderia and Paratrechina s. str. are so slight that there is really no justification for using Nylanderia as a subgenus, certainly not as a genus.

Taxonomically, Paratrechina is a group to inspire nightmares! Few of the species have ever been adequately described. Even more rare are studies of the variation within any of these species, many of which seem to be quite variable. Finally, we are faced with the vexing problem of dealing with inadequately known and poorly described species which have assigned to them a plethora of subspecies and varieties, also very inadequately described. Often these are based on one or a few specimens from localities where they may well not be native.

There are several distinct forms in the desert area of this project. One is P. longicornis. Another is unusually distinct, apparently native, and apparently undescribed. The third form is problematic, for it belongs to that multitude of superficially

similar forms which has made this genus such an unwieldy mess. For the present there is no way to determine what name, if any, may be applied to this form.

KEY TO SPECIES OF PARATRECHINA

workers only

- 1a. Antennal scape less than twice as long as head; body without violaceous reflections 2
- b. Antennal scape at least twice as long as head (Fig. 226, 227); body with conspicuous violaceous reflections
. longicornis (Latreille)
- 2a. Pronotum with 3-6 coarse, brown, erect setae on each side (Fig. 230); pubescence of antennal scape short, fine, usually appressed; SL about 1.1 x HL; PW about 1.6 x PL . . species A
- b. Pronotum with 8-10 coarse, brown, erect setae on each side (Fig. 228); pubescence of antennal scape long, coarse, subdecumbent to suberect; SL about 1.3 x HL; PW about 1.2 x PL
. species B

Paratrechina longicornis (Latreille)

Figures 226-227

Formica longicornis Latreille, 1802:113: ♀.

Formica vagans Jerdon, 1851:124: ♀.

Formica gracilescens Nylander, 1856:73; pl.3 fig.20: ♀.

Tapinoma gracilescens, F. Smith, 1858:56.

Paratrechina currens Motschulsky, 1863:14: ♀.

Prenolepis longicornis, Roger, 1863b:10. Mayr, 1865:50: ♀.

Mayr, 1867:72: ♀ ♀. E. Andre, 1882:203: ♀ ♀ ♂. Forel, 1891:81;

pl.2 fig.8: ♀. Forel, 1894:406: ♀ ♂. Bingham, 1903:326: ♀ ♀ ♂.

Arnold, 1922:605; pl.9 fig.133: ♀ ♀ ♂.

Prenolepis (Nylanderia) longicornis, Emery, 1910:129; figs.

2, 3: ♀ ♀ ♂. Emery, 1914:422 (note); ♀.

Paratrechina (Paratrechina) longicornis, Creighton, 1950:404,

405: ♀. M. Smith, 1965:74-76; fig. 41: ♀. Wilson & Taylor, 1967:

87; fig. 72: ♀.

RANGE: Tropicopolitan pest species. In the United States:

"Florida to South Carolina and west to Texas and sporadically in residences, warehouses and greenhouses over much of the eastern United States" (Creighton, 1950). In California, sporadically from Los Angeles to San Diego; Imperial Valley.

DESERT RECORDS. Riverside Co.: Indio, no date (A. J.

Basinger; LACM). Imperial Co.: El Centro, 15 Sept 1969 (R. A.

Flock; CDA, #69I19-6). Map 7.

DISCUSSION. The brown body with bluish iridescence and the long scape and legs will readily identify this ant. Although widely dispersed by commerce and now well established in many areas

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we have no evidence that it is firmly established in the desert areas. If it is successful, it will be limited to urban areas where it could become a household and garden pest somewhat similar to the Argentine ant, Iridomyrmex humilis.

Colonies may be very populous. Nests may be in plant and tree cavities, rotten wood, under objects in soil and in refuse or trash.

Workers are omnivorous foragers, gathering seeds, honeydew from aphids, mealybugs and scales, plant exudates, fruit juices, live and dead insects and household foods. They are also known to attack larvae of the rat flea, Xenopsylla cheopis, and of various fly species. The biology and economic importance of P. longicornis are discussed by M. Smith (1965).

Paratrechina species A

Figures 230-231

RANGE: Southern Arizona to southeastern California.

DESERT RECORDS. San Bernardino Co.: 10.5 mi NE El Cerrito, 375', 2 Apr 1969 (RRS; LACM). Riverside Co.: Palo Verde, 25 Jan 1955 (R. H. Crandall; LACM). Imperial Co.: Brawley, 15 July 1959 (E. I. Schlinger; LACM); same locality, 26 June-12 Oct 1964 (R. A. Flock; CDA); El Centro, 21 May 1956 (RRS; LACM); Calexico, 15 Oct 1958 (E. I. Schlinger; LACM). Map 7.

DISCUSSION. This will run to P. melanderi Wheeler in Creighton's (1950) key and is evidently near that species. The western form is larger, darker and less shiny than the P. melanderi cotypes from Texas and there are more erect setae on head and thorax. The female is considerably larger than that of P. melanderi and the

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eyes are larger. These western specimens are, however, very similar to specimens from Tennessee determined by Creighton as P. melanderi, evidently incorrectly. The current concept of P. melanderi probably includes at least two species.

Most of our records are from now cultivated regions once Salt-bush Scrub. Other habitats include Alkali Sink and Wash Woodland, and elevations range from -113 to 375 feet. Several of these records are from tomato and alfalfa fields. The El Centro specimens, including males and females, were from soil under a brick.

Paratrechina species B

RANGE: Southeastern California.

DESERT RECORDS. Inyo Co.: 3/4 mi N, 3/4 mi W Badwater Springs, 2200', 15 June 1976 (DG; LACM); nr. Grapevine Ranger Sta., 2100', DVNM, 4 Mar 1968 (GJW, #Cal.816; GJW); Artists Drive, DVNM, 4 Nov 1967 (RRS; LACM). Riverside Co.: Pushawalla Palms, 6 Dec 1967 (GJW, #Cal.272; GJW). Map 7.

DISCUSSION. Only the few samples cited above for this species are known. The long scape, abundant erect setae and the head shape (Fig. 229) are distinctive. It is not at all like any species known to us and certainly is undescribed. In considering the localities at which the ant has been collected, it seems highly improbable that this is adventive from another area.

Genus MYRMECOCYSTUS Wesmael

With 18 species known to occur in our area, Myrmecocystus must rank as one of the important ant genera in the deserts. Only Pogonomyrmex (9 species) and Pheidole (12 species) are comparably important. Although the number of species recorded here is high, only 12 of these are true xerophiles and two of those are marginal from deserts outside our area.

The taxonomy of this genus, which is restricted to western North America, is now fairly stable. The genus was revised by Snelling (1976). Some taxonomic difficulties are yet to be fully resolved, but do not involve any of our species. The genus is divided into three subgenera. The species of these subgenera have characteristic "gestalts" and the temporal foraging activities are different.

KEY TO SPECIES OF MYRMECOCYSTUS

workers

- 1a. Integument light yellow or brownish yellow; mandible 8-10 toothed; eye large, EL distinctly exceeding length of second antennomere; ocelli absent or much reduced; nocturnal (Myrmecocystus s. str.) 2
- b. Integument (a) bicolored, head and thorax ferruginous, gaster blackish; (b) unicolorous ferruginous or orange; or (c) unicolorous blackish or dark brown; mandible 6- or 7-toothed; eye small, EL less than to slightly more than length of second antennomere; ocelli usually distinct; diurnal, matinal or crepuscular 5

- 2a. Dorsal surface of propodeum flat or evenly convex, often abundantly hairy; upper eye margin usually well below upper margin of head 3
- b. Dorsal surface of propodeum strongly, angularly projecting upward on posterior two-thirds; erect hairs very sparse, few on outer face of hind tibia; upper eye margin little below upper margin of head (Fig. 232-233) ewarti Snelling
- 3a. Head, pronotum and gaster with abundant appressed pubescence; mid and hind tibiae usually with numerous erect hairs along apical half of outer face; if metanotal suture impressed, HL exceeds 1.3 mm 4
- b. Head, pronotum and gaster with little or no appressed pubescence; mid and hind tibiae with fewer than 5 erect hairs beyond basal third of outer face, usually none; metanotal suture deeply impressed and dorsal face of propodeum convex (Fig. 235) navajo Wheeler
- 4a. Large, polymorphic species, HL 1.0-2.0 or more, usually in excess of 1.3; metanotal suture usually impressed and propodeum as long as high or longer, juncture of dorsal and posterior faces broadly rounded (Fig. 237) mexicanus Wesmael
- b. Smaller, weakly polymorphic, HL 0.8-1.4 mm; metanotal suture not impressed, propodeum higher than long, juncture of basal and posterior faces abruptly rounded, often subangulate (Fig. 239) testaceus Emery

- 5a. Small, HL not exceeding 1.26 mm; uniformly blackish or dark brown; erect hairs much reduced on head and thorax, pubescence sparse on head; crepuscular or matinal (subg. Eremnocystus) 6
- b. Larger, HL exceeding 0.83 mm, usually over 1.3; bicolored or ferruginous; usually abundantly hairy, erect hairs numerous on head and thorax, appressed pubescence usually dense on third tergum; diurnal (subg. Endiodiocytes) 10
- 6a. Antennal scape and dorsum of propodeum without fully erect hairs (Figs. 243, 245) 7
- b. Antennal scape usually and dorsum of propodeum always with fully erect hairs (Figs. 247, 249, 251) 8
- 7a. Pronotum, mesonotum with at least 8 fully erect hairs (Fig. 243); petiolar scale compressed in profile, crest usually distinctly notched lugubris Wheeler
- b. Pronotum, mesonotum with no more than two fully erect hairs (Fig. 245); petiolar scale not notably compressed, crest flat or slightly concave, not notched creightoni Snelling
- 8a. Scape with conspicuous erect or suberect hairs; femora and tibiae with abundant erect hairs, some on dorsal femoral surface; petiolar scale variable, often compressed & notched . 9
- b. Scape without erect hairs; femora and tibiae with few erect hairs, none on femoral dorsum; petiolar scale thick in profile, crest flat or slightly convex yuma Wheeler

- 9a. Appressed pubescence abundant on frons and third tergum; petiolar scale thick at level of spiracle (Fig. 249), crest flat or concave, viewed from rear colei Snelling
- b. Appressed pubescence sparse on frons and third tergum; sparser on second than first; petiolar scale thin (Fig. 251), crest notched, viewed from rear tenuinodis Snelling
- 10a. Abundantly hairy: 20+ erect hairs on malar area in frontal view (Fig. 253); scape, femora and tibiae with numerous erect hairs on all surfaces; first three or four terga with dense pubescence; HW of major usually over 1.7 mm 11
- b. Less hair: fewer than 20 erect hairs on malar area, usually less than 6 (Figs. 254, 255); scape and femora often sparsely hairy; third tergum often sparsely pubescent; HW of major less than 1.7 mm 12
- 11a. Longest hairs on pronotal dorsum and disc of second tergum no more than 0.5 x MOD, usually less; femora ferruginous; head and thorax clear ferruginous semirufus Emery
- b. Longest hairs on pronotal dorsum and disc of second tergum at least 0.6 x MOD, usually about 0.75; femora usually dark brownish; head and thorax usually heavily infuscated mendax Wheeler
- 12a. Malar area with six or more erect hairs evenly distributed between eye and mandible (Fig. 255, 258) 13
- b. Malar area with no more than four erect hairs, confined to lower half, near mandible (Figs. 254, 257, 259) 17

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- 13a. Fourth tergum conspicuously pubescent in specimens with PW over 1.0 mm; erect hairs present over at least half of distance between inner eye margin and antennal socket; punctures of frontal lobes and frons of variable size and irregularly distributed semirufus Emery
- b. Fourth tergum with pubescence widely scattered; erect hairs only adjacent to inner eye margin; punctures of frontal lobes and frons uniformly minute and evenly distributed .. 14
- 14a. Gaster uniformly black, shiny 15
- b. Gaster mostly ferruginous, or basal half of first segment at least half yellowish 16
- 15a. Longest pronotal hairs more than 0.5 x MOD; malar area usually with 12-16 erect hairs; vertex usually conspicuously, though finely, punctate laterad romainei Cole
- b. Longest pronotal hairs less than 0.5 x MOD; malar area usually with fewer than 12 erect hairs; vertex without obvious punctures at sides flaviceps Wheeler
- 16a. Frontal lobes and frons finely, closely and uniformly punctate; mandible 7-toothed; gaster usually wholly orange-ferruginous wheeleri Snelling
- b. Frontal lobes and frons finely and very irregularly punctate; mandible 7- or 8-toothed; gaster usually with yellowish on first two segments only kathjuli Snelling

- 17a. Third tergum with little or no pubescence 18
- b. Third tergum densely pubescent flaviceps Wheeler
- 18a. Pubescence very sparse on face; head often subpolished and shiny, side of head of large worker often convex; head, thorax and legs brownish mimicus Wheeler
- b. Pubescence abundant on face; head usually distinctly tessellate not notably shiny; side of head straight in frontal view, except in largest workers; head, thorax and legs ferruginous kennedvi Cole

females

- 1a. Integument light yellow or brownish yellow; mandible 8- or 9-toothed; wing membrane without short, erect hairs, marginal fringe present or absent (Myrmecocystus s. str.) 2
- b. Integument red and black or wholly blackish; mandible 7-toothed; wings various 5
- 2a. Penultimate segment of maxillary palp broadest in middle, narrowed basally and apically (Fig. 260); hind femur without erect hairs dorsally; hairs of hind tibia reclinate, not fully erect 3
- b. Penultimate segment of maxillary palp broadest well basad of middle, gradually narrowed toward apex or parallel-sided; hind femur with erect hairs dorsally; hind tibiae with abundant fully erect and suberect hairs 4

- 7a. Punctures of side of clypeus subcontiguous, very coarse, distinctly coarser than those of upper half of mesopleura; occiput shiny, polished, with scattered fine punctures; mid and hind femora without fully erect hairs except a few along lower side creightoni Snelling
- b. Punctures of side of clypeus distinctly separated, no coarser than those of upper half of mesopleura; occiput slightly shiny, densely tessellate, with fine obscure punctures; mid and hind femora with conspicuous fully erect hairs on all surfaces colei Snelling
- 8a. Fourth segment of maxillary palp not clavate, about as broad in basal third as in apical third; parapsis with punctures uniform in size and spacing (about as in Fig. 264) yuma Wheeler
- b. Fourth segment of maxillary palp clavate, conspicuously broader at apex than at base; parapsis sparsely punctate, punctures irregular in size and spacing, but mostly separated by two or more puncture diameters tenuinodis Snelling
- 9a. Penultimate segment of maxillary palp more than twice wider in basal third as at apex (Fig. 261), other segments very broad; gaster ferruginous 10
- b. Penultimate segment of maxillary palp slender, more or less parallel-sided, never more than 1.5 x wider in basal third than at apex, remaining segments slender; gaster blackish or dark brownish 11

- 3a. Antennal scape with abundant fully erect, coarse hairs; OOD
2 x OD; ocelli large, OD greater than 0.15 mm. navajo Wheeler
- b. Antennal scape with fine reclinate hairs; OOD 3 x OD; ocelli
normal, OD less than 0.12 mm ewarti Snelling
- 4a. Thorax and gaster brown, legs usually yellowish; HW usually
less than 1.85 mm; penultimate segment of maxillary palp
slender, parallel-sided testaceus Emery
- b. Thorax and gaster light brownish yellow, legs concolorous with
thorax; HW 1.90 mm or more, usually more than 2.0 mm; penul-
timate segment of maxillary palp distinctly broader basally
. mexicanus Wesmael
- 5a. Integument uniformly blackish or dark brown; HL not over 1.46
mm and usually less than 1.40; wing membrane with short, erect
white hairs (subg. Eremnocyclus) 6
- b. Integument of head and thorax largely ferruginous, gaster
usually blackish; HL exceeding 1.46 mm, usually more than 1.5
wing membrane without erect white hairs (subg. Endiodiocetes)
. 9
- 6a. Mesoscutum finely, densely and uniformly punctate 7
- b. Mesoscutal punctation irregular, punctures often of two sizes,
with large median impunctate area or with widely scattered
punctures or disc impunctate except along midline 8

- 10a. Punctures of frontal lobes separated by a diameter or more;
middle of scutellum punctate, punctures 1 to 2 diameters
apart; longest scutal hairs exceeding EL .. kathjuli Snelling
- b. Punctures of frontal lobes separated by less than a diameter;
middle of scutellum impunctate to very sparsely punctate,
punctures 3 to 5 diameters apart; longest scutal hairs less
than EL wheeleri Snelling
- 11a. Middle area of first two terga very sparsely punctate . . . 12
- b. Middle area of first two terga densely micropunctate . . . 13
- 12a. Middle area of third and fourth terga nearly impunctate; scu-
tellum sparsely punctate; HW less than 1.9 mm
. flaviceps Wheeler
- b. Middle area of third and fourth terga densely micropunctate;
scutellum closely micropunctate; HW 2.0 mm or more
. semirufus Emery
- 13a. Punctures of parapsis of two sizes and variably spaced, never
uniformly dense (Fig. 263); malar area usually with few or
no standing hairs; HW usually less than 1.9 mm 14
- b. Punctures of parapsis close, uniform (Fig. 264); malar area
with abundant standing hairs; HW may exceed 2.0 mm 15

- 14a. Face, between eye and frontal lobe, with punctures irregularly distributed, with large impunctate areas; vertex usually with sparsely punctate areas between ocellus and eye mimicus Wheeler
- b. Face, between eye and frontal lobe, uniformly punctate; vertex with evenly spaced punctures between eye and ocelli kennedyi Cole
- 15a. Small, HW less than 1.9 mm; malar area with 10 or fewer hairs; disc of mesoscutum finely, sparsely punctate, usually broadly impunctate in center (Fig. 264) romainei Cole
- b. Larger, HW more than 2.0 mm; malar area with at least 15 erect hairs; mesoscutal disc closely, coarsely punctate, sometimes impunctate anteromedially mendax Wheeler

males

- 1a. Wing membrane without short, erect white hairs; mandible with or without denticles basad of apical tooth; aedeagus with or without setae; HL over 0.66 mm 2
- b. Wing membrane with short, erect white hairs; mandible without denticles basad of apical tooth; aedeagus without fine setae on sides; HL always less than 0.75 mm
- subg. Eremnocystus, NOT KEYED FURTHER

- 2a. Aedeagus without fine setae on sides; mandible almost always with two, sometimes three or four, distinct denticles basad of apical tooth; integument light to medium brownish to unaided eye (Myrmecocustus s. str.) 3
- b. Aedeagus with at least a few fine setae on sides (Fig. 265); mandible usually with no denticles basad of apical tooth, rarely one or two present; integument blackish to unaided eye (subg. Endiodictes) 6
- 3a. Scape always and tibiae usually with standing hairs; posterior margin of hind wing with or without fringe hairs; HL 0.80 mm or more 4
- b. Scape and tibiae without standing hairs; hind wing with fringe hairs along posterior margin; HL 0.66-0.76 mm
 ewarti Snelling
- 4a. Occipital hairs shorter than maximum diameter of lateral ocelli; posterior and/or apical margin of hind wing with at least a few long fringe hairs 5
- b. Many occipital hairs longer than maximum diameter of lateral ocelli; hind wing without fringe hairs testaceus Emery
- 5a. Small, HL less than 0.85 mm; scape with scattered erect hairs; tibiae with numerous decumbent hairs; apical margin of forewing without fringe hairs navajo Wheeler
- b. Larger, HL 0.90 mm or more; scape and tibiae with abundant erect and suberect hairs; apical margin of forewing with e vestiges of fringe mexicanus Wesmael

- 6a. Lower margin of ventral lobe of aedeagus strongly convex in profile, teeth fine (Fig. 265) 7
- b. Lower margin of ventral lobe of aedeagus concave or straight in profile, teeth coarse (Fig. 266) wheeleri Snelling
- 7a. Disc of second tergum moderately to slightly shiny, uniformly micropunctate and pubescent, first and third terga usually similar; mesoscutum dull, densely and uniformly tessellate . 8
- b. Discs of first two or three terga polished, impunctate and apubescent, at least in middle; mesoscutum wholly, or in part, polished and shiny 10
- 8a. Posterior margin of hind wing with fringe hairs along basal half; if less, longest occipital hairs less than 0.5 x MOD; HW often less than 0.90 mm 9
- b. Posterior margin of hind wing without fringe hairs; longest occipital hairs at least 0.6, usually 0.75 or more, x MOD; HW over 0.90 mm mendax Wheeler
- 9a. Longest occipital and mesoscutal hairs exceeding MOD; frontal lobes shiny; side of dorsum of first tergum smooth, shiny, with scattered coarse punctures; HW 0.80-0.87 mm
. kathjuli Snelling
- b. Occipital and mesoscutal hairs usually less than 0.5 X MOD; frontal lobes dull; dorsum of first tergum uniformly densely micropunctate; HW 0.83-0.97 mm semirufus Emery

- 10a. Posterior margin of hind wing with fringe hairs 11
b. Posterior margin of hind wing without fringe hairs
. kennedyi Cole
- 11a. First tergum largely apubescent, second and third with numerous appressed hairs over larger area than median, apubescent area flaviceps Wheeler
b. First three terga without conspicuous appressed pubescence or with apubescent median areas of first and second segments much larger than latera, pubescent areas
. mimicus Wheeler and romainei Cole

NOTE: Females are unknown for M. lugubris. Males are unknown for M. lugubris, M. tenuinodis and M. yuma; these males all are in subgenus Eremnocystus, and no attempt has been made to key males in this subgenus.

Myrmecocystus colei Snelling

Figures 248-249

Myrmecocystus (Eremnocystus) colei Snelling, 1976:94-97; figs. 203-211, 253-258; ♀ ♂.

RANGE: Southern California coastal valleys; western Mojave Desert.

DESERT RECORDS. Los Angeles Co.: Hwy. 138, 2700', 12.2 mi W jct Hwy 14, 15 Sept 1978 (RRS & CDG, #78-60, 61, 62; LACM). Map 9.

DISCUSSION. The samples which we collected are a little less pilose than those from the coastal valleys. The significance of this reduced pilosity cannot be determined until males and females

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from this population become available.

This species is primarily known from semiarid valleys and canyons of the coastal area, inland to Cajon Canyon. It occurs in Coastal Sagebrush Scrub up to areas where this intergrades with oak-juniper-Joshua tree associations. Our collections were from a sandy wash heavily populated with Salsola iberica. A grassland of gently rolling terrain surrounded the wash. The nest was inconspicuous, a mere hole in the ground.

Foragers are diurnal scavenger-predators, but also collect nectar from flowers (Snelling, 1976).

Myrmecocystus creightoni Snelling

Figures 244-245

Myrmecocystus lugubris, Wheeler & Wheeler, 1968:213 (larva, misident.).

Myrmecocystus creightoni Snelling, 1971:6-11: ♀ ♂. Wheeler & Wheeler, 1973:120: ♀ ♀ ♂.

Myrmecocystus (Eremnocystus) creightoni, Snelling, 1976:93, 94, 98-101; figs. 212-220, 259-262: ♀ ♀ ♂.

RANGE: Mountain ranges along western margin of Mojave Desert.

DESERT RECORDS. Kern Co.: Freeman Jct., 3100', 3 May 1952 (WSC; LACM); Lonetree Cyn., 6.8 mi S jct Randsburg Rd & Hwy 14, 15 June 1970 (M. Wasbauer; CDA); Short Cyn., 3500', 3 Nov 1967 (RRS, #67-270; LACM). Los Angeles Co.: 2 mi S Pearblossom, 3500', 2 Mar 1966 (RRS; LACM); 4 mi SE Pearblossom, 4300', 20 Mar 1966 (RRS; LACM); 6 mi SE Pearblossom, 3500', 16 Mar 1972 (RRS, #72-8; LACM). San Bernardino Co.: 7 mi SE Joshua Tree, 7 Sept 1967 (R. J.

Hamton; LACM). Riverside Co.: Dos Palmas, 3700', 8 Mar 1970 (GJW, #Cal.854, 857; GJW); Black Hill, 3000', 9-11 Mar 1970 (GJW, #Cal. 863, 868, 871; GJW). Map 9.

DISCUSSION. This is one of the small, dark species, fairly common in the western Mojave. The characters in the key are sufficient for its recognition.

California desert records for M. creightoni are from elevations of 3000 to 4300 feet in Creosote Bush Scrub and Joshua Tree Woodland communities.

Small conical craters of sand surmount the minute entrance holes of this ant. Often the entrance will be under a small pebble or twig with little or no visible tumulus.

Foraging takes place in the afternoon during cooler months. During the warmer period of spring and summer foraging activity begins in the morning after daybreak when ST is about 13°C. Occasionally a worker will leave the nest to forage during the hotter periods of the day when surface temperatures may be as high as 49°C.

Nectar is gathered from local plants (Fig. 315) and aphids are solicited for honeydew. These ants also collect fragments of arthropods such as other ants, beetles, flies, homopterans and hemipterans. In addition, they utilize insect eggs and small fecal pellets.

Mating flights of M. creightoni occur in February and March.

Myrmecocystus ewarti Snelling

Figures 232-233.

Myrmecocystus ewarti Snelling, 1971:2-6: ♀ ♂. Wheeler & Wheeler, 1973:120; fig. 72: ♀.

Myrmecocystus (M.) ewarti, Snelling, 1976:115, 116, 129-132; figs. 290-298, 326, 327, 338, 339: ♀ ♂.

RANGE: Southwestern Nevada, southeastern California.

DESERT RECORDS. San Bernardino Co.: 23 mi S Needles, 475', 31 Jan 1967 (RRS; LACM); 44 mi E Twentynine Palms, 2 Oct 1963 (RRS; LACM). Riverside Co.: Deception Cyn., JTNM, 26 Jan 1967 (R. J. Hamton; LACM); Fan Hill, JTNM, 26 Jan 1967 (R. J. Hamton; LACM); 1.5 mi N Thousand Palms, 190', 5 Feb 1967 (RRS; LACM); Thousand Palms Rd & Dillon Rd. 16 Feb 1964 (W. H. Ewart; LACM); 3 mi W Shaver's Well, 1 & 8 Mar 1964 (RRS; LACM); Carrizo Cr. Cyn., 1100', 27 Feb & 20 Mar 1963 (W. H. Ewart; LACM); Deep Cyn., 800'-1000', numerous dates (GJW, 15 samples; GJW). Imperial Co.: 6 mi E Glamis, 925', 30 Mar 1967 (RRS; LACM). Map 9.

DISCUSSION. This small, pale species is closely related to M. pyramicus M. Smith, a species of the Great Basin Sagebrush Desert. Within our fauna it is easily recognized by the peculiar shape of the propodeal profile (Fig. 233).

The known elevational range for this species is from 190 to 1100 feet and it has been collected in Creosote Bush Scrub, Wash Woodlands, Cactus Scrub and Pinon-juniper Woodlands on stoney desert floors to sandy washes.

Nests usually have craters which may measure 5-15 cm in diameter.

PROBATIONARY REPORT

Form No. 100-100

REPORT OF PROBATION OFFICER ON THE PROGRESS OF THE PROBATIONER

NAME OF PROBATIONER: _____

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Workers forage at night, collecting nectar from plants and honeydew from aphids. They also bring dead arthropods and their fragments back to the nest (Snelling, 1976).

Female reproductives have been found in the nest in January and March. Males were found in March. According to Wheeler & Wheeler (1973) pupae were found in Deep Canyon nests in late April.

Myrmecocystus flaviceps Wheeler

Figures 254, 262

Myrmecocystus melliger mimicus var. depilis, Wheeler, 1908b: 354 (in part).

Myrmecocystus yuma var. flaviceps Wheeler, 1913a:177: ♀.

Myrmecocystus flaviceps, Creighton, 1950:443. Wheeler & Wheeler, 1973:121-122; figs. 43-44: ♀ ♀ ♂.

Myrmecocystus (Endodiocetes) flaviceps, Snelling, 1976:28, 29, 30, 82-92; figs. 146-154, 166, 178, 201, 202: ♀ ♀ ♂.

RANGE: Southwestern Utah and southern Nevada to northern Sonora and southeastern California and northeastern Baja California.

DESERT RECORDS. General over Colorado and much of Mojave Deserts; 138 records. Map 8.

DISCUSSION. This is one of the most common ants in our deserts, ubiquitous in the Colorado Desert, but generally restricted to the eastern Mojave Desert. It is quite variable in color. Some populations have the head and thorax clear red and they can be confused with M. kennedyi. Others are heavily infuscated and look much like M. mimicus. In both of these species, however, the third tergum of the worker is shiny, with very sparse pubescence.

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M. flaviceps occurs at elevations as low as -250 feet (in Death Valley) and as high as 5325 feet in Joshua Tree National Monument. Nests most commonly are in stoney, gravelly soil, but may also be in finely textured alkaline soil and in areas with sand dunes or other fine sand. This species is found in Creosote Bush Scrub, Wash Woodlands, Cactus Scrub, Saltbush Scrub and Joshua tree Woodlands.

Although craters around nest entrances may be as large as 40 cm diameter, they are generally about 15 cm across. Refuse chambers may be located just beneath the surface around the entrance hole(s).

This species is diurnal and may be seen foraging as early as 0815 and as late as 1800. Foragers have been followed 23 m from the nest to food sources, but undoubtedly travel much further. Floral visits include nectaries and extrafloral nectaries of such desert plants as Euphorbia micromera, Encelia farinosa, Cercidium floridum, Hymenoclea salsola and Asclepias sp. Foragers have also been seen on Oenothera deltoides, Larrea tridentata, Prosopis glandulosa, Atriplex sp. and Croton californicus. Intercepted workers returning to the nest were found with the following: ants (Pogonomyrmex rugosus, P. imberbiculus, Pheidole desertorum, P. gilvescens, Solenopsis maniosa and Forelius foetidus); other Hymenoptera, Andrenidae, Sphecidae, Torymidae; larval Lepidoptera; fragmentary Coleoptera, Hemiptera and Homoptera.

Head capsules of M. flaviceps have been removed from fecal pellets of the lizard, Phrynosoma mcalli and they have been found in debris piles of the ant Forelius foetidus.

A mating flight was observed in February. Alate sexual forms of both castes have been found in nests in the months of January, February, March, April May, October, November and December. Thus, there are possibly two flight seasons, spring and fall.

Myrmecocystus kathjuli Snelling

Figure 256

Myrmecocystus (Endiodiocetes) kathjuli Snelling, 1976:28, 29, 59-62; figs. 92-99, 160, 172, 185, 193: ♀ ♂.

RANGE: Western Mojave Desert.

DESERT RECORDS. Kern Co.: Red Rock Cyn., 1 May 1971 (R. J. Hamton; LACM); Short Cyn., 3500', 3 Nov 1967 (RRS; LACM). San Bernardino Co.: Hodge, 14 Sept 1935 (P. H. Timberlake; LACM); Kramer Hills, 30 Mar 1963 (M. E. Irwin; UCD). Los Angeles Co.: Lancaster, 2355', 17 Aug 1954 (RRS; LACM) & 10 Mar 1957 (RRS & MDStage; LACM); Hwy 138, 12.2 mi W jct Hwy 14, 2700', 15 Sept 1978 (RRS & CDG, #78-59; LACM); Piute Butte, 12 May 1944 (P. H. Timberlake; LACM); Big Rock Wash, 2770', nr Palmdale Blvd., 31 Mar 1972 (J. P. & K. E. Donahue; LACM); 8 mi N Llano, 16 Apr 1962 (E. I. Schlinger, J. C. Hall; LACM); 2 mi S Pearblossom, 2500', 23 May 1977 (RRS & CDG, #77-31; LACM); 8 mi SE Pearblossom, 17 Aug 1978 (G. C. Duffy; LACM). Map 8.

DISCUSSION. This is a poorly known species allied to M. kennedyi and replacing it in the western Mojave. The long pronotal hairs and, usually, bicolored gaster are characteristic of M. kathjuli.

M. kathjuli has been collected in Creosote Bush Scrub-Joshua Tree Woodland ecotone, at elevations from 2355 to 3500 feet.

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Although according to Snelling (1976) nests are in deep sand of washes with a low, broad crateriform tumulus, we now have records of nests without tumuli and in situations other than washes.

These ants appear to be active from May to November, estimating the cooler months. When active, they forage diurnally at STs between 24°C and 49°C. The foragers are active scavengers and return to the nest with dead, whole or fragmentary, arthropods: spiders, true bugs and ant, such as Veromessor pergandei and Pogonomymex spp. In the fall, nectar is the predominant food taken and foragers have been observed on such plants as Eriogonum brachyanthum in very large numbers.

Dehated females have been collected in April and May.

The horned lizard, Phrynosoma coronatum, has been observed at nest entrance of M. kathjuli, taking workers as they emerged to forage.

Myrmecocystus kennedvi Cole

Figure 257

Myrmecocystus melliger subsp. semirufus, Wheeler, 1908:355 (in part). Wheeler, 1913:174 (in part). Cole, 1932: 536. Cole, 1934: 392, 402. Mallis, 1941:20. Cole, 1942:386 (all misident.).

Myrmecocystus melliger subsp. semirufus var. kennedvi Cole, 1936:119: ♀ ♀ ♂.

Myrmecocystus semirufa, Creighton, 1950:442, 449 (in part).

Myrmecocystus semirufus, Gregg, 1963:643, 653-655 (in part). LaRivers, 1968:9 (misident.). Wheeler & Wheeler, 1968:213 (misident.).

According to the 1975 census, the population of the area is 1,000.

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Myrmecocystus kennedyi, Snelling, 1969:6. Wheeler & Wheeler, 1973:122; fig. 45: ♀.

Myrmecocystus (Endiodiotes) kennedyi, Snelling, 1976:28, 29, 62-67; figs. 100-108, 161, 173, 184, 192: ♀ ♀ ♂.

RANGE: Southern Oregon and Idaho to northern Baja California and Sonora; western Utah and Arizona.

DESERT RECORDS. Eastern Mojave, entire Colorado Desert, at low elevations; 59 records. Map 8.

DISCUSSION. The clear red head and thorax with shiny black gaster, the third tergum apubescent or nearly so, are characteristic of this species. It is ubiquitous in the Colorado Desert at low elevations, but in the Mojave is restricted to those eastern portions which grade into the Colorado. Over its extensive distribution it inhabits a wide range of habitats. Thus, its rarity in the western Mojave seems anomalous, especially in view of its abundance in Great Basin Sagebrush Desert.

Over its extensive range, M. kennedyi inhabits such biomes as Great Basin Sagebrush Scrub, Creosote Bush Scrub, Wash Woodlands, sand dunes and Saltbush Scrub. It prefers well drained desert sands and nests are usually in exposed areas. Nests may have circular or semilunar craters which may be as much as 20 cm across. Within our area it has been taken at elevations between -190 and 3100'.

Workers are diurnal foragers and collect nectar from plants and honeydew from pseudococcids (Phenacoccus gossypii, Orthezia sp.), aphid and lycaenid larvae. They also take both live and dead arthropods.

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A mating flight was observed in mid-February following a rain. Males and alate females have been found in the nests in November.

Known vertebrate predators include the lizards, Phrynosoma mcalli, P. platyrhinos and Uma sp.

Myrmecocystus lugubris Wheeler

Figures 242-243

Myrmecocystus lugubris Wheeler, 1909:98: ♀. Wheeler, 1913: 176. Creighton, 1950:443: ♀. Creighton, 1956:1-4 (in part). Cole, 1966:21: ♀. LaRivers, 1968:9.

Myrmecocystus (Eremnocystus) lugubris, Snelling, 1976:104-106; figs. 230-233: ♀.

RANGE: Mojave Desert, California and southwestern Nevada.

DESERT RECORDS. Inyo Co.: Eureka Valley, various dates (DG et al.; CDA); dunes, 1150', Saline Valley, 29 May 1978 (A. V. Evans; LACM); Death Valley Wash, 2100', DVNM, 9 Mar 1968 (GJW, #Cal.331, 332; GJW); nr Grapevine Ranger Sta., 2500', DVNM, 25 Mar 1969 (GJW, #Cal.562; GJW); Mesquite Spring, 1600', DVNM, 3 Apr 1962 (WSC; LACM); Mesquite Spring, 1700', DVNM, 30 Apr 1968 (GJW, #Cal. 436; GJW); Stovepipe Well, DVNM, 12 Mar 1931 (A. H. Sturvenant; USNM); Shorty's Well, -100', DVNM, 4 Nov 1967 (RRS, #67-281; LACM); Beatty Jct., -200', DVNM, 25 Jan 1968 (GJW, #Cal.294; GJW); same locality, 24 Mar 1970 (GJW, #Cal.877; GJW); Ashford Mill, 0', DVNM, 23 Apr 1952 (WSC; LACM); same locality, 5 Nov 1967 (RRS, #78-282; LACM). San Bernardino Co.: Otis, 16 Sept 1908 (J. C. Bradley; AMNH); Kelso dunes, 2500', 18 Apr 1974 (F. Andrews, M. Wasbauer;

CDA) and 1 May 1974 (T. Eichlin, A. Hardy; CDA). Map 9.

DISCUSSION. Another of the small, uniformly dark species, M. lugubris is easily recognized by the reduced pilosity and very thin petiole. It is restricted to the northern Mojave Desert and seems to be common only within Death Valley.

The elevation range for this species is from -200 feet to 2500 feet. It occurs in both Creosote Bush Scrub and Saltbush Scrub habitats.

M. lugubris constructs small craters of fine sand, 5-10 cm across. They may be situated under stones.

Workers are matinal and crepuscular foragers and have generalized feeding habits (Snelling, 1976).

A dealate female has been collected in March at Kelso. It is probably the female of this species, but was not associated with workers, so not included in the key.

Myrmecocystus mendax Wheeler

Figures 5, 19, 253

Myrmecocystus melliger var. semirufa Emery, 1893:667: ♀ ♂ (in part).

Myrmecocystus melliger subsp. orbiceps Wheeler, 1908b:349-351: ♀ ♀ (in part). Wheeler, 1913a:173, 175 (in part); Creighton, 1950:445 (in part).

Myrmecocystus melliger subsp. mendax Wheeler, 1908b:351-352: ♀ ♂. Wheeler, 1913a:173. Cole, 1942:385. Gregg, 1963:645-648.

Myrmecocystus melliger, Wheeler, 1913a:173, 174 (in part). Creighton, 1950:444-445 (in part).

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Myrmecocystus mendax, Creighton, 1950:445. Cole, 1954:284.
Snelling, 1969:2, 8: ♀ ♀.

Myrmecocystus semirufa, Creighton, 1950:449-450 (in part).

Myrmecocystus comatus, Cole, 1954:284. Gregg, 1963:643-645
(misident.).

Myrmecocystus placodons, Snelling, 1969:6 (in part).

Myrmecocystus (Endiodioctes) mendax, Snelling, 1976:27, 29,
35-41; figs. 43-51, 155, 167, 179, 187: ♀ ♀ ♂.

RANGE: Central Colorado south to Texas, west to desert mountain ranges of southeastern California; adjacent northern Mexico.

DESERT RECORDS. Inyo Co.: Willow Creek, 2400', Inyo Mts., 17 Mar 1976 (DG; LACM); south Saline Range, 2500', 22 Apr 1974 (DG; LACM); Badwater, -280', DVNM, 11 Mar 1947 (A. T. McClay; UCD). San Bernardino Co.: 9.5 mi NNE Cima, 4200-4260', Ivanpah Mts., 14 Apr 1977 (RRS & CDG, #77-12; LACM); 7 mi S Kelso, 15 Apr 1962 (UCB); Granite Pass, 3800'-4320', Granite Mts., 27 Apr 1968 (R. Hobza; LACM); Van Winkle Spg., Van Winkle Mts., 19 June 1965 (G. E. Wallace; LACM); Carson's Well, 1900', Turtle Mts., 31 Jan 1967 (RRS; LACM). Riverside Co.: Whitewater Canyon, 14 Mar 1965 (S. & S. Frommer; LACM); Fried Liver Wash, JTNM, 12 June 1966 (E. L. Sleeper, S. L. Jenkins; LACMO; Cottonwood Cyn., JTNM, 1 Mar 1967 (S. & S. Frommer; LACM); Painted Cyn., 8 Mar 1930 (USNM); 12 mi E Mecca, 5 Apr 1963 (C. H. Musgrove; LACM); Shaver's Well, 13 Apr 1963 (RRS; LACM); 24 mi E Mecca, 13 Apr 1965 (D. Veirs; UCB); Hidden Springs, Little San Bernardino Mts. (LACM); 24.5 rd mi WSW Wiley's Well, 2100', 25 Oct 1978 (RRS, #78-135; LACM). Imperial

1. General - The purpose of this document is to provide information regarding the activities of the organization.

2. Objectives - The primary objectives of the organization are to promote the welfare of the community and to support the development of the region.

3. Structure - The organization is structured into several departments, each responsible for a specific area of activity.

4. Activities - The organization engages in a variety of activities, including community service projects, educational programs, and social events.

5. Membership - The organization is open to all individuals who share its goals and objectives, and who are willing to contribute to its efforts.

6. Financials - The organization's financial statements are available for review, and all financial transactions are conducted in a transparent and accountable manner.

7. Conclusion - The organization is committed to its mission and to the success of its members, and it looks forward to continuing its work in the future.

8. Appendix - The appendix contains additional information, including a list of members, a list of donors, and a list of resources.

9. References - The references list the sources of information used in the preparation of this document.

10. Index - The index provides a quick reference to the various sections of the document.

11. Glossary - The glossary defines the terms and abbreviations used throughout the document.

12. Notes - The notes section contains additional information and observations related to the organization's activities.

13. Signatures - The signatures of the organization's leaders and members are included at the end of the document.

14. Final Remarks - The final remarks section provides a summary of the organization's achievements and a vision for the future.

Co.: Black Mtn. Rd., 1000', ab. 4 rd mi SE Hwy 78, 5 May 1978 (RRS & CDG, #78-24; LACM). Map 8.

DISCUSSION. This wide-ranging species is one of our largest Myrmecocystus. The only species of comparable size are M. semirufus and M. mexicanus. The latter is a pale, nocturnal species and cannot be confused with M. mendax. M. semirufus, on the other hand, is a closely related species, but has the head, thorax and femora clear reddish, parts usually more or less extensively infuscated in M. mendax.

The record from Death Valley is based on a single male taken at Badwater. No data are available to explain the presence of this ant in such an unlikely area for M. mendax. It may be a wind-blown individual from the Black Mountains which rise rather sharply immediately east of Badwater.

The Badwater record aside, M. mendax is a mountain range ant in our area, with its occurrence between about 1000 feet and 4320 feet. Collections have usually been made from rocky slopes and sandy or gravelly washes in Creosote Bush Scrub, Wash Woodlands, Joshua tree Woodlands, Cactus Scrub and Piñon-juniper Woodlands.

The entrance to the nest is often situated beneath a stone (Fig. 316) and tumuli are absent or inconspicuous as a rule.

This is another diurnal forager and the workers are both scavengers and predators of arthropods. Prey includes lepidopterous larvae, hemipterans, homopterans, muscoid flies and acridids. The workers also gather nectar from plants and honeydew from Homoptera (Snelling, 1976).

Although we have no records of myrmecophiles from nests in

our area, the ant cricket Myrmecophila nebrascensis Scudder, has been found associated with M. mendax in Arizona.

Males have been found in nests in California during January, March and April. Females have been in nests in April. In Arizona mating flights take place during July, but in our area most likely take place during the spring months.

Myrmecocystus mexicanus Wesmael

Figures 236-237, 252

Myrmecocystus mexicanus Wesmael, 1838:756-761. Emery, 1893: 666: ♀. Wheeler, 1908b:356-358: ♀ ♀ ♂. Wheeler, 1913:173, 178: ♀. Mallis, 1941:81. Creighton, 1950:446. Cole, 1954:285. Cole, 1966: 21, 22. Wheeler & Wheeler, 1968:213. Wheeler & Wheeler, 1973:122-124; fig. 47: ♀ ♀ ♂.

Myrmecocystus melliger var. hortus-deorum McCook, 1881:75: ♀ ♀ ♂. McCook, 1882:75.

Myrmecocystus hortus-deorum, Forel, 1886:202: ♀ ♀ ♂.

Myrmecocystus mexicanus var. horti-deorum, Emery, 1893:666. Wheeler, 1908b:358-360. Wheeler, 1913a:173, 178, 179. Cole, 1934: 396, fig. 4. Mallis, 1941:81. Cole, 1942:386.

Myrmecocystus mexicanus subsp. hortideorum, Creighton, 1950: 446. Cole, 1954:285. Gregg, 1963:648-651.

Myrmecocystus (M.) mexicanus, Snelling, 1976: 115, 116, 119-124; figs, 278-281, 316, 317, 328, 329: ♀ ♀ ♂.

RANGE: Colorado south to central Mexico, west to California and Lower California.

DESERT RECORDS. General throughout the Mojave and Colorado Deserts; 51 records. Map 9.

DISCUSSION. M. mexicanus is the most widely distributed of all the Myrmecocystus and accordingly tolerant of a wide habitat range. It is a pale, nocturnal species which cannot be confused with any others in our area.

Within the Mojave and Colorado Deserts it has been collected in Creosote Bush Scrub, sand dunes, Wash Woodlands, grasslands, Joshua Tree Woodlands, Sagebrush Scrub, Cactus Scrub and Piñon-juniper Woodlands, at elevations ranging from -22 to 5000 feet.

Of all the species of honey ants, nests of this species are most easily recognized (Figs. 318, 319). The tumulus is crateriform and exceptionally well defined. It generally contrasts sharply with the substrate because it consists of either coarse pebbles and gravel or bits of local vegetation (e. g., in areas with juniper, leaves of this plant may surmount the entrance). When the nest is in fine sand, the tumulus is constructed of the coarsest sand particles available.

We have excavated several nests of this species (Fig. 320) to depths of about 4 meters, with repletes present down to about 3 m. Replete chambers, sometimes more than 20 in a nest, occurred at various depths. They are joined by well-formed galleries with the appearance of flying buttresses at junctures with the chambers. During an excavation, distended repletes can be seen hanging by their tarsal claws from the ceilings of these domed chambers (Fig. 322). The contents of some repletes are darker than others (Figs. 322, 323), probably representing nectar that has been stored for a longer time. Water and insect hemolymph may also be stored.

Analysis of the contents of several repletes of M. mexicanus

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revealed that glucose and fructose were the main constituents of the dark repletes, while sucrose made up the bulk of the solids of clear (pale) repletes. Amino acids were also present in trace amounts (Conway, 1977).

This is a nocturnal species, generally emerging from the nest to forage around 2100. It forages throughout the year although it is quite slow moving when ST gets down to 4.4°C , which is about the minimum temperature at which it will attempt to forage.

Food consists of local arthropods which the workers scavenge (about 40% of which is ants) and carbohydrates. Aphids and coccids are tended for honeydew and nectar is collected directly from such plants as Opuntia bigelovii and Yucca whipplei. In oak woodlands M. mexicanus may utilize exudates from oak galls (Wheeler, 1908). The workers have been observed taking live prey, especially when it is available in numbers. Male reproductives of other ants, termites and weakened insects are often seized by cooperating workers (Fig. 324).

The myrmecophilous scarab, Cremastocheilus stathamae Cazier, is reported to be an obligatory predator on the larvae (Cazier & Stat-ham, 1962). Snelling (1976) reported C. puncticollis Cazier in a nest of M. mexicanus.

Mating flights take place at night during August and September. The sexual forms are sometimes attracted to lights.

Myrmecocystus mimicus Wheeler

Figures 259, 263 .

Myrmecocystus melliger subsp. mimicus Wheeler, 1908b:353:
♀ ♀ ♂ (in part). Wheeler, 1913a:174-176 (in part). Wheeler,
1917a:180-182. Cole, 1934:401-402. M. Smith, 1936:170. Mallis,
1941:20.

Myrmecocystus melliger mimicus var. jesuita Wheeler, 1908b:
354: ♀. Wheeler, 1913a:174. M. Smith, 1936:170.

Myrmecocystus melliger subsp. lomaensis Wheeler, 1913a:174,
175: ♀. Mallis, 1941:20.

Myrmecocystus mimicus, Creighton, 1950:446-447 (in part).
Cole, 1954:285 (in part). Cole, 1966:22. Wheeler & Wheeler, 1968:
213. Wheeler & Wheeler, 1973:124-125; fig. 47: ♀ ♀ ♂.

Myrmecocystus (Endiodioctes) mimicus, Snelling, 1976:28, 29,
30, 54-59; figs. 83-91, 159, 179, 183, 191: ♀ ♀ ♂.

RANGE: Southwestern Kansas south to Big Bend region of Texas
and northcentral Mexico, west to California and Baja California.

DESERT RECORDS. Los Angeles Co.: 2 mi S Pearblossom, 3500',
various dates (RRS & CDG; LACM); 1.5 mi S Little Rock, 3500', 21
Apr 1969 (RRS, #69-119; LACM). San Bernardino Co.: Hesperia, 3190',
18 Sept 1978 (RRS & CDG, #78-96; LACM); Cajon Cyn., 4000', 13 Mar
1972 (RRS, #72-4; LACM); Morongo Valley, 2500', 7 Apr & 13 Oct 1963
(RRS; LACM); Yucca Valley, 3300', 10 Apr 1963 (D. Q. Cavagnaro; UCD).
Riverside Co.: nr Indian Wells, 160', 2 May 1969 (GJW, #Cal.708;
GJW); Deep Canyon, 925', 3 May 1969; (GJW, #Cal.717; GJW); Dos Dalmas,
3700', 8 Mar 1970 (GJW, #Cal.852, 855; GJW). Map 8.

DISCUSSION. This wide-ranging species barely enters our area along the western margins. It can be confused with M. flaviceps which is similar in size and color, but in that species the third tergum is extensively pubescent.

According to our records this species is found at elevations between 160 and 4000 feet. Biomes in which it has been taken include Creosote Bush Scrub, Cactus Scrub, sand dunes and Joshua Tree Woodland.

Nests rarely have tumuli. More often a single hole marks the nest, with little excavated material in evidence. The nests may be in exposed areas or at the base of a clump of grass.

Workers are diurnal foragers, sometimes with a bimodal pattern, remaining in the nest at midday. However, they are capable of foraging at high temperatures and have been observed foraging during July when surface temperatures were as high as 62°C.

M. mimicus workers solicit honeydew from aphids and visit plants for nectar; we have observed them in our area on Opuntia bigelovii, Yucca whipplei, Eriogonum davidsonii, E. brachyanthum, E. fasciculatum and Euphorbia albomarginata. Various arthropods, whole or fragmentary, dead or alive, are also included among the forage items of this species: flies (ceratopogonids, simuliids, asilids), ants (Pogonomyrmex spp., Solenopsis maniosa, Pheidole barbata, Veromessor pergandei, Crematogaster sp., Camponotus spp.) and homopterans. We have also seen this species raiding neighboring conspecific colonies for larvae and pupae.

Territorial "tournaments" were observed by Hölldobler (1976c) who opined that successful may then raid the weaker and carry off

larvae and pupae to function as slaves.

The myrmecophilous scarabs Cremastocheilus lengi and C. constricticollis have been recorded from nests by Cazier & Statham (1962).

Mating flights have been observed in May. The winged sexual forms have been found in nests between March and May.

Myrmecocystus navajo Wheeler

Figures 234-235, 260

Myrmecocystus mexicanus subsp. navajo Wheeler, 1908b:360:

♀. Wheeler, 1913a:173, 179. Cole, 1942:386. Fautin, 1946: 299, 307.

Myrmecocystus navajo, Creighton, 1950:449. Gregg, 1963:651-653. Wheeler & Wheeler, 1973:125; fig. 48. ♀.

Myrmecocystus (M.) navajo, Snelling, 1976:115, 116, 124-129; figs. 282-289, 322, 323, 334, 335: ♀ ♂.

RANGE: Inyo Co.: Inyo Mts., 8000', 8 mi NE Keeler, 11 May 1969 (J. Haddock; UCB). San Bernardino Co.: 2 mi N Essex, 3-5 May 1966 (P. A. Opler; UCB); Joshua Tree, 2750', 9 Feb 1957 (A. R. Gillogly; LACM); Golden Crown Mine, JTNM, 22 Feb 1968 (R. J. Hamton; LACM). Riverside Co.: T6S, R5E, sec 25, 3200', 1 Dec 1967 (GJW, #Cal.222; GJW); Nightingale, 4100', 5 Dec 1967 (GJW, #Cal.253; GJW).. Map 9.

DISCUSSION. This is a medium-sized, yellow, nocturnal species. It looks like a small version of M. mexicanus. It is, however, less pilose and the shape of the propodeum is different. Its occurrence in our area is sporadic and this ant seems to be intrusive in our

deserts.

All our records are for higher elevations (2750' to 8000') in Joshua Tree Woodland and Piñon-juniper Woodland.

Myrmecocystus romainei Cole

Figures 255, 264

Myrmecocystus melliger subsp. mimicus Wheeler, 1908b:353-354:
♀ (in part).

Myrmecocystus melliger semirufus, Wheeler, 1908b:355 (in part).

Myrmecocystus melliger semirufus var. romainei Cole, 1936:120: ♀.

Myrmecocystus semirufa, Creighton, 1950:449 (in part). Cole,
1954a:285 (misident.). Buren, 1968:119 (misident.).

Myrmecocystus melliger, Cole, 1954a:285 (in part).

Myrmecocystus semirufus, Gregg, 1968:653-655 (in part)

Myrmecocystus (Endiodictes) romainei, Snelling, 1976:28, 29,
30, 78-82; figs. 136-145, 165, 177, 197, 198: ♀ ♀ ♂.

RANGE: Western Kansas, Oklahoma and Texas to southeastern California; Utah.

DESERT RECORDS. San Bernardino Co.: 9.5 mi NNE Cima, 4200-4265',
Ivanpah Mts., 13 Apr 1977 (RRS & CDG, #77-5, 11, 13, 14, 15; LACM).
Map 8.

DISCUSSION. There are no previous records of this species in California. We found it to be abundant on the eastern side of the Ivanpah Mts. Oddly, it was not found in the Piute Range. Apparently M. romainei filters down from adjacent portions of Nevada and probably has a very minor distribution in California.

In the Ivanpah Mountains we found nests in coarse alluvium and sandy washes in Creosote Bush Scrub-Joshua Tree Woodland ecotone.

Small, regular, well elevated sand craters marked the nests (Fig. 325).

M. romainei is a diurnal species. During warm summer months it was observed to begin foraging at 0645 (ST 20°C). Activity was curtailed during the warmer midday and a second foraging period took place in late afternoon. This species is probably omnivorous as are most others of its subgenus. Workers were observed to scavenge in the debris pile of Myrmecocystus n. sp., picking up dead workers of that species.

We also observed this species robbing workers of Forelius pruinosus as they returned to their nest. A worker of M. romainei would circle the Forelius column, often concealing itself behind rocks, then suddenly dart forward, jostle a Forelius worker, snatch up the dropped forage item, then hastily depart for her own nest. The Forelius workers did not always drop the forage item and a "tug-of-war" would ensue, with the much larger Myrmecocystus usually the victor. If other Forelius were close enough they would attack and spray the Myrmecocystus, which then retreated in obvious distress. For about two minutes after having been sprayed, the Myrmecocystus seemed disoriented and moved in an erratic manner, often rubbing the head and palpi on pebbles and the soil. However, they seemed to recover quickly and would resume their brigandage. Often two or three of these robbers would harass the Forelius simultaneously.

Males and females were found in nests in April.

Myrmecocystus semirufus Emery

Figures 1, 2, 11, 265

Myrmecocystus melliger var. semirufa Emery, 1893:667: ♀.

Myrmecocystus melliger subsp. semirufus, Wheeler, 1908b:355: ♂
(in part). Mallis, 1941:80 (in part).

Myrmecocystus semirufa, Creighton, 1950:449-450 (in part).

Myrmecocystus semirufus, Snelling, 1969:6, 8.

Myrmecocystus placodops, Wheeler & Wheeler, 1973:125-126
(misident.)

Myrmecocystus (Endiodiotes) semirufus, Snelling, 1976:27, 29,
46-50; figs. 61-69, 157, 169, 181, 189: ♀ ♂.

RANGE: Desert mountain ranges, Inyo County south to Baja California.

DESERT RECORDS. Mountain ranges of Mojave and Colorado Deserts;
45 records. Map 8.

DISCUSSION. This is the western equivalent of M. mendax and replaces it in the western desert mountain ranges and adjacent lowlands. It is similar in stature to M. mendax and differs, in the field, in having a clear red head and thorax, legs and petiolar scale.

Elevation range for this species is 40 to 5000 feet. Known habitats here include Creosote Bush Scrub, Cactus Scrub, Wash Woodlands and Joshua Tree Woodland.

Nests are most commonly on a slope in coarse, well-drained sandy soil. Craters are most often regular and range from 15-30 cm diameter, with a central entrance (Fig. 326). Older colonies may have more than one opening. While nests are usually situated

in open areas, they may be near the base of a plant or beside a stone.

Foraging is diurnal. Scouts leave the nest to explore from 0900 to 1000 when ST is around 27°C. They return within about 10 minutes and a swarm of workers then leaves the nest for the days foraging (Fig. 327). Foragers come and go during the day, the last group generally returning by 1530 to 1600. They can tolerate STs as high as 57°C but normally remain within the nest during the hot afternoon hours.

M. semirufus is opportunistic and has been observed taking nectar from flowers of Eriogonum brachyanthum, E. davidsonii, E. fasciculatum, Chrysothamnus nauseosus, C. paniculatum, Eriophyllum pringlei, Cleomella obtusifolia, Euphorbia albomarginata and Chilopsis linearis. It also feeds on the resins produced by glands on foliage of Haplopappus linearifolius.

A broad assortment of arthropods is captured or scavenged. These include hemipterans (lygaeids, scutellarids, mirids), homopterans (cicadellids, aphids), termites, beetles, flies, small wasps, bees and ants (Pogonomyrmex spp., Pheidole spp., Veromessor pergandei, Camponotus spp.).

Although the only observed mating flights have been in May, we have records of the sexual forms present in the nests during the months of February, March and April.

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Myrmecocystus tenuinodis Snelling

Figures 250-251

Myrmecocystus lugubris, Creighton, 1956:1-2 (in part).

Myrmecocystus (Eremnocystus) tenuinodis Snelling, 1976:94,
107=110; figs. 241-247: ♀ ♀.

RANGE: Southwestern Nevada to northwestern Sonora and north-eastern Baja California.

DESERT RECORDS. San Bernardino Co.: Giant Rock, 5 mi N Joshua Tree, 29 Dec 1957 (A. R. Gillogly; LACM). Riverside Co.: 1.9 mi N Thousand Palms, 190', 5 Feb 1967 (RRS; LACM); 3 mi E Thousand Palms, 100', 21 Feb 1972 (RRS, #72-2; LACM); 3 & 5 mi E Thousand Palms, 16 Feb 1963 (WSC; LACM); 6 mi N Palm Springs, 13 Nov 1945 (P. H. Timberlake; LACM); Garnet, 650', 30 Dec 1952 (J. C. Hall; UCD); same locality, no date (A. H. Sturtevant; USNM); Carrizo Cr. Cyn., 1000' 29 Feb 1963 (WSC; LACM). Map 9.

DISCUSSION. This small, uniformly dark species is closely related to M. yuma with which it is broadly sympatric, though there few stations where the two occur together. Workers are quite similar, but that of M. tenuinodis has a thin petiolar scale and has conspicuous erect hairs on the tibiae and scape, though these may be few in number. Females are easily separated by the differences noted in the key.

Our desert collections show that M. tenuinodis occurs in Creosote Bush Scrub at elevations from 100 to 1000 feet. Nests have all been situated in exposed areas in fine sand. Craters are low, about 10 cm diameter.

Workers are usually matinal and crepuscular foragers (Snelling, 1976), but activity on the surface has been observed at midday in February. Foragers have been collected at nectaries of Chrysanthamnus paniculatus and Malacothrix sp. This ant is also a scavenger of arthropods. At Yuma, Arizona, workers were observed to bring in immature cicadellids (Snelling, 1976). M. tenuinodis appears to estivate during the hotter periods (mid-May to mid-October) of the year.

Mating flights were observed near Thousand Palms during February by W. S. Creighton (Snelling, 1976)

Myrmecocystus testaceus Emery

Figures 238-239

Myrmecocystus melliger semirufa var. testacea Emery, 1893:667: ♂.

Myrmecocystus mexicanus subsp. mojave Wheeler, 1908b:360-361: ♀. Leonard, 1911:87-92. Wheeler, 1913a:173, 179; fig. 1: ♀ ♂. Cole, 1934a:403. Mallis, 1941:81.

Myrmecocystus mexicanus, undescr. var., Cole, 1934b:225.

Myrmecocystus mexicanus subsp. idahoensis Cole, 1936:118: ♀ ♂.

Myrmecocystus mojave, Creighton, 1950:448-449: o. Cole, 1966: 22. Wheeler & Wheeler, 1968:213.

Myrmecocystus testaceus, Snelling, 1969:6. Snelling, 1971:15. Wheeler & Wheeler, 1973:126-127: ♀ ♀.

Myrmecocystus (M.) testaceus, Snelling, 1976:115, 116, 135-140; figs. 308-315, 320, 321, 332, 333: ♀ ♂.

RANGE: Southern Washington to Idaho and Utah, south to Baja California.

DESERT RECORDS. Inyo Co.: T9S, R36E, 7000', 16 mi E Big Pine, 1 Nov 1967 (GJW, #Cal.216; GJW). San Bernardino Co.: 4.5 mi N Cima, 4100-4200', 15 Apr 1977 (RRS & CDG, #77-20; LACM); Cajon Cyn., 4000', 21 Apr 1967 (RRS, #67-116, 117; LACM). Los Angeles Co.: 2 mi S Pearblossom, 3500', 17 Dec 1966 (RRS; LACM). Riverside Co.: Pinon Wells, JTNN, 28 Mar 1965 (S. L. Jenkins; LACM). Map 9.

DISCUSSION. This species is another of those which barely enters our region from peripheral areas. We have only the record from north of Cima which is not clearly intrusive. This may represent a relict population or, perhaps, an intrusion from Great Basin Sagebrush Desert populations.

Superficially this looks somewhat like M. mexicanus but is smaller, stouter and with a very different propodeal profile and mandibular dentition.

California desert records are from Joshua Tree Woodland and Piñon-juniper Woodland communities at elevations from 3500 to 7000 feet.

Most nests which we have encountered have not been marked by conspicuous mounds. Usually, the nest is indicated by one or more small holes surrounded by a little coarse-grained clayey soil.

Foragers are nocturnal, emerging en masse at dusk. Irregular small pulses of additional workers continue to leave the nest during the night. In the early morning hours only a few foragers are still out and by daybreak activity is confined to nest cleaning only. Surface temperatures during the hours of foraging range from -2.8°C to 29°C. We have observed workers taking nectar from

Eriogonum fasciculatum and Euphorbia albomarginata. Aphids and mealybugs are also solicited for honeydew. These ants are scavengers of locally available arthropods such as spider, lepidopterous larvae, flies, aphids, beetles and other ants (Pogonomyrmex spp., Camponotus semitestaceus and Myrmecocystus wheeleri). They are also predaceous and will coordinate attacks on arthropods that come near the nest.

Mating flights have been observed in February.

Myrmecocystus wheeleri Snelling

Figures 258, 261

Myrmecocystus melliger semirufus var. testaceus, Wheeler, 1908b: 355-356 (in part). Wheeler, 1913a:174, 176 (misident.). Cole, 1934: 402 (misident.). Mallis, 1941:81 (in part).

Myrmecocystus semirufa, Creighton, 1950:449 (in part).

Myrmecocystus wheeleri Snelling, 1971:11-15: ♀ ♂. Wheeler & Wheeler, 1973:119, 127; fig. 50: ♀.

Myrmecocystus (Endiodictes) wheeleri, Snelling, 1976:28, 29, 70-74; figs. 117-126, 163, 175, 195, 196: ♀ ♂.

RANGE: Central California to Baja California; arid coastal and inland valleys, desert margin.

DESERT RECORDS. Inyo Co.: Sheep Cr. Cyn., 25 Apr 1946 (A. L. Melander; LACM). San Bernardino Co.: Mojave R. at Deep Creek, 14 Aug. 1936 (P. H. Timberlake; LACM). Los Angeles Co.: 6 mi SE Pearblossom, 3500', various dates (RRS; LACM); 2 mi S Pearblossom, 3500', various dates (RRS, CDG; LACM); Little Rock Dam, 3400', 2 May

1970 (RRS, #70-1; LACM). Imperial Co.: San Felipe Cr., 1 mi W Harper's Well, 7 Feb 1968 (M. E. Irwin & P. A. Rauch; LACM). Map 8.

DISCUSSION. This is a species primarily of chaparral habitats and is marginal in our area. It is the only species which, in the field, looks entirely uniformly reddish or even orange. It is nearest M. kathjuli but has shorter occipital and pronotal hairs.

Desert records for M. wheeleri are from higher elevations, 3500 to 4000 feet. Nests are in sandy soil in Joshua Tree Woodland and Pinon-juniper Woodland. They may have a semicircular crater around the entrance hole (Fig. 329) or no crater at all.

Workers of this species are capable of foraging at extremely high surface temperatures because they move very rapidly, using rocks, plants or other objects as "stepping stones" across the hot surface. When pausing on such objects they assume stilt-legged postures, raising the body from the substrate (Fig. 331) to avoid excessive heat. This diurnal species forages when surface temperatures range from 26°C to 63°C. M. wheeleri estivates during the cool winter and spring months.

Food for this species consists of nectar which is collected from floral and extrafloral nectaries of such desert plants as Eriogonum davidsonii, E. fasciculatum and Euphorbia albomarginata (Fig. 330). Plant resins are also gathered. Scavenged arthropods include hemipterans, homopterans, small Coleoptera and other ants (Camponotus spp., Pogonomyrmex californicus).

Dehatched females have been collected in June. Sexual forms have been found in the nests in March, June and August.

Myrmecocystus yuma Wheeler

Figures 246-247

Myrmecocystus yuma Wheeler, 1913a:174: o. Creighton, 1950:

450: ♀.

Myrmecocystus lugubris, Creighton, 1956:1-4 (in part).

Myrmecocystus (Eremnocystus) yuma, Snelling, 1976:94, 110-114;
figs. 248-254: ♀ ♀.

RANGE: Southwestern Nevada to northwestern Sonora and north-eastern Baja California.

DESERT RECORDS. San Bernardino Co.: Salt Cr., 28.5-29 mi N Baker, 29-30 Sept 1978 (RRS, #78-100, 102; LACM); Yermo, 1935', 27 Apr 1952 (WSC; LACM); 11.9 mi E Newberry Spgs., 2300', 17 Sept 1978 (RRS & CDG, #78-84b; LACM); Pisgah Crater, 11 Mar 1961 (Norris & Heath; LACM); 10.7 mi NNE Earp, 375', 7 Apr 1967 (RRS; LACM); 27 mi E Twentynine Palms, 13 Oct 1963 (RRS; LACM); Golden Crown Mine, JTNM, 22 Feb 1968 (R. J. Hamton; LACM). Riverside Co.: Fried Liver Wash, 1700', JTNM, 26 Apr 1952 (WSC; LACM); 3 mi NE Old Dale Jct., JTNM, 6 Apr 1967 (R. J. Hamton; LACM); 13 mi N Desert Center, 22 Feb 1968 (R. J. Hamton; LACM); 4 mi N Wiley's Well, 500', 24 Oct 1978 (RRS, #78-122; LACM); Wiley's Well, 400', 6 Nov 1978 (RRS & CDG, #78-169; LACM). Imperial Co.: 2.9 mi N Glamis, 335', 4-5 May 1978 (RRS & CDG, #78-6, 17, 20; LACM); 3 mi N Glamis, 7-13 Apr 1973 (M. S. & J. S. Wasbauer; CDA). San Diego Co.: n end Clark Lake, ABDP, 25 Mar 1978 (M. Wasbauer et al.; CDA); 4 mi S Borrego, 16 Feb 1964 (RRS; LACM). Map 9.

INTERNATIONAL TRADE UNION

January 20, 1951

Mr. J. Edgar Hoover, Director, Federal Bureau of Investigation

Dear Sir: I am writing to you regarding the activities of the International Trade Union, which is a labor union operating in the United States.

The International Trade Union is a labor union which is active in the United States.

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The International Trade Union is a labor union which is active in the United States.

DISCUSSION. This species is closely allied to M. tenuinodis and broadly sympatric with it in the Colorado Desert. In the Mojave Desert, M. yuma is more abundant than M. tenuinodis.

Our records show an elevational range for this species from 335 to 2300 feet. All nests have been situated in sand, generally in washes, in Creosote Bush Scrub, Saltbush Scrub and Wash Woodland. Nest craters were about 10 cm diameter.

Foraging activity has been observed from 1800 to 2100. The workers visit flowers and solicit aphids and pseudococcids for honeydew. Wheeler (1913a) found insect remains in the debris piles around nest tumuli. Forage items recovered from returning workers consisted of mirids, cicadellids, small beetles, a sphecid wasp, small chalcidids and ants (Pogonomyrmex californicus, Veromessor pergandei and Solenopsis maniosa), this sampling taken in about 20 minutes at Salt Creek.

Myrmecocystus new species

Figures 240-241

RANGE: Presently known only from Ivanpah Mts.

DESERT RECORDS. San Bernardino Co.: 9.5 mi NNE Cima, 4200-4265', Ivanpah Mts., 14 Apr 1977 (RRS & CDG, #77-9, 10, 16; LACM). Map 9.

DISCUSSION. At present this species is known only from the collections made on the east side of the Ivanpah Mts. We have also seen a few specimens labeled simply "Cima"; it seems unlikely that this ant occurs at Cima and we presume these specimens are from the Ivanpah Mts. also.

This ant appears to be intermediate between the mexicanus and pyramicus groups of the nominate subgenus. In addition to its yellow color and large eyes, this species is characterized in the worker by lacking erect hairs on the scape, tibiae and thoracic dorsum.

The Ivanpah Mts. nest sites for this ant consisted of shallow sandy washes with creosote bush and occasional Joshua trees. The nests were surmounted by circular craters of sand (Fig. 317). An excavation to 1.1 m below the surface did not reveal any chambers.

This is a nocturnal species. The activity we observed began at 2030 (AT 29°C, ST 22°C) with the emergence of scouts. Peak activity occurred from 2200 to 2300 (ST 18°-19°C). At 0600 (ST 14°C) 20-25 foragers were still out, but most surface activity consisted of the usual "house-cleaning". All foragers returned shortly thereafter and the nest entrance was closed just as the first rays of the sun approached.

Returning foragers carried nectar and arthropod fragments. No freshly killed prey was observed.

Male and female reproductives were present in those nests located in April.

Genus FORMICA Linné

This is a large, complex Holarctic ant genus. Most of the species are northern or are associated with wooded areas. Accordingly, we have few in the Creosote Bush Scrub deserts. Of those which do occur here, only two may be considered normal inhabitants and they are uncommon, limited to scattered favorable niches.

With one exception (F. perpilosa) all our species belong to the so-called fusca group of Wheeler (1913b) and Creighton (1950). This group was revised by Francoeur (1973) with some rather drastic modifications. The keys seem inordinately difficult and it seems likely that further study will reduce the number of species recognized by Francoeur.

KEY TO SPECIES OF FORMICA

workers

- 1a. Apical margin of clypeus more or less acute in middle; clypeus with longitudinal carina; integument of head and thorax densely tessellate, only very slightly shiny 2
- b. Apical margin of clypeus weakly concave or distinctly notched in middle, median carina weak or absent (Fig. 271); integument of head and thorax smooth and shiny .. perpilosa Wheeler
- 2a. Metasternum without a pilose process on each side of spinasternal pit 3
- b. Metasternum with a pilose process on each side of spinasternal pit 4

GENERAL PRINCIPLES

There are a number of important principles which should be kept in mind when dealing with the various types of cases which may be encountered. The first principle is that the facts of the case must be ascertained as completely as possible. This is done by a careful study of the evidence and by a thorough examination of the parties. The second principle is that the law applicable to the case must be determined. This is done by a study of the statutes, regulations, and decisions of the courts. The third principle is that the facts of the case must be applied to the law. This is done by a logical and consistent analysis of the facts and the law. The fourth principle is that the result of the case must be stated clearly and concisely. This is done by a brief and to the point statement of the result.

KEY TO SYMBOLS ON CASES

The following symbols are used to indicate the type of case which is being dealt with. A capital letter indicates a case which is a matter of first impression. A lowercase letter indicates a case which is a matter of second impression. A number indicates a case which is a matter of third impression. A symbol indicates a case which is a matter of fourth impression. A combination of symbols indicates a case which is a matter of fifth impression. A combination of numbers indicates a case which is a matter of sixth impression. A combination of letters indicates a case which is a matter of seventh impression. A combination of letters and numbers indicates a case which is a matter of eighth impression. A combination of letters, numbers, and symbols indicates a case which is a matter of ninth impression. A combination of letters, numbers, symbols, and a combination of letters and numbers indicates a case which is a matter of tenth impression.

- 3a. Mesometasternal profile elongate, without angle; metasternal pilosity restricted to area caudad of spinasternal pit; propodeum, in profile, low and elongate . . . xerophila M. Smith
- b. Mesometasternal profile compressed and delimiting an angle; metasternal pilosity partially surrounding spinasternal pit; propodeum, in profile, high and short, distinctly subangulate gnava (Buckley)
- 4a. Eye and scape with abundant short, fully erect hairs (Fig. 272) pilicornis Emery
- b. Eye and scape without standing hairs altipetens Wheeler

females

- 1a. Apical margin of clypeus more or less acute in middle; clypeus with longitudinal median carina; integument of head densely tessellate, not, or slightly, shiny 2
- b. Apical margin of clypeus weakly to distinctly notched in middle; clypeus without median carina; integument of head smooth and shiny perpilosa Wheeler
- 2a. Metasternum without a pilose process on each side of spinasternal pit 3
- b. Metasternum with pilose process on each side of spinasternal pit 4
- 3a. Eye projecting beyond side of head in frontal view; mesometasternal profile low and elongate, followed by concavity; metasternal pilosity not surrounding spinasternal pit xerophila M. Smith

- b. Eye not projecting beyond margin of head in frontal view;
mesometasternal profile with high, rather narrow, convexity
followed by angle; metasternal pilosity partially surround-
ing spinasternal pit gnava (Buckley)
- 4a. Eye and scape with abundant short, fully erect hairs
. pilicornis Emery
- b. Eye and scape without erect hairs altipetens Wheeler

Formica altipetens Wheeler

Formica cinerea cinerea var. altipetens Wheeler, 1913b:523-
524: ♀ ♂ (in part).
Formica cinerea var. altipetens, Wheeler, 1917c:550 (in part).
Formica altipetens, Creighton, 1950:529, 531 (in part). Fran-
coeur, 1973:52-60, 273, 280, 288, 293, 300, 306; fig. 39-55. ♀ ♂.

RANGE: Montana and Idaho, south to New Mexico, northern Ari-
zona and eastern California.

DESERT RECORDS. Inyo Co.: Deep Springs, 25 May 1974 (M. S. &
J. S. Wasbauer; CDA). Map 7.

DISCUSSION. There are few records for F. altipetens (sensu
Francoeur) in California, but it appears that the Deep Springs
record represents an intrusion from Great Basin Sagebrush Desert.

Formica gnava Buckley

Figures 267, 270, 273

Formica gnava Buckley, 1866:156: ♀ ♀ ♂. Francoeur, 1973:238-245; figs. 425-441: ♀ ♀ ♂.

Formica fusca var. gnava, Wheeler, 1902c:19.

Formica rufibarbis var. gnava, Wheeler, 1913b:518.

Formica rufibarbis subsp. gnava, Creighton, 1950:539-541.

RANGE: Central Texas, southern Colorado, to southeastern California, northeastern Baja California.

DESERT RECORDS. San Bernardino Co.: Needles (Francoeur, 1973: 244). Riverside Co.: Mecca, -189', 4 Apr 1958 (F. Colley; LACM); "Coachella Valley" (A. Mallis; LACM). Imperial Co.: Picacho State Rec. Area, 6 May 1978 (RRS & CDG, #78-36; LACM); Imperial Dam, 20 June 1954 (W. A. McDonald; LACM); Winterhaven, 19 July 1962 (W. J. Akins; LACM). Map 7.

DISCUSSION. This ant appears to be a genuine element of our fauna, albeit limited to a few favorable areas. It is probably more common along the Colorado River than present records indicate. With exception of the specimens from Mecca and "Coachella Valley" all are from the vicinity of the River. The Mecca specimens are two females. They are about normal for the species except that the frons is more finely and sharply punctate and the head and thorax a little shinier than usual. These differences suggest that they represent an isolated population and not an introduction. The workers labeled "Coachella Valley" seem entirely normal.

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Our records for this ant are all from areas of Alkali Sink and Saltbush Scrub. Nests at Picacho State Recreation Area were in moist salty soil at the base of a clump of Pluchea sericea; workers were foraging at midafternoon. Cole (1934) observed colonies to be situated under large flat rocks in shaded, moist habitats and Creighton (1950) noted the occurrence of this ant in canyon bottoms.

Males have been taken at lights at night in July.

Formica perpilosa Wheeler

Figures 268, 271, 275

Formica fusca subsp. subpolita var. perpilosa Wheeler, 1902d:

141: ♀.

Formica perpilosa, Wheeler, 1913b:421: ♀ ♀ ♂. Cole, 1942:

376, 378: ♀.

Formica (Raptiformica) perpilosa, Creighton, 1950:463, 467:

♀. Gregg, 1963:611-613; map: ♀.

RANGE: Kansas to Texas, west to California; northern Mexico.

DESERT RECORDS. Inyo Co.: Salt Lake, 1060', Saline Valley, 23 Mar, 7 June 1976 (DG; LACM); sand dunes, 1150', Saline Valley, 8 July 1976 (DG; LACM); Artesian Spring, 1100', Saline Valley, 4 May 1976 (DG; LACM); Willow Creek, 2400', Inyo Mts., 17 Mar 1976 (DG; LACM); Shoshone, 1600', 2 May 1970 (I. Savage; CDA). Kern Co.: Randsburg Rd., ca. 4.9 mi W Last Chance Cyn. Rd., 16 Sept 1978 (RRS & CDG, #78-70; LACM). San Bernardino Co.: Yermo, 1935', 7 Sept 1952 (RRS; LACM); 0.5 mi E Newberry Spgs., on Pioneer Rd., 2275', 17 Sept 1978 (RRS & CDG, #78-79, 80; LACM); Morongo Valley, 2600', 30 June 1963

M. E. Irwin; LACM); Twentynine Palms, 1855', 3 Aug 1933, .9 Aug 1946 (P. H. Timberlake; LACM). Map 7.

DISCUSSION. The clypeal structure, shiny integument and long, flexuous body hairs make this ant easily recognized among our species of Formica. It is a Sagebrush Desert species and the desert records in our region probably represent relict populations. The ant occurs also in coastal southern California.

This is a largely Riparian Community species in the Mojave Desert, occurring at elevations between 1000 and 2600 feet. We have records, however, from Creosote Bush Scrub, Saltbush Scrub and Joshua Tree Woodland. Nests have low mounds and are often situated at the base of a shrub or tree (Cole, 1934) along desert stream bottoms (Creighton, 1950).

The ant is omnivorous and an aggressive forager. According to Whitford (1978a) the species is nocturnal near Las Cruces, New Mexico. We found it foraging at midday at Newberry Springs in May and it is the experience of RRS that the species is normally diurnal even in the hot part of the year.

Formica pilicornis Emery

Figures 269, 272, 274

Formica fusca var. cinerea, Mayr, 1886:427 (in part)

Formica pilicornis Emery, 1893:664: ♀ ♀. Creighton, 1950: 538: ♀. Francoeur, 1973:74-80; figs. 90-106: ♀ ♀ ♂.

Formica cinerea subsp. pilicornis, Wheeler, 1913b:527: ♀.

RANGE: Coastal California, south of San Francisco Bay area; Baja California.

DESERT RECORDS. Kern Co.: Indian Wells, 18 Apr 1962 (C. A. Toschi; UCB). Los Angeles Co.: 4 mi SE Pearblossom, 3700', 8 Apr 1972 (C. Gross; LACM); Big Rock Wash & Palmdale Blvd., 1 Apr 1972 (J. P. & K. E. Donahue; LACM). San Bernardino Co.: Barstow, 2100', 22 Sept 1934 (P. H. Timberlake; LACM); Victorville, 2700', 29 Sept 1965 (RRS; LACM); Apple Valley, 2877', 12 June 1959 (N. McFarland; LACM). Imperial Co.: Coyote Wash (Francoeur, 1973:79). Map 7.

DISCUSSION. The short, stiff, erect hairs on the eyes and scapes will immediately identify all castes of this ant, which is an intrusive element in our fauna.

F. pilicornis is commonly encountered nesting under large boulders in dry sandy arroyos, especially along the foothills (Mallis, 1941). Our collections are from Salix-Populus associations in similar situations. Nests may be situated at the base of a tree.

Foragers feed on nectar and honeydew from aphids and other homopterans they tend. They have also been collected at flowers of Malvastrum fasciculatus and on cottonwood stems and fruit.

Cole (1934a) collected this species from low crater mounds in ". . . the interspaces of Larrea tridentata and Ephedra sp."

Formica xerophila M. Smith

Formica moki Wheeler, 1913b:558-560: ♀ (in part).

Formica moki xerophila M. Smith, 1939b:581-584: ♀. Creighton, 1950:550: ♀.

Formica moki grundmanni Cole, 1943:184: ♀.

Formica xerophila, Francoeur, 1973:259-263; figs. 455-458: ♀.

RANGE: Southeastern Washington to southern California; Utah; northwestern Arizona.

DESERT RECORDS. Inyo Co.: 7 mi W Lone Pine, 5800', 21 June 1965 (GJW, #Cal.14; GJW). Map 7.

DISCUSSION. The one record which we have is somewhat outside our project area but we have included it on the assumption it may ultimately be found here. Other ants found in the Lone Pine area do reach our area. This species is nearest F. gnava among our species. A little practice is necessary to recognize the difference in the propodeal shape, but since the two species are widely separated geographically no problems should arise in distinguishing between them.

Our only record is from Sagebrush Scrub and it probably will be found in similar habitats within the BLM area.

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Table 2. Feeding habits of California desert ants .

Species	Guild:	Carnivore	Scavenger	Nectivore	Granivore	Fungivore	Parasite
<u>Hypoponera</u> spp. (2)		C	O				
<u>Cerapachys</u> sp.		C	I				
<u>Neivamyrmex</u> spp. (6)		C	O				
<u>Pseudomyrmex</u> spp. (2)				I			
<u>Manica mutica</u>		O	C		C		
<u>Pogonomyrmex imberbiculus</u>			C		C		
" n. sp.							E
" spp. (8)			O		C		
<u>Aphaenogaster</u> spp. (2)			C				
<u>Novomessor cockerelli</u>		O	C		O		
<u>Veromessor</u> spp. (3)			O		C		
<u>Pheidole barbata</u>					C		
" <u>clydei</u>		O	C				
" <u>desertorum</u>			C		C		
" <u>gilvescens</u>					C		
" <u>hyatti</u>		O	C		C		
" <u>paiute</u>					C		
" <u>psammophila</u>					C		
" <u>rugulosa</u>			O		C		
" <u>sciophila</u>		I	C		I		
" <u>tucsonica</u>					C		
" <u>vistana</u>		C	C				
" <u>yaqui</u>					C		

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Table 2. Feeding habits of California desert ants (cont.)

Species	Guild:	Carnivore	Scavenger	Nectivore	Granivore	Fungivore	Parasite
<u>Cardiocondyla ectopia</u>			C	C			
<u>Crematogaster</u> spp. (6)			O	C			
<u>Monomorium minimum</u>		O	C	O			
<u>Solenopsis aurea</u>		O	C	O	O		
" <u>maniosa</u>		C	C	O	C		
" <u>molesta</u>		O	C	I			
" n, sp.		I	I				
<u>Leptothorax</u> spp. (3)		O	C				
<u>Cyphomyrmex</u> spp. (2)						E	
<u>Acromyrmex versicolor</u>						E	
<u>Liometopum occidentale</u>		C	C	C			
<u>Tapinoma sessile</u>		O	O	C			
<u>Forelius</u> spp. (2)		O	C	C			
<u>Conomyrma</u> spp. (2)		O	C	C			
<u>Brachymyrmex depilis</u>			I	C			
<u>Camponotus</u> spp. (8)		O	C	C			
<u>Paratrechina</u> spp. (3)		O	C	C	O		
<u>Myrmecocystus</u> spp. (18)		O	C	C			
<u>Formica</u> spp. (5)		O	C	C			

E = exclusively

C = commonly

O = occasionally

I = insufficient information

1. Qualitative Information
 2. Quantitative Information
 3. Qualitative Information
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in scavenging is evident once the table is examined. This category usually involves the collection of dead arthropods, but includes fecal pellets and fragments which can be removed from larger carcasses as well.

48% of these ants are common nectivores, a category which includes "honeydew" and plant resins as well as floral and extra-floral nectar. The bulk of such species are members of subfamilies Dolichoderinae and Formicinae.

Species with primarily granivorous habits comprise 23% of our desert ant fauna, and all are myrmecines.

As opposed to the tropics, desert ants that kill for a living are rare. Only 12% are commonly predaceous (listed as carnivores in Table 2), and half of these are army ants that have tropical origins. 49% will occasionally take prey.

Only three of our desert species are members of the specialized "fungivore guild". Although they collect varied vegetable matter to use as a substrate for their gardens, they feed exclusively on fungus. These are the only desert ants with so unique a diet.

Pogonomyrmex n. sp. represents the only ant in our deserts that is suspected to be an obligate parasite. Reproductives (no workers have ever been collected) are fed and groomed by workers of the host, Pogonomyrmex rugosus.

Because of the limitations and conflicts of the literature, we based most of the guild assignments of Table 2 on our own field observations made over the course of the past several years. These

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assessments apply to the ants in their California desert habitats only.

We suspect there is a great deal of raw data which have been collected in conjunction with recent ecological studies (almost exclusively pertaining to harvesters) that has not been disseminated to the myrmecological community. Much of the forage collected in such studies is never identified and thus represents hours of wasted effort. If these data are not worked up and presented at least as a note in the appropriate journal, a data bank will never develop. Knowledge of the diets of ants is particularly important, as it helps to reveal the importance of these invertebrates to the desert ecosystem.

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ANTS AND THE CONDITION OF THE ENVIRONMENT

Habitat Selection

In most ants, macrohabitat selection occurs during the nuptial flight by the female reproductive caste. After fertilization, the inseminated female (queen) dealates, searches for the proper microhabitat (nest site), and commences excavating.

The work performed by Wilson and Hunt (1966) with mating flights of Solenopsis molesta and Lasius neoniger has shown that habitat selection is not a random event. The direction of the flight appears to be controlled in order to enhance the probability that a favorable habitat (one similar to that of the parental nest) will be selected.

For species where queens drop to the ground immediately after copulation, "each new generation disperses only as far as the nuptial swarms can be organized away from the parental nests, plus the very short distance walked by the dealated queens" (Wilson 1971). In some ants, especially tropical species, the queen continues flying after copulation and may be carried a considerable distance (8-64 kms) by the wind.

Although we do not know the copulation patterns that are part of the nuptial flights of our desert species, the many observations we have made in the course of our studies of desert ants suggest that most of these species do not generally disperse over wide ranges as a result of their mating flight activities.

If colony establishment by founding queens is as localized as we suspect, then new colonies would not be able to "escape"

extensive disturbances in their macrohabitats.

Known Habitats of California Desert Ants

The information presented in Table 3 can be used to determine general plant community/ant associations. Failure to collect a species from its listed preferred habitat(s) in any locality may be indicative of some past ecological disturbance. However, its absence may also be due to the fact that the range of that particular species does not include the locality in question. The presence of species preferring disturbed situations (see Table 4) might be used here to test this hypothesis.

Table 3 reflects only the collections made to date. Some of these species may occur in additional habitats that have not yet been collected.

Susceptibility of Desert Ants to Disturbances

We do not feel we have sufficient information to comparatively rate each ant species according to its susceptibility to the categories of disturbances presented in Table 4. However, based on our knowledge of their habits, we have listed the probable occurrence or nonoccurrence of ants under each of these conditions.

Some of our species occupy restricted ranges/habitats which probably will never be impacted by these activities. Thus, when a species is listed as "predictably absent", it does not necessarily reflect the susceptibility of a species to a given disturbance.

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Table 3. Distribution of California desert ants according to plant communities.

Key to biome types. MOJAVE: 1, Creosote Bush Scrub; 2, Creosote Bush/Dunes Scrub; 3, Saltbush Scrub; 4, Shadscale Scrub; 5, Blackbush Scrub; 6, Joshua Tree Woodland; 7, Great Basin Sagebrush Scrub; 8, Pinon-Juniper Woodland. COLORADO: 1, Creosote Bush Scrub; 2, Creosote Bush/Dunes Scrub; 3, Cactus Scrub; 4, Wash Woodland; 5, Palm Oasis; 6, Saltbush Scrub; 7, Alkali Sink. Introduced urban species are marked *.

	Mojave Desert	Colorado Desert
<u>Hypoponera opaciceps</u>	*	
" <u>opacior</u>	3	
<u>Cerapachys</u> sp.	6	4,7
<u>Neivamyrmex californicus</u>	1,6,7	4
" <u>leonardi</u>	1,6,7	
" <u>minus</u>	6,8	
" <u>mojave</u>	6	
" <u>nigrescens</u>		4
" <u>swainsoni</u>		4,6,7
<u>Pseudomyrmex apache</u>		4,6,7
" <u>pallidus</u>	6	4,6,7
<u>Manica mutica</u>	7,8	
<u>Pogonomyrmex anzensis</u>		4
" <u>californicus</u>	1-8	1-7
" <u>desertorum</u>		1 ?
" <u>imberbiculus</u>	1,6	1,3
" <u>magnacanthus</u>	1,2	1,2,4,6
" <u>maricopa</u>	1	1,3,4,6

Table 3. Distribution of California desert ants according to plant communities (cont.)

	Mojave Desert	Colorado Desert
<u>Pogonomyrmex rugosus</u>	1,3,5,6	1,3
" <u>subnitidus</u>	1,6,8	
" <u>tenuispinus</u>		1,3
" new species	5-6 ?	
<u>Aphaenogaster boulderensis</u>	1	1,3
" <u>megommatus</u>	1,3,7	1,4,7
<u>Novomessor cockerelli</u>	1,6	1,3
<u>Veromessor andrei</u>	6,8	
" <u>lariversi</u>	1,7	
" <u>pergandei</u>	1,3,4,5,6	1,3,4,5,6
<u>Pheidole barbata</u>	1,2,6	1,2,4
" <u>clydei</u>	1,8	1,4
" <u>desertorum</u>	1,6,7	1,3,4
" <u>gilvoscens</u>	1,6	1,4
" <u>hyatti</u>	2,6,8	4,5,7
" <u>paiute</u>	1,7	1,4
" <u>psammophila</u>	1,2	1,2
" <u>rugulosa</u>	1,6	1,4
" <u>sciophila</u>		4,6
" <u>tucsonica</u>	1,6,8	1,4
" <u>vistana</u>	1,6	1,4
" <u>yaqui</u>	1	1,4
<u>Cardiocondyla ectopia</u>		*
<u>Crematogaster californica</u>	6	4

Table 3. Distribution of California desert ants according to plant communities (cont.)

	Mojave Desert	Colorado Desert
<u>Crematogaster</u> <u>depilis</u>	1,3,6,7	1,4
" <u>hespera</u>	3	6,7
" <u>larreae</u>	1,6	
" <u>mormonum</u>	6,7,8	
" <u>opuntiae</u>	1	1,3
<u>Monomorium</u> <u>minimum</u>	1,6	1,3,4,5
<u>Solenopsis</u> <u>aurea</u>		1,4,5,6
" <u>maniosa</u>	1,3,4,6	1,4,5,6,7
" <u>molesta</u>	1,3,6	1,4
" new species	1,3	
<u>Leptothorax</u> <u>andrei</u>	6	1,2
" sp. A	6	
" sp. B	3	4
<u>Cyphomyrmex</u> <u>rimosus</u>		1,3,4
" <u>wheeleri</u>		1,4,6
<u>Acromyrmex</u> <u>versicolor</u>		4
<u>Liometopum</u> <u>occidentale</u>	3	
<u>Tapinoma</u> <u>sessile</u>	7,8	4,5
<u>Forelius</u> <u>foetidus</u>	1,3-8	1,3-7
" <u>pruinus</u>	1,3-8	1,3-7
<u>Conomyrma</u> <u>bicolor</u>	1,3,6	4,5,6,7
" <u>insana</u>	1,3,6	4,5,6,7
<u>Brachymyrmex</u> <u>depilis</u>	3,7	4,5
<u>Camponotus</u> <u>festinatus</u>	6	1,4,6,7

Table 3. Distribution of California desert ants according to plant communities (cont.)

	Mojave Desert	Colorado Desert
<u>Camponotus hyatti</u>	1,7	
" <u>ocreatus</u>	6,8	1,4
" <u>sansabeanus</u>	6,8	4
" <u>sayi</u>	3	4,6,7
" <u>semitestaceus</u>	7,6	
" <u>vicinus</u>	6,7,8	
<u>Paratrechina longicornis</u>		*
" <u>sp. A</u>		4,6,7
" <u>sp. B</u>	1	5
<u>Myrmecocystus colei</u>	1	
" <u>creightoni</u>	1,6	
" <u>ewarti</u>	1	1,3,4
" <u>flaviceps</u>	1,3,6	1,3,4,6
" <u>kathjuli</u>	1,6	
" <u>kennedyi</u>	1,3,7	1,2,4,6
" <u>lugubris</u>	1,3	
" <u>mendax</u>	1,6,8	3,4
" <u>mexicanus</u>	1,2,6,7,8	1,4
" <u>mimicus</u>	1,6	3
" <u>navajo</u>	6,8	
" <u>romainei</u>	6	
" <u>semirufus</u>	1,6	3,4
" <u>tenuinodis</u>		1
" <u>testaceus</u>	6,7,8	

Table 1. Distribution of *Salmonella* isolates by serotype and phage type (1965-1966).

Phage type	Serotype	Number of isolates
1	1	1
	2	0
	3	0
	4	0
2	1	1
	2	0
	3	0
	4	0
3	1	1
	2	0
	3	0
	4	0
4	1	1
	2	0
	3	0
	4	0
5	1	1
	2	0
	3	0
	4	0
6	1	1
	2	0
	3	0
	4	0
7	1	1
	2	0
	3	0
	4	0
8	1	1
	2	0
	3	0
	4	0
9	1	1
	2	0
	3	0
	4	0
10	1	1
	2	0
	3	0
	4	0
11	1	1
	2	0
	3	0
	4	0
12	1	1
	2	0
	3	0
	4	0
13	1	1
	2	0
	3	0
	4	0
14	1	1
	2	0
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15	1	1
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	4	0
16	1	1
	2	0
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17	1	1
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18	1	1
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19	1	1
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20	1	1
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21	1	1
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22	1	1
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23	1	1
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24	1	1
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25	1	1
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26	1	1
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31	1	1
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32	1	1
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33	1	1
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35	1	1
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36	1	1
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37	1	1
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38	1	1
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39	1	1
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40	1	1
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41	1	1
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42	1	1
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43	1	1
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44	1	1
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45	1	1
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46	1	1
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47	1	1
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48	1	1
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49	1	1
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67	1	1
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88	1	1
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	3	0
	4	0
89	1	1
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	3	0
	4	0
90	1	1
	2	0
	3	0
	4	0

Table 3. Distribution of California desert ants according to plant communities (cont.)

	Mojave Desert	Colorado Desert
<u>Myrmecocystus wheeleri</u>	6,8	
" <u>yuma</u>	1,3	1,4
" new species	6	
<u>Formica altipetens</u>	7	
" <u>gnava</u>		6,7
" <u>perpilosa</u>	1,3,6	
" <u>pilicornis</u>	3,6	
" <u>xerophila</u>	7	

1. General Information
 2. Physical Description
 3. Chemical Composition
 4. Biological Characteristics
 5. Ecological Data
 6. Geographical Distribution
 7. Historical Records
 8. References
 9. Notes
 10. Appendix

1. General Information	2. Physical Description	3. Chemical Composition	4. Biological Characteristics	5. Ecological Data	6. Geographical Distribution	7. Historical Records	8. References	9. Notes	10. Appendix
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Table 4. Occurrence of native ant species in disturbed habitats.

Species	Land Use Categories:	Roads		Agriculture	Urban Development	Recreation
		Grazing	Paved NonPaved			
<u>Hypoponera</u> spp.		O	A A	O	O	O
<u>Cerapachys</u> sp.		A	A A	A	A	A
<u>Neivamyrmex</u> spp.		O	A A	A	O	O
<u>Pseudomyrmex</u> spp.		O	A A	A	O	O
<u>Pogonomyrmex</u> <u>anzensis</u>		A	A A	A	A	?
" <u>californicus</u>		P	O O	P	P	P
" <u>desertorum</u>		O	A A	A	A	O
" <u>imberbiculus</u>		O	A A	A	A	O
" <u>magnacanthus</u>		A	A A	O	A	O
" <u>maricopa</u>		O	O O	P	P	P
" <u>rugosus</u>		O	O O	A	O	O
" <u>subnitidus</u>		A	A A	A	A	O
" <u>tenuispina</u>		A	A A	A	A	O
" n. sp.		?	? ?	?	?	O
<u>Aphaenogaster</u> <u>boulderensis</u>		O	A A	A	A	O
" <u>megommatius</u>		A?	A A	A	A	A
<u>Novomessor</u> <u>cockerelli</u>		O	A A	A	A	O
<u>Veromessor</u> <u>pergandei</u>		P	P P	A	A	O
<u>Pheidole</u> <u>barbata</u>		P	O O	A	A	O
" <u>clydei</u>		O	A A	A	A	O
" <u>desertorum</u>		O	A A	A	A	O
" <u>gilvescens</u>		O	O O	A	A	O
" <u>hyatti</u>		O	A A	A	O	O
" <u>paiute</u>		O	A A	A	A	O

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Table 4. Occurrence of native ant species in disturbed habitats (cont.)

Species	Land Use Categories:	Roads			Urban		Recreation
		Grazing	Paved	NonPaved	Agriculture	Development	
<u>Pheidole</u> <u>psammophila</u>		A	A	A	A	A	O
" <u>rugulosa</u>		O	A	A	A	A	O
" <u>tucsonica</u>		O	O	O	A	A	O
" <u>vistana</u>		O	A	A	A	A	O
" <u>yaqui</u>		O	A	A	A	A	O
<u>Crematogaster</u> <u>californica</u>		O	A	A	A	A	O
" <u>depilis</u>		O	A	A	A	A	O
" <u>hespera</u>		O	A	A	A	A	O
" <u>larreae</u>		O	A	A	A	A	O
" <u>mormonum</u>		O	A	A	A	A	O
" <u>opuntiae</u>		O	A	A	A	A	O
<u>Monomorium</u> <u>minimum</u>		O	O	A	O	P	P
<u>Solenopsis</u> <u>aurea</u>		O	A	A	O	O	O
" <u>maniosa</u>		P	P	O	P	P	P
" <u>molesta</u>		A	A	A	A	P	O
" n. sp.		A	A	A	A	A	A?
<u>Leptothorax</u> <u>andrei</u>		A	A	A	A	A	O
" sp. A		A	A	A	A	A	O
" sp. B		A	A	A	A	A	O
<u>Cyphomyrmex</u> <u>rimosus</u>		O	A	A	A	A	O
" <u>wheeleri</u>		O	A	A	O	A	O
<u>Acromyrmex</u> <u>versicolor</u>		A	A	A	A	A	O
<u>Forelius</u> spp.		P	O	O	O	O	P
<u>Conomyrma</u> spp.		P	O	O	O	O	P

Table 4. Occurrence of native ant species in disturbed habitats (cont.)

Species	Land Use Categories:	Roads			Agriculture	Urban Development	Recreation
		Grazing	Paved	NonPaved			
<u>Brachymyrmex depilis</u>		A	A	A	A	A	0
<u>Camponotus sayi</u>		0	A	A	A	0	0
<u>Paratrechina</u> sp. A		0	A	A	A	A	0
" sp. B		A	A	A	A	A	0
<u>Myrmecocystus colei</u>		0	A	A	A	A	0
" <u>creightoni</u>		0	A	A	A	A	0
" <u>ewarti</u>		A	A	0	A	A	0
" <u>flaviceps</u>		0	0	0	A	A	0
" <u>kathjuli</u>		0	A	A	A	A	0
" <u>kennedyi</u>		A	A	0	A	0	0
" <u>lugubris</u>		A	A	A	A	A	0
" <u>mendax</u>		0	A	A	A	A	0
" <u>mexicanus</u>		0	A	A	A	A	0
" <u>mimicus</u>		0	A	0	A	A	0
" <u>navajo</u>		0	A	A	A	A	0
" <u>romainei</u>		0	A	0	A	A	0
" <u>semirufus</u>		0	A	0	A	A	0
" <u>tenuinodis</u>		A	A	A	A	A	0
" <u>testaceus</u>		0	A	A	A	A	0
" <u>wheeleri</u>		0	A	A	A	A	0
" <u>yuma</u>		?	A	A	A	A	0
<u>Formica gnava</u>		0	A	A	0	0	0
" <u>perpilosa</u>		0	A	A	0	A	0

P = Predictably present
 0 = Occasionally present
 A = Predictably absent
 ? = Information insufficient

It may simply reflect its absence entirely from a range which includes at least one of the disturbed conditions. For example, Aphaenogaster boulderensis is absent from areas of agricultural and urban development, only because it nests in rock faces. It is likewise impossible to reflect in the table the degree of development involved in each of the categories and the relative impact on an ant species. Such differences are treated in the discussion section for each of the categories listed.

Table 4 does not include introduced species such as Cardiocondyla ectopia or Paratrechina longicornis. It also is restricted to the ants characteristic of the hot desert and thus omits such species as Manica mutica, Veromessor andrei, V. lariversi, Liometopum occidentale, Tapinoma sessile, Formica altipetens, F. pilicornis and F. xerophila, and most species of Camponotus.

Ants as Indices to the Condition of the Environment

Some of the more obvious cues for determining the condition of the environment based on the presence (or absence) of ants are outlined below. They are to be used in conjunction with the information presented in Tables 3 and 4.

Presence of Highly Sensitive Species

The presence of highly sensitive species (see Appendix 4) such as Acromyrmex versicolor, Cyphomyrmex spp., Neivamyrmex spp., and Myrmecocystus spp. (with the exception of M. flaviceps, Kennedyi, romainei and semirufus) generally indicate a rich, well-

balanced, undisturbed environment.

High Species Diversity/Feeding Guilds Well-Represented

A study of Table 3 will indicate the desert habitats that are highest in ant species diversity. These are undisturbed communities characterized by mild soils and diverse vegetation, including an abundance of annuals. In these "ideal" settings, a minimum of 15 ant species, representing most of the feeding guilds, (see Table 2) should be present. The annuals, especially grasses, support granivores, and these ants, as well as ants of some of the other guilds, will provide food for the predaceous species. In a highly diverse community such as this, ants characteristic of disturbed habitats (see Table 4) such as Solenopsis maniosa, may be present, but will not be a dominant element of the myrmecological fauna.

Dominance by Granivore Guild

A community rich in harvesters indicates high seed production (largely due to small-seeded annuals). This situation could be the result of grazing and replacement of native vegetation with grasses. Some Pheidole (those that are graminivorous) appear to prefer such situations. For example, in the Kofa Mountains at a burro-grazed site, Pheidole tucsonica was unusually common, while Ph. barbata was entirely absent, even though the site was well within its range.

Presence of Species Preferring Disturbed Habitats

Solenopsis maniosa, Cardiocondyla ectopia and Paratrechina longicornis are species that prefer disturbed habitats. S. maniosa can predictably be found at least some time during the year in almost all the disturbed situations listed in Table 4. C. ectopia and P. longicornis are introduced species (thus are not listed in the table) that are easily transported to new localities since they nest in potting soil and plant cavities. They do especially well in urban settings. Although C. ectopia establishes itself in yards, it is unaggressive, forms small colonies only, and scavenges or takes nectar. It is thus not considered a pest species. However, the diets of S. maniosa and P. longicornis include meats, animal fats, vegetable oils, grain, fruits and sweets, and they are thus well known household pests. They also tend aphids and other homopterous insects which are detrimental to domestic plants. In addition to their omnivorous habits, they are polygynous (possess multiple queens) and aggressive, features which afford them the competitive ability necessary for establishment in new environments.

An abundance of Solenopsis maniosa or the presence of species such as Cardiocondyla ectopia or Paratrechina longicornis are strong indications that extensive disturbance has occurred. Species diversity in these situations will be severely reduced.

Observations on the nesting habits of the

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Land Use Categories and their Impact on Ants

Effects of Livestock Grazing on Ant Populations

The effect of livestock grazing on species diversity in ants depends on the type and number of animals allowed to graze and the duration of such activity. If grazing is casual and intermittent so as to allow the land a period of recuperation sufficient for germination and survival of occasional seedlings, then grazing could be tolerated. For example, one of our sites at Koehn Dry Lake (near Randsburg, Kern County) had been grazed each winter for some time by sheep. Salsola iberica and Bebbia juncea co-dominated this Creosote Bush Scrub which appeared to be low in the diversity of perennial dicots. However, grasses were more abundant and diverse than in comparable undisturbed sites, resulting in an increase in colonies of harvesters such as Veromessor pergandei, Pogonomyrmex californicus, and Pheidole gilvescens. The area was by no means depauperate in terms of non-harvesters such as Conomyrma insana, Forelius pruinosis and Myrmecocystus flaviceps. The presence of Myrmecocystus in particular is an indication that this frequency and type of grazing did not represent a serious threat to the local ant fauna.

Our observations of burro grazing (although made in the Kofa Mountains of Arizona), support these conclusions. With an increase in grasses, colonies of harvesters such as Veromessor, Pogonomyrmex and Pheidole are more abundant, but species diversity of non-harvesters is reduced. Ants relying on more diverse vegetation which provides nectar and supports the arthropods that serve as prey are naturally unable to survive. Dense mats of

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grasses also discourage nesting by species which require exposed, well-drained soils.

Effects of Cultivation of Land on Ant Populations

The development of desert lands for cultivation precludes habitation by most species of desert ants. The extent of this impact is dependent on the type of agriculture practiced. Desert orchards of the Coachella Valley, for instance, whether citrus, carob or date, provide generally unsuitable nesting habitats for ants. Species found in these situations include Solenopsis maniosa, S. aurea, Pogonomyrmex californicus and Forelius pruinosus, but they are not abundant. The only species which could be predictably found in orchards is Solenopsis maniosa.

Many agricultural fields are completely plowed and disced after each harvesting, a process which destroys nests located as deep as 10 feet under the soil. Permanent crops such as alfalfa, however, may stand for as long as 12 years with no more disturbance than periodic cutting or harvesting. One would expect to find more ants under these latter conditions.

We found it difficult to find agricultural fields with adjacent undisturbed areas which could be surveyed to test this hypothesis. We therefore had to accept sites for comparison that had at some time in the distant past been exposed to perturbation.

In one such survey, we compared a cultivated field of carrots near Mecca (Riverside County) with the uncultivated field lying directly across a paved highway. The uncultivated field

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was densely populated with the codominants Atriplex hymenelytra and Haplopappus acradenius eremophilus. Suaeda Torreyana, Larrea tridentata and Cercidium floridum were also present. The soil was the extremely fine, alkaline sand characteristic of the upper Salton Sink. Ant species diversity was sampled at both sites and was found to be reduced by 67% at the carrot field.

An additional survey was conducted to compare a more stable type of crop, that of a 12-year old alfalfa field, with an adjacent Creosote Bush Scrub community. The site was located in the Koehn Dry Lake region (near Randsburg, Kern County). The alfalfa field had been replanted three years prior to our survey and cut several times during the past year, the most recent cutting having occurred two weeks before the survey was performed. Larrea tridentata, Salsola iberica and Bebbia juncea were the most common plants encountered in the area across from the alfalfa field. The soil there was fine sand with good drainage. Ant species diversity was reduced 57% in the alfalfa field as compared to this adjacent Creosote Bush Scrub community.

As would be expected, the reduction in species diversity was sharper at the Mecca carrot field site where frequent plowing and discing was practiced than in the alfalfa field where the soil had been undisturbed by plowing for three years. Those species of ants inhabiting agricultural areas that undergo plowing on a regular basis possess certain characteristics which enable them to successfully recolonize. They are polygynous, omnivorous, very aggressive and often are polymorphic. Having more than one queen increases the rate of replacement of the

worker force and allows rapid repopulation of disturbed areas. Omnivory and polymorphism confer tremendous flexibility in feeding habits. The ants may be completely opportunistic with broad niches. Their aggressive nature further enhances their effectiveness as good competitors.

Table 5 lists ants of the surveyed agriculturally-disturbed areas and indicates relative frequency of occurrence.

Effect of Urbanization on Desert Ants

With the exception of invasions made by "tramps" such as Paratrechina, urban settings are populated with ant species which occur in the general desert environs. Diversity and population levels found in urban areas vary according to the degree of urbanization that has taken place.

In rural desert communities, dwellings are scattered. Here the majority of the native perennial desert vegetation persists, although annuals may be greatly reduced or eliminated. In these situations, little disparity exists between the ant species found around these dwellings and in the peripheral open desert.

In industrialized desert communities, such as Barstow, Indio, El Centro and Needles, the impact is much more severe. Native perennials are often eliminated with consequent reduction or elimination of the ants dependent upon them. The more adaptable and aggressive ants are able to survive in the vacant lots, railroad right-of-ways, ditches, canals and other marginal habitats that remain within a city. Some of these may become house pests

Table 5. Ants of surveyed agriculturally-disturbed areas and relative frequency of occurrence.

Species	Common	Occasional
<u>Hypoponera opaciceps</u>		X
" <u>opacior</u>		X
<u>Pogonomyrmex californicus</u>	X	
" <u>maricopa</u>	X	
" <u>rugosus</u>		X
<u>Veromessor pergandei</u>		X
<u>Pheidole hyatti</u>		X
" <u>tucsonica</u>		X
<u>Monomorium minimum</u>		X
<u>Solenopsis aurea</u>		X
" <u>maniosa</u>	X	
<u>Forelius foetidus</u>		X
" <u>pruinosis</u>	X	
<u>Conomyrma bicolor</u>		X
" <u>insana</u>		X
<u>Camponotus festinatus</u>		X
<u>Paratrechina</u> sp. A		X
<u>Myrmecocystus flaviceps</u>		X
" <u>kennedyi</u>		X
<u>Formica gnavia</u>		X
" <u>perpilosa</u>		X

TABLE 1. List of subjects artistically-inclined and
relative frequency of occurrence

Subject	Frequency
1. <u>Artistic</u>	1
2. <u>Music</u>	1
3. <u>Reading</u>	1
4. <u>Writing</u>	1
5. <u>Painting</u>	1
6. <u>Drawing</u>	1
7. <u>Modeling</u>	1
8. <u>Photography</u>	1
9. <u>Video</u>	1
10. <u>Television</u>	1
11. <u>Radio</u>	1
12. <u>Stage</u>	1
13. <u>Screen</u>	1
14. <u>Journalism</u>	1
15. <u>Public Relations</u>	1
16. <u>Advertising</u>	1
17. <u>Design</u>	1
18. <u>Architecture</u>	1
19. <u>Interior Design</u>	1
20. <u>Graphic Design</u>	1
21. <u>Illustration</u>	1
22. <u>Storyboarding</u>	1
23. <u>Visual Arts</u>	1
24. <u>Visual Communication</u>	1
25. <u>Visual Arts and Design</u>	1
26. <u>Visual Arts and Design</u>	1
27. <u>Visual Arts and Design</u>	1
28. <u>Visual Arts and Design</u>	1
29. <u>Visual Arts and Design</u>	1
30. <u>Visual Arts and Design</u>	1

(Solenopsis maniosa) or yard pests (Pogonomyrmex californicus and P. maricopa).

In a survey of the ants present on a vacant lot in Indio, we collected 7 species. The open desert environs yielded 23 species (see Table 6). This represents almost a 70% reduction in species numbers at the Indio lot.

Effects of Highway and Freeway Corridors and Dirt Roads on Ant Populations

Corridors, whether asphalt or dirt, are, in themselves, not particularly detrimental to ant populations. However, where they provide access to desert areas for man, there is a potential for extensive disturbance (figs. 294, 295).

Water run-off from both asphalt surfaces and hard-packed dirt roads promotes the growth of dense populations of roadside annuals, and increased seed productivity by both annuals and perennials results. It is not surprising, then, to find a greater abundance of ants, especially harvesters associated with such corridors. Peripheral to asphalt surfaces, species like Pogonomyrmex californicus, P. rugosus, P. maricopa and Solenopsis maniosa flourish. Not only are seeds more abundant here, but the asphalt provides a surface beneath which moisture is well retained, probably improving conditions for nesting in these species. Vermessor pergandei may be hindered by the amount of moisture retained under asphalt surfaces since this harvester is less commonly encountered close to asphalt bedding. However, it is one of the species which increases in abundance both on and at the side of

Table 6. List of ant species collected in Indio and in open desert environs.

Species	Desert	Vacant Lot
<u>Pogonomyrax californicus</u>	X	X
" <u>magnacanthus</u>	X	
" <u>maricopa</u>	X	X
<u>Aphaenogaster megommatus</u>	X	
<u>Veromessor pergandei</u>	X	
<u>Pheidole barbata</u>	X	
" <u>gilvescens</u>	X	
" <u>hyatti</u>	X	
" <u>tucsonica</u>	X	
" <u>vistana</u>	X	
<u>Crematogaster opuntiae</u>	X	
<u>Monomorium minimum</u>	X	
<u>Solenopsis aurea</u>	X	X
" <u>maniosa</u>	X	X
<u>Forelius foetidus</u>	X	
" <u>pruinosis</u>	X	X
<u>Conomyrma bicolor</u>	X	X
" <u>insana</u>	X	
<u>Camponotus festinatus</u>	X	
<u>Myrmecocystus ewarti</u>	X	
" <u>flaviceps</u>	X	
" <u>kennedyi</u>	X	X
" <u>tenuinodis</u>	X	

hard-packed dirt roads. Myrmecocystus kennedyi, M. semirufus and Conomyrma insana also appear to be successful in these situations. Most ants are not.

Impact of Recreational Activities on Ant Populations

To assess the impact of recreational activity on ant populations, we surveyed four different sites. They were widely separated and represented four distinct habitats, differing in soil and dominant vegetation. The level of "traffic" also varied at each area under study.

The first site, Desert Flower Road, is located five miles north of Adelanto (San Bernardino County) and is exposed to a relatively low level of disturbance. It is basically a Creosote Bush Scrub community (fig. 277). The soil is comprised of fine sand in the lower areas, but grades into gravelly rocky soil on the slopes. Salsola iberica dominates the most disturbed portion of the site, while Larrea tridentata and Ambrosia dumosa are more evenly distributed. A few scattered Yucca brevifolia also occur here. Annuals are plentiful at this locality. Visitation here is heaviest in the Spring when most of the annual wildflowers are in bloom. There are no formal campsites, but the presence of waste material and charred pits indicated that occasional overnight camping probably does occur. Although there was evidence that motorcycles and other recreational vehicles had been at the site, deviations from the dirt roads and makeshift campground appeared to be infrequent.

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Ant colonies were abundant and populous. In addition, species diversity was not significantly reduced from that found in surrounding areas. Neivamyrmex mojave, Pogonomyrmex californicus, P. rugosus, Veromessor pergandei, Pheidole barbata, Ph. gilvescens, Solenopsis maniosa, Conomyrma insana, Forelius foetidus, and Myrmecocystus flaviceps were collected here.

A more formal camp setting prevailed at the Picacho State Recreation Area on the Colorado River (Imperial County). The camping area, which is adjacent to the river, is situated on an alkali fan which emerges from a small wash. It is much overgrown with Tamarix and Pluchea, plants characteristic of alkali situations. There was considerable activity in this area. Motorcycles, vans and four-wheel drive vehicles dominated as did some pretty careless campers. Although ant species diversity and abundance was low, we attributed the paucity to the extremely moist and alkaline soil and low plant diversity rather than the traffic. Solenopsis maniosa, Camponotus festinatus and Formica gnavia were collected at this site.

The Corn Springs Campground in the Chuckwalla Mountains near Desert Center (Riverside County) is more developed and the facilities are well maintained. Enforcement of the campground regulations has kept extensive disturbances to ant fauna to a minimum. The area is well managed and much of the native vegetation is still present around the campsites. Cactus and Creosote Bush Scrub occupy the surrounding rocky slopes, a Wash Woodland occurs alongside the site, and a Palm Oasis is situated within the campground boundaries (figs. 278, 279).

With such an array of habitats, it was not surprising to find a diverse collection of ants. Eight genera were represented, including the specialized leaf-cutting ant, Acromyrmex versicolor. Restrictions on campground activities has no doubt played an important role in the survival of these ants here. Collected were: Pogonomyrmex californicus, Veromessor pergandei, Pheidole tucsonica, Solenopsis maniosa, Acromyrmex versicolor, Conomyrma bicolor, Forelius foetidus, Myrmecocystus flaviceps and M. kennedyi.

At the Algodones Dunes of Glamis (Imperial County), Highway 78 separates a B.L.M. preserve from an area of intense recreational vehicle activity. The site provides an excellent opportunity for a comparative study of a protected dunes habitat (where only authorized vehicles are permitted) and an area where the use of recreational vehicles is widespread and heavy. For the most part, this dunes area is comprised of fine sand and is dominated by Larrea tridentata and Cercidium floridum (figs. 290,291). Dicoria canescens is the abundant Fall annual. Oenothera deltoides is the most conspicuous of the Spring annuals, of which there are many. The physiognomy of the preserve and the adjacent recreational area is basically the same. However, the vegetation of the side permitting recreational vehicles has been severely reduced (mainly due to dune buggy use), and is now confined to small "islands" between the crossroads of traffic (figs. 292,293). Annuals are rare here. Although our survey showed only a 38% reduction in ant species numbers in the unprotected area, the abundance of colonies was severely reduced. Naturally, all suitable nesting

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ROLE OF ANTS IN DESERT ECOSYSTEMS

To date, 100 species of ants, belonging to 26 genera (Appendix I) are known to occur in the desert areas of California. These comprise about 37% of the known ant fauna of the state.

Although some are very widely distributed species which enter the deserts only marginally, most are truly xerophilous. Ants are a dominant life form in our deserts and may outnumber, in terms of individuals, all other terrestrial animals. Colonies often consist of thousands of individuals and are remarkably stable due to the longevity of the reproductive females (13-17 years). Because of their ubiquity, abundance and longevity, ants are an important element in the desert ecosystem.

Nests of desert ants consist of extensive galleries and tunnels (fig. 321) which may reach depths of four to five meters. A single colony of Veromessor pergandei may occupy an acre or more. Such extensive excavation of nests results in the mixture, comminution and aeration of soils. Not only are deep and superficial layers exchanged, but important organic components from chaff piles (fig. 301), refuse chambers and seed stores are added to the soils at considerable depths. The excavated soil from nests, once brought to the surface and deposited on the mound, is exposed to wind and rainstorms which disperse it. Significant amounts of soil are overturned. A single mound formed by the tropical fungus-growing ant, Atta sexdens, may involve as much as 42 cubic meters of soil (Weber 1972).

Plant/Ant Interactions

Almost all ants are dependent on plants, either directly for nectar, seeds, or other plant parts, or indirectly, for their ability to attract potential prey or homopterans which secrete honeydew. In turn, ants pollinate plants, disperse their seeds, and may act as "pugnacious bodyguards" (Bentley 1977), protecting the plant from nectar thievery by corolla-piercing bees such as Xylocopa and some species of Anthocopa, Perdita, etc.

Flower Visitation

Nectar or plant exudates constitute an important portion of the diet in at least half of the 100 species of ants on our California deserts. Sources vary, but include not only nectar from flowers or extrafloral nectaries, but resins from leaves and honeydew from aphids and scale insects as well.

Ants of the genus Myrmecocystus, of which there are 18 desert-dwelling species, rely most heavily on these carbohydrates and collect from plants on a regular basis. They are thus known as "honey ants". Members of the subfamilies Formicinae and Dolichoderinae seem to have a thinner and more flexible integument than other ants, which allows for considerable distention of the gaster. When a forager becomes engorged with nectar, the sclerites separate and the intersegmental membrane can be seen stretched between (fig. 330). Internally, the crop, where the nectar is temporarily stored, expands, displacing the other organs of the abdominal cavity. Returning honey ant foragers regurgitate their nectar to repletes which hang from the ceilings of subterranean

nest chambers (figs. 322,323). The gasters of the repletes are enormously distended and their role is one of storage alone. Since workers are selected for storage purposes while still callow, they have more pliable integuments and a greater capacity for storage than the workers that leave the nest to forage.

Most of the flowers visited by desert ants for nectar are small and in fairly close proximity (fig. 315). The plants themselves vary greatly in height and configuration (e.g. see lists of plants utilized by Conomyrma and Myrmecocystus species). Despite the length of time required for ants to climb up to the position of the flowers, once there, they move rapidly from one to another, sipping nectar and often making contact with the anthers and other reproductive parts as well (fig. 330). Pollen is generally deposited on the head and thoracic regions of the body. The ants we observed visited several flowers in succession before grooming themselves. During this process, much of the pollen was collected in the infrabuccal pocket and may have been used later in larval nutrition. Although ants are generally not considered to pollinate flowers with any regularity, our observations of honey ant visitation to some of the smaller desert plants that conform to the ant pollination syndrome characterized by Hickman (1974) suggest they do commonly effect fertilization in these plants.

Seed Harvesting and Dispersal

One of the prominent characteristics of many desert ants is their utilization of seeds for food. Nearly one-fourth (23%) of the ant species known to occur in our California deserts subsist

largely on seeds.

Foragers dig for the previous year's seeds in subsurface soil. As the season progresses, they climb plants and cut off the fruits. Some seeds are extracted from their capsules while still attached to the plant, often even before ripening. Workers inside the nest cut open the fruits and select usable seeds from material which may contain empty capsules, stem and leaf fragments, and other debris. Once husked, the seeds are transported to seed storage chambers located at varying levels below the surface. As these granaries fill, new ones, which can be supplied more efficiently from a new and closer nest entrance, are opened. Thus a nest that appears to be defunct, may simply represent an abandoned entrance, with the new hole usually located a few feet or even inches away.

A great deal of organic material accumulates on ant mounds, altering the soil conditions there and producing improved germination sites for stray or mistakenly discarded seeds. Figure 302 shows an abandoned Veromessor pergandei mound which is covered with grasses. The substrate peripheral to it is devoid of such vegetation.

Harvesters gather and store impressive quantities of seeds during a season. Tevis (1958) reports the average number of seeds collected by one colony of Veromessor pergandei to be 7,000 per day. His study area contained six colonies per acre. Thus, 42,000 seeds per acre (or 15 million seeds per acre per year) were harvested by this species alone!

Due to the difficulty in excavating nests of most granivorous ants (especially the Pheidole species), seed caches are generally not collected and identified. Records provided by Tevis (1958), Wheeler and Wheeler (1973), Rissing and Wheeler (1976), and Whitford (1978b) represent the bulk of the available data on seed types utilized by ants. We collected seeds primarily from foragers as they returned to the nest. Records for the ubiquitous black harvester, Veromessor pergandei include seeds from 50 plant species representing 20 families (Table 1).

Not all gathered seeds are stored. Many are lost in transit to the nest. Often, viable seeds are discarded after some useful part such as the elaiosome (fat body) is removed. Pheidole desertorum, Ph. hyatti, and Pogonomymex californicus utilize the elaisomes from Datura discolor seeds. Removal is apparently accomplished at the nest site. Considered an adaptive feature to enhance seeds dispersal by ants, the presence of an elaiosome functions to encourage these insects to transport seeds away from the parent plant, thus reducing parent-cohort competition. Elaisomes, which are rich in fat, sugars and vitamins, are fed upon by larvae as well as adult ants (Handel 1976).

At the rate that granivorous ants consume seeds, it seems doubtful that the positive role ants play in seed dispersal could be significantly offset by the negative effect of their predation on seeds.

After his study of Veromessor pergandei in a portion of the Sonoran Desert which had suffered 12 years of drought, Tevis (1958) concluded that this species harvested only 1% of the seeds avail-

less favorable periods. They generally spent less time searching for seeds and experienced a proportionately higher success rate than did coexisting individual foragers. Those species which engaged in individual foraging harvested seeds predominately from dispersed distributions, which required that the seeds be independently discovered. This generally took more search time and resulted in a lower foraging success than that of group foragers. Davidson (1977b) points out that, although group foraging appears "to promote coexistence between species with similar food requirements", it probably evolved as "a specialization for exploiting high diversity resources efficiently."

Hölldobler (1974, 1976a) suggests that the trunk trails of Pogonomyrmex rugosus and P. barbatus (paths established and maintained for exclusive use by the workers of one nest for the purpose of avoiding confrontations with neighboring colonies) function efficiently in reducing aggressive encounters that would otherwise be quite frequent in densely-populated areas. Differences in daily or seasonal activity periods would also reduce competitive interactions. Whitford (1978a) found that where there was an overlap in the body length of workers occupying the same habitat, they "exhibited marked differences in diel and seasonal activity."

The ability of harvesters to so partition their resources allows for greater species packing by members of this guild and enhances the overall effect they will have on local vegetation patterns.

low density patches. They generally found the same locations

for nests and eggs, and a proportionately higher success rate

than the cooperative individual foragers. These species which

foraged in isolation, foraging harvested more sporadically from

the same locations, which resulted in a lower success rate

than the cooperative. This generally took no more than a few

minutes in a lower foraging success than that of group foragers.

It is possible that one that, although group foraging appears

to be a cooperative behavior between species with similar food

resources, it probably evolved as a specialization for exploiting

high density resources efficiently.

Wilson (1974, 1976) suggests that the same could be

applied to Parasitoid wasps and Y. castaneae (both solitary and semi-

societal foragers) use by the workers of the nest for the pur-

pose of avoiding confrontation with higher-level workers (which

will result in the death of the subordinate) and social cooperation

in the foraging in a highly organized manner. Differences in

the degree of social activity would also result from the

degree of social activity. Wilson (1976) found that more than 50%

of the foraging was done by the workers of the nest, which

was consistent with the idea of social cooperation in the nest

and social cooperation in the nest.

Wilson (1976) suggests that the same could be

applied to Parasitoid wasps and Y. castaneae (both solitary and

semi-societal foragers) use by the workers of the nest for the pur-

pose of avoiding confrontation with higher-level workers (which

able from ephemerals. However, he did note that seeds of the favored Malvastrum, Mentzelia and Oenothera clavataeformis, although they made up less than 8% of the total available supply, comprised 90% of the seed forage these ants took to their nests. By preying so heavily on a preferred seed species, it is conceivable that granivorous ants could shape the composition of vegetation in a given area.

In a desert community near Las Cruces, New Mexico, Whitford (1978b) found Pogonomyrmex rugosus foraged selectively on grama grass seeds (Bouteloua barbata) when they were plentiful. Although this preference was altered when seed production diminished, Whitford felt a significant fraction of the seeds were removed from the population and that the "density, species composition and relative abundance of annuals should reflect those seeds which escape predation."

A rich desert environment may support as many as 8 coexisting species of harvesters. Sizes of ants in a given habitat may vary both interspecifically and intraspecifically. Polymorphic species such as Veromessor pergandei, V. lariversi, Pheidole desertorum and Solenopsis maniosa can take several seed sizes and thus represent species with broader feeding niches than monomorphic granivores. Davidson (1977a) found that worker body lengths are highly correlated with size indices of seeds foraged, and that "species of similar body size can coexist within local habitats if they differ in foraging strategy." She also noted (1977b) that group foragers were most active during intervals of high seed density and "low climatic stress", and estivated or hibernated during

Leafcutting

Predation on plants by our desert fungus-growing ants takes a different form. Essentially, they chew up one plant so they can eat another! The most conspicuous species, Acromyrmex versicolor, systematically strips desert plants of leaves, stems and flowers. This species also collects pod fragments, seed capsules and leaves from the ground (figs. 308-311). These are transported back to the nest where they are masticated and used as a substrate for growing fungus. The ants feed on the inflated tips of the fungal filaments and actually imbed their larvae in these filaments so they may feed at will. Although Cyphomyrmex wheeleri, a smaller species, also uses vegetable matter for culturing its fungus garden, its congener C. rimosus has the unusual habit of collecting caterpillar feces for this purpose.

Leaf-cutter ants play a major role in tropical ecosystems where they are more diverse and the colonies more populous. Here, foragers may denude entire trees. However, in our deserts, they are limited in distribution and rarely defoliate more than small shrubs that are drought-deciduous anyway.

Plants as Domiciles for Ants

Plants often function as domiciles for ants. The best known example is that of the tropical acacia ants, Pseudomyrmex spp. which nest in the hollow thorns of the bull-horn acacia.

Our desert Pseudomyrmex, P. apache, nests in branches of mesquite (and evergreen oaks at higher elevations) that have been previously penetrated by wood-boring insects. These ants clean

any remaining debris from the passages before establishing a colony there. Its congener, P. pallidus, nests in desert lavender (Hyptis emoryi).

Camponotus hyatti nests in Yucca stalks and hollow stems of Atriplex and Artemisia. C. sayi rarely excavates its own galleries, but utilizes old ones prepared by termites or wood-boring beetles in dead limbs or under the bark of cottonwood, willow, desert willow, mesquite, etc.

Crematogaster hespera also nests under the bark of cottonwood trees. C. larreae uses the roots of creosote and C. opuntiae nests in rotting roots and stems of the cactus Opuntia.

It is possible that the foraging activities of nectivorous ants such as Myrmecocystus, Formica, Crematogaster, etc. on plants discourage plant predation by other insects or by vertebrate herbivores as is the case in the tropics (Janzen 1966; Bentley 1977).

Interactions of Ants with Other Faunal Elements

Ants and Vertebrates

Since ants are abundant and active throughout most of the year, they represent a predictable and dependable food source. Ants are preyed upon by many desert vertebrates.

During their mating flights, they represent a particularly abundant and concentrated resource which is utilized by birds and bats, as well as other arthropods.

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Lizards, particularly the genus Phrynosoma, prey heavily on ants, especially those of the genera Veromessor, Pogonomyrmex, and Myrmecocystus. Even though an ant is a small food item with a considerable amount of unusable chitin, ant colonies represent a spatially-clumped resource. Phrynosoma have unusually large stomachs so they may consume great numbers of ants at one feeding. In addition, Hotton (1955) "noted that Phrynosoma have blunt, stout, non-cusped, low-crowned and peglike teeth, which he termed an "ant-eating" dentition" (Pianka and Parker 1975). All of our observations of ant predation have involved lizards positioned at the nest entrance rather than at foraging sites or on foraging trails where the ants are moving along rapidly. Ants leaving or coming to their nests may be less wary of predators than when foraging, and a Phrynosoma with cryptic coloration and behavior would hardly be detectable. However, in an analysis of Phrynosoma m'callii scats, we usually found ants from several species in each scat, suggesting that these lizards probably move around from nest to nest in a given area or take ants at a food source that attracts a variety of species. Lizards such as Uma spp. are less specialized for myrmecophory, but also take ants as prey.

Another reptile, the blind snake, Leptotyphlops dulcis, exhibits a very sophisticated adaptation for feeding on Neivamyrmex nigrescens. Watkins, et al (1967) have found that this nocturnal snake is capable of following the pheromone trails of these army ants back to their bivouac to locate and feed upon their brood. When attacked by these aggressive, predaceous ants, the snake coils up to reduce surface area for attack, and discharges a

cloacal sac fluid over its body which serves to repel further ant attacks.

Coyotes and badgers dig into nests of honey ants (Myrmecocystus spp.) to feed on the nectar-filled repletes within (Snelling 1976). Although they may not terminate the colony if the queen somehow remains undisturbed, they usually obliterate much of the nest architecture in the process of reaching the repletes (which may be located as deep as 10 feet).

In a study performed to assess the degree of competition between seed-eating rodents and ants, Brown and Davidson (1977) found there were extensive overlaps in the diets of these two taxa. Foraging rodents and ants selected overlapping sizes and species of both native and domestic seeds and collected the latter from the same microhabitats. When one of the taxa was experimentally excluded from a study plot, there was a significant increase in the remaining taxon. For example, colonies of granivorous ants increased 71 percent on plots from which rodents had been excluded, and rodents increased 18 percent in number of individuals and 24 percent in biomass on plots where ants had been removed." When both ants and rodents were excluded from a plot, the density of seeds from annuals was 5.5 times greater than it had been. Nelson and Chew (1977) found the seed reserves at their Mojave Desert site in Nevada decreased 40% under heavy rodent populations, and 20% where the population was light, but concluded that "it takes an exceptional coincidence of events [less than threshold requirements in rainfall and seed dormancy period] even in deserts, to cause a severe depletion of seed reserves." However, the effect

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of rodents and ants together on the desert plant community is obviously extensive.

Other interactions between rodents and ants are less well documented. Kangaroo rats, Dipodomys spp., are known to frequently raid the seed caches of granivorous ants such as Pheidole spp. that store their seeds in shallow chambers of the nest (Wheeler and Wheeler, pers. comm.; Snelling unpubl.), and are thought to be capable of detecting these clumped resources by olfaction (Reichman 1977). The response of the ants to such thievery is unknown. Although species of the aggressive Solenopsis are known to attack and kill bird nestlings (Smith 1965), the rodents are undoubtedly too fast for an aggressive encounter to ensue.

Ants and Other Invertebrates

The arthropod predators of ants greatly outnumber any other taxon. Spiders, beetles, bugs, wasps and flies comprise the bulk of the groups that find ants appetizing or convenient.

Spiders such as Steatoda (Theridiidae) are common ant predators in our local deserts. The spider builds a fine web over the nest entrance of a colony, presumably during a period when it is inactive, and seizes unwary ants as they emerge to forage. It is cryptically colored and barely visible among the soil particles which hang in the webbing (fig. 328). The colony members eventually become aware of the spider and close the nest entrance entirely, constructing a new one in the vicinity sometime later (George, unpubl.).

Several types of beetles prey on the larvae of ants. Cre-
mastocheilus spp. (Scarabaeidae) feed on larvae of Myrmecocystus,
Formica, Camponotus, Veromessor and Pogonomyrmex. Helluomorphoides
(Carabidae) feeds on Neivamyrmex larvae. The larvae of a group in
the Chrysomelidae reside in nests of Camponotus. It is unknown
whether they are predators or scavengers.

Members of the family Phymatidae sit on flowers and ambush
ants when they come to feed on nectar.

The chalcidoid, Orasema occidentalis Ashmead (Eucharitidae)
is a larval parasite that has been taken from nests of Pheidole
desertorum.

Clypeadon (Sphecidae) are often very species-specific with
regard to prey. They "alight near an ant nest and remain motion-
less until an ant hurries by. The wasp then rushes the ant, stings
it," and flies away with it. An egg is laid on each captured ant
(Bohart and Menke 1976).

Flies of the family Phoridae alight on foraging ants such as
Pogonomyrmex and Pheidole and oviposit their eggs inside the head
capsule, gaining access through the foramen magnum. The developing
maggots feed on the tissue inside. Syrphid flies of the genus
Microdon also parasitize ants.

Predaceous ants often feed upon other ants. Neivamyrmex spp.
specialize on ants and termites, consuming workers, larvae, pupae
and eggs. Cerapachys sp. also feeds on ants. Hypoponera spp. are
generalized predators and only occasionally take ants.

Some ants conduct raids on nests of neighboring colonies and appropriate their brood for use later as slaves in their own nests. Once the captive larvae and pupae eclose as adult workers, they join in the duties of maintaining the slave-maker's colony. Even though it is a phenomenon that is known to occur in many parts of the world (at least 35 species of ants depend to some extent on slave labor for their existence), records of dulosis in our deserts are limited. Workers of Myrmecocystus mimicus have been observed in the Mojave Desert (George, unpubl.) breaking into a neighboring nest and extracting larvae and pupae which were then transported back to their own nest. Although their behavior was frenzied and aggressive at the time of the observation, it is not known if fighting preceded this activity and thus if it represents a slave raid or merely relocation of the colony. In southeastern Arizona, Hölldobler (1976) observed conspecific colonies of Myrmecocystus mimicus engaging in ritualized tournaments (highly stereotyped display fights to challenge territorial borders) where the weaker colony was subsequently raided. He speculates that the members of the losing colony (larvae, pupae, workers and repletes) which were dragged off, were to be incorporated as slaves in the victor's colony.

In Nevada, reproductives of Pogonomyrmex n. sp. have been found in the nest of P. rugosus (Rissing, pers. comm.). Since mating flights of both species in this nest have been observed, it is apparent that the host queen has not been destroyed as is often the case in social parasitism. Presumably, a Pogonomyrmex n. sp. queen enters a newly founded nest of P. rugosus, and lays her own

eggs which develop into reproductives only (no workers of this species have been collected). The P. rugosus queen produces workers as well as reproductives. This new species of Pogonomyraxes is now under study.

Other forms of social parasitism in ants (plesiobiosis, cleptobiosis, lestobiosis, parabiosis, xenobiosis, temporary parasitism, and inquilism) are reviewed and well documented in Wilson (1971, 1975a,b). The cleptobiotic practices of Myrmecocystus romainei on foraging columns of Forelius pruinus (George, Snelling unpubl.) are discussed under the section devoted to that species.

There are many insects other than ants (i.e. beetles, silverfish, etc.) that live within ant nests. The records we have are presented with the life history data for each species. The limits and details of these relationships are generally not well known and deserve further study.

Well known mutually-beneficial relationships do exist between ants and phytophagous insects such as aphids, mealybugs, scales, and lycaenid caterpillars. Ant species of the genera Crematogaster, Solenopsis, Myrmecocystus and Formica regularly tend these insects for their secretions ("honeydew"). In turn, the ants defend them from parasites and predators and transport them from plant to plant. Formicids are thus important in the survival and dispersal of these plant pests.

Most desert ants are at least occasionally predaceous (12% commonly; 49% occasionally). As such, they are important in

regulating populations of arthropods, and thus play a major role in the maintenance and stability of the desert ecosystem. A wide array of arthropods is taken, but termites (especially Reticulitermes, Hesperitermes), grasshopper egg masses, lepidopteran larvae, homopterans and spiders are favored. Details of their feeding habits are listed under each species.

Scavenging and Decomposition

As scavengers, ants serve as agents of the decomposition process. Dead arthropods and their fragments are regularly collected by most deserticolous ant species and further broken down to organic nutrients which may then be returned to the soil. Carcasses of deceased ants are often discarded on the tumulus around a nest entrance. Neighboring species regularly peruse such mounds for these carcasses (George, unpubl.) which represent a dependable and renewable source of food.

When food items are too large for ants to drag off, they recruit great numbers of nestmates to the site. The item is rapidly "disassembled" and pieces transported to the nest. Any desert animal, no matter how large or small (coyotes, hawks, snakes, rodents) represents a potential food source to ants. No stone, or fecal pellet is left unturned!

Summary of Feeding Habits for California Desert Ants

Feeding habits of our California desert ants are summarized in Table 2. The fact that most (57.5%) of these commonly engage

sites were confined to these small islands of vegetation.

We did not observe aggressive encounters between ants, but competition for food and nesting sites surely must be intensified due to the contraction of these refuges. We feel it is only a matter of time before the islands themselves disappear, and with them the ant refugees they support. Pogonomyrmex californicus, Pheidole psammophila, Acromyrmex versicolor, Conomyrma bicolor and Myrmecocystus kennedvi were collected on these islands. Additional species collected on the preserve consisted of Veromessor pergandei, Solenopsis maniosa, and Forelius foetidus.

All ant species are dependent on vegetation, whether directly or indirectly for the arthropods it attracts. Although we did not survey the California City (Kern County) area for ants, figures 294 and 295 show how severe an impact recreational vehicles can have on the desert vegetation.

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Figure 282. Edge of salt pan with limited Saltbush Scrub.
South of Badwater, Death Valley National
Monument.

Figure 283. Saratoga Springs, Death Valley National
Monument.

Figure 284. Saltbush Scrub, edge of Troy Dry Lake, San
Bernardino Co. Note mesquite hummocks.

Figure 285. Saltbush Scrub, halophytic phase, with
Mesquite and Cottonwood. Near Newberry
Springs.

Figure 280. Cactus scrub on rocky slope, Iron Mtn., Imperial Co. Habitat of Myrmecocystus mendax and Pogonomyrmex rugosus.

Figure 281. Middle falls of Darwin Falls. Typical habitat for Aphaenogaster boulderensis and Pheidole clydei.

Figure 286. Joshua Tree Woodland, Pearblossom.

Figure 287. Juniper Woodland near Pearblossom.

Figure 288. Stipa Grassland near Pearblossom.

Figure 289. Wash Woodland, Shaver's Well, Riverside Co.

Figure 290. Wash Woodland at edge of dunes, BLM Preserve,
Glamis.

Figure 291. Dunes habitat, BLM Preserve, Glamis.

Figures 292 & 293. Disturbed Wash Woodland at edge of
Algadones Dunes, ORV area.

Figures 294 & 295. Effect of ORVs on desert vegetation
near California City, Kern Co. Courtesy of
James Cook.

Figure 296. Nest tumulus of Pogonomyrmex californicus.

Figure 297. Pogonomyrmex maricopa. Mandibular carry of naive worker to foraging area.

Figure 298. Nest tumulus of Pogonomyrmex maricopa.

Figure 299. Nest tumulus of Pogonomyrmex maricopa.
Compare with Fig. 298.

Figure 308. Acromyrmex versicolor forager on boxthorn, Lycium Andersonii.

Figure 309. Workers of Acromyrmex versicolor gathering seed coat of mesquite, Prosopis glandulosa.

Figure 310. Acromyrmex versicolor foragers returning to nest with stem and leaflets from legume.

Figure 311. Acromyrmex versicolor forager returning to nest with dried leaflets of creosote, Larrea tridentata.

Figure 312. Nest tumulus of Conomyrma insana.

Figure 313. Nest tumulus of Forelius foetidus.

Figure 314. Camponotus semitestaceus taking caterpillar
as prey item.

Figure 315. Myrmecocystus creightoni taking nectar from
Eriogonum fasciculatum.

Figure 316. Nest entrance of Myrmecocystus mendax (under edge of rock).

Figure 317. Nest tumulus of Myrmecocystus n. sp.

Figure 318. Nest tumulus of Myrmecocystus mexicanus.

Figure 319. Nest tumulus of Myrmecocystus mexicanus.

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Figure 322. Replete chamber of Myrmecocystus mexicanus.
Repletes (honey pots) in situ; note size
relative to workers.

Figure 323. Dark and light repletes of Myrmecocystus
mexicanus.

Figure 320. Excavation of Myrmecocystus mexicanus nest.

Figure 321. Cross-section of nest of Myrmecocystus
mexicanus exposed during excavation.

Figure 306. Aggregate nest entrances of Crematogaster
opuntiae colony.

Figure 307. Aggregate nest tumuli of Acromyrmex versicolor,
ORV area of Algodones Dunes.

Figure 304. Aggregate nest tumuli of Pheidole gilvescens colony.

Figure 305. Nest tumulus of Pheidole gilvescens. Compare with fig. 304.

Figure 300. Nest entrance of Novomessor cockerelli.

Figure 301. Nest tumulus of Veromessor pergandei. Note chaff around periphery of mound.

Figure 302. Inactive nest tumulus, Veromessor pergandei. Note grass seeds have germinated on periphery of mound.

Figure 303. Nest entrance of Pheidole hyatti.

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Figure 324. Workers of Myrmecocystus mexicanus attacking anthophorid bee, Synhalonia sp. Courtesy of C. D. MacNeill.

Figure 325. Nest tumulus of Myrmecocystus romainei.

Figure 326. Nest tumulus of Myrmecocystus semirufus.

Figure 327. Myrmecocystus semirufus workers emerging en masse to forage.

Figure 328. Spider, Steatoda sp. (Theridiidae) in web covering entrance of Myrmecocystus semirufus nest.

Figure 329. Nest tumulus of Myrmecocystus wheeleri.

Figure 330. Worker of Myrmecocystus wheeleri at extrafloral nectary of Euphorbia albomarginata. Sclerites of gaster are widely separated and intersegmental membranes exposed due to engorgement.

Figure 331. Myrmecocystus wheeleri worker on rock in stilt-legged heat avoidance posture (substrate 57°C).

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11-10-50 The content of the letter is as follows:
Dear Sir,
I am writing to you in regard to the letter of the 11-10-50.

APPENDIX I. Checklist and Distribution of California Desert Ants

	Mojave Desert	Colorado Desert
Subf. PONERINAE		
1. <u>Hypoponera opaciceps</u> (Mayr, 1887)	x	
2. " <u>opacior</u> (Forel, 1893)	x	
3. <u>Cerapachys</u> sp.	x	x
Subf. ECITONINAE		
4. <u>Neivamyrmex californicus</u> (Mayr, 1870)	x	x
5. " <u>leonardi</u> (Wheeler, 1915)	x	
6. " <u>minus</u> (Cresson, 1872)	x	
7. " <u>mojave</u> (M. Smith, 1943)	x	
8. " <u>nigrescens</u> (Cresson, 1872)		x
9. " <u>swainsoni</u> (Shuckard, 1840)		x
Subf. PSEUDOMYRMECINAE		
10. <u>Pseudomyrmex apache</u> Creighton, 1952		x
11. " <u>pallidus</u> (F. Smith, 1855)	x	x
Subf. MYRMICINAE		
12. <u>Manica mutica</u> (Emery, 1895)	x	
13. <u>Pogonomyrmex anzensis</u> Cole, 1968		x
14. " <u>californicus</u> (Buckley, 1866)	x	x
15. " <u>desertorum</u> Wheeler, 1902		x
16. " <u>imberbicus</u> Wheeler, 1902	x	x
17. " <u>magnacanthus</u> Cole, 1968	x	x
18. " <u>maricopa</u> Wheeler, 1914	x	x
19. " <u>rugosus</u> Emery, 1895	x	x
20. " <u>subnitidus</u> Emery, 1895	x	

APPENDIX I. (Continued)

Subf. MYRMICINAE (cont.)	Mojave Desert	Colorado Desert
21. <u>Pogonomyrmex tenuispinus</u> Forel, 1914		x
[22. " n. sp. (Snelling, ms) ?]		
23. <u>Aphaenogaster boulderensis</u> M. Smith, 1941	x	x
24. " <u>megommatus</u> M. Smith, 1963	x	x
25. <u>Novomessor cockerelli</u> (E. Andre, 1893)	x	x
26. <u>Veromessor andrei</u> (Mayr, 1886)	x	
27. " <u>lariversi</u> M. Smith, 1951	x	
28. " <u>pergandei</u> (Mayr, 1886)	x	x
29. <u>Pheidole barbata</u> Wheeler, 1908	x	x
30. " <u>clydei</u> Gregg, 1950	x	x
31. " <u>desertorum</u> Wheeler, 1906	x	x
32. " <u>gilvescens</u> Wheeler, 1908	x	x
33. " <u>hyatti</u> Emery, 1895	x	x
34. " <u>paiute</u> Gregg, 1958	x	x
35. " <u>psammophila</u> Creighton & Gregg, 1955	x	x
36. " <u>rugulosa</u> Gregg, 1958	x	x
37. " <u>sciophila</u> Wheeler, 1908		x
38. " <u>tucsonica</u> Wheeler, 1908	x	x
39. " <u>vistana</u> Forel, 1914	x	x
40. " <u>yaqui</u> Creighton & Gregg, 1955	x	x
41. <u>Cardiocondyla ectopia</u> Snelling, 1974*		x
42. <u>Crematogaster californica</u> Emery, 1895	x	x
43. " <u>depilis</u> Wheeler, 1908	x	x
44. " <u>hespera</u> Buren, 1968	x	x

APPENDIX I. (Continued)

		Mojave Desert	Colorado Desert
Subf. MYRMICINAE (cont.)			
45.	<u>Crematogaster</u> <u>larreae</u> Buren, 1968	x	
46.	" <u>mormonum</u> Emery, 1895	x	
47.	" <u>opuntiae</u> Buren, 1968	x	x
48.	<u>Monomorium</u> <u>minimum</u> (Buckley, 1866)	x	x
49.	<u>Solenopsis</u> <u>aurea</u> Wheeler, 1906		x
50.	" <u>maniosa</u> Wheeler, 1915	x	x
51.	" <u>molesta</u> (Say, 1836)	x	x
52.	" n. sp. (Snelling, ms)	x	
53.	<u>Leptothorax</u> <u>andrei</u> Emery, 1895	x	x
54.	" sp. A	x	
55.	" sp. B	x	x
56.	<u>Cyphomyrmex</u> <u>rimosus</u> (Spinola, 1853)		x
57.	" <u>wheeleri</u> (Forel, 1900)		x
58.	<u>Acromyrmex</u> <u>versicolor</u> (Pergande, 1893)		x
Subf. DOLICHODERINAE			
59.	<u>Liometopum</u> <u>occidentale</u> Emery 1895	x	
60.	<u>Tapinoma</u> <u>sessile</u> (Say, 1836)	x	x
61.	<u>Forelius</u> <u>foetidus</u> (Buckley, 1866)	x	x
62.	" <u>pruinus</u> (Roger, 1863)	x	x
63.	<u>Conomyrma</u> <u>bicolor</u> (Wheeler, 1906)	x	x
64.	" <u>insana</u> (Buckley, 1866)	x	x
Subf. FORMICINAE			
65.	<u>Brachymyrmex</u> <u>depilis</u> Emery, 1893	x	x
66.	<u>Camponotus</u> <u>festinatus</u> (Buckley, 1866)	x	x

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38	W. H. Auden	Collected Poems	1955
39	W. H. Auden	Collected Poems	1955
40	W. H. Auden	Collected Poems	1955
41	W. H. Auden	Collected Poems	1955
42	W. H. Auden	Collected Poems	1955
43	W. H. Auden	Collected Poems	1955
44	W. H. Auden	Collected Poems	1955
45	W. H. Auden	Collected Poems	1955
46	W. H. Auden	Collected Poems	1955
47	W. H. Auden	Collected Poems	1955
48	W. H. Auden	Collected Poems	1955
49	W. H. Auden	Collected Poems	1955
50	W. H. Auden	Collected Poems	1955

APPENDIX I. (Continued)

Subf. FORMICINAE (Cont.)

		Mojave Desert	Colorado Desert
67.	<u>Camponotus</u> <u>hyatti</u> Emery, 1893	x	
68.	" <u>ocreatus</u> Emery, 1893	x	x
69.	" <u>papago</u> Creighton, 1952		7
70.	" <u>sansabeanus</u> (Buckley, 1866)	x	x
71.	" <u>sayi</u> Emery, 1893	x	x
72.	" <u>semitestaceus</u> Emery, 1893	x	
73.	" <u>vicinus</u> Mayr, 1870	x	
74.	<u>Paratrechina</u> <u>longicornis</u> (Latreille, 1802)*		x
75.	" sp. A		x
76.	" sp. B	x	x
77.	<u>Myrmecocystus</u> <u>colei</u> Snelling, 1976	x	
78.	" <u>creightoni</u> Snelling, 1971	x	
79.	" <u>ewarti</u> Snelling, 1971	x	x
80.	" <u>flaviceps</u> Wheeler, 1912	x	x
81.	" <u>kathjuli</u> Snelling, 1976	x	
82.	" <u>kennedyi</u> Cole, 1936	x	x
83.	" <u>lugubris</u> Wheeler, 1909	x	
84.	" <u>mendax</u> Wheeler, 1908	x	x
85.	" <u>mexicanus</u> Wesmael, 1838	x	x
86.	" <u>mimicus</u> Wheeler, 1908	x	x
87.	" <u>navajo</u> Wheeler, 1908	x	
88.	" <u>romainei</u> Cole, 1936	x	
89.	" <u>semirufus</u> Emery, 1893	x	x
90.	" <u>tenuinodis</u> Snelling, 1976		x
91.	" <u>testaceus</u> Emery, 1893	x	

Bibliography (Contd.)		Bibliography (Contd.)	
101	"	101	"
102	"	102	"
103	"	103	"
104	"	104	"
105	"	105	"
106	"	106	"
107	"	107	"
108	"	108	"
109	"	109	"
110	"	110	"
111	"	111	"
112	"	112	"
113	"	113	"
114	"	114	"
115	"	115	"
116	"	116	"
117	"	117	"
118	"	118	"
119	"	119	"
120	"	120	"
121	"	121	"
122	"	122	"
123	"	123	"
124	"	124	"
125	"	125	"
126	"	126	"
127	"	127	"
128	"	128	"
129	"	129	"
130	"	130	"
131	"	131	"
132	"	132	"
133	"	133	"
134	"	134	"
135	"	135	"
136	"	136	"
137	"	137	"
138	"	138	"
139	"	139	"
140	"	140	"
141	"	141	"
142	"	142	"
143	"	143	"
144	"	144	"
145	"	145	"
146	"	146	"
147	"	147	"
148	"	148	"
149	"	149	"
150	"	150	"

APPENDIX I. (Continued)

Subf. FORMICINAE (Cont.)

		Mojave Desert	Colorado Desert
92.	<u>Mymecocystus wheeleri</u> Snelling, 1971	x	
93.	" <u>yuma</u> Wheeler, 1912	x	x
94.	" n. sp. (Snelling, ms)	x	
95.	<u>Formica altipetens</u> Wheeler, 1913	x	
96.	" <u>gnava</u> Buckley, 1866		x
97.	" <u>perpilosa</u> Wheeler, 1902	x	
98.	" <u>pilicornis</u> Emery, 1893	x	
99.	" <u>xerophila</u> M. Smith, 1939	x	

* Introduced species

[Not known to occur in our area, but expected to be present.]

APPENDIX II. Zoogeographic Summary

For purposes of the following zoogeographic summary, two species are eliminated. They are obvious introductions: Cardiocondyla ectopia and Paratrechina longicornis. We therefore consider the normal composition of our desert area to consist of 25 genera and 97 species, the geographic affinities of which are indicated below.

1. Generic Components of Desert Ant Fauna

a. Cosmopolitan & Subcosmopolitan Genera: (11)

<u>Hypoponera</u>	<u>Crematogaster</u>	<u>Tapinoma</u>
<u>Cerapachys</u>	<u>Monomorium</u>	<u>Camponotus</u>
<u>Aphaenogaster</u>	<u>Solenopsis</u>	<u>Paratrechina</u>
<u>Pheidole</u>	<u>Leptothorax</u>	

b. Holarctic Genera: (3)

<u>Manica</u>	<u>Liometopum</u>	<u>Formica</u>
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c. Nearctic Genera: (3)

<u>Novomessor</u>	<u>Veromessor</u>	<u>Myrmecocystus</u>
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d. New World Genera: (8)

<u>Neivamyrmex</u>	<u>Cyphomyrmex</u>	<u>Conomyrma</u>
<u>Pseudomyrmex</u>	<u>Acromyrmex</u>	<u>Brachymyrmex</u>
<u>Pogonomyrmex</u>	<u>Forelius</u>	

2. Species Composition of Desert Ant Fauna

a. Holarctic Species: (0)

The purpose of this document is to provide information regarding the

classification of information. The following information is provided:

1. The classification of information is determined by the following factors:

a. The sensitivity of the information to the national defense.

b. The extent to which the information is disseminated.

c. The potential for damage to the national defense.

d. The extent to which the information is controlled.

e. The extent to which the information is protected.

f. The extent to which the information is classified.

g. The extent to which the information is controlled.

h. The extent to which the information is protected.

i. The extent to which the information is classified.

j. The extent to which the information is controlled.

k. The extent to which the information is protected.

l. The extent to which the information is classified.

m. The extent to which the information is controlled.

n. The extent to which the information is protected.

o. The extent to which the information is classified.

p. The extent to which the information is controlled.

q. The extent to which the information is protected.

r. The extent to which the information is classified.

s. The extent to which the information is controlled.

b. Neotropic Species: (5)

Hypoponera opacior

" opaciceps

Neivamyrmex swainsoni

Pseudomyrmex pallidus

Cyphomyrmex rimosus

c. Continental Species: (7)

Neivamyrmex nigrescens

Monomorium minimum

Solenopsis molesta

Tapinoma sessile

Forelius pruinus

Conomyrma insana ?

Brachymyrmex depilis

d. Great Basin Species: (8)

Manica mutica

Veromessor lariversi

Pheidole paiute

Crematogaster mormonum

Myrmecocystus testaceus

Camponotus vicinus

Formica altipetens

" xerophila

e. California Chaparral Species: (14)

Neivamyrmex californicus

" minus

Pogonomyrmex subnitidus

Veromessor andrei

Pheidole vistana

Crematogaster californica

Leptothorax andrei

Liometopum occidentale

Camponotus hyatti

" semitestaceus

Myrmecocystus colei

" semirufus

" wheeleri

Formica pilicornis

f. Sonoran Species: (38)

<u>Cerapachys</u> sp. ?	<u>Solenopsis</u> <u>aurea</u>
<u>Neivamyrmex</u> <u>leonardi</u>	" <u>maniosa</u>
<u>Pseudomyrmex</u> <u>apache</u>	<u>Cyphomyrmex</u> <u>wheeleri</u>
<u>Pogonomyrmex</u> <u>californicus</u>	<u>Acromyrmex</u> <u>versicolor</u>
" <u>desertorum</u>	<u>Forelius</u> <u>foetidus</u>
" <u>imberbicus</u>	<u>Conomyrma</u> <u>bicolor</u>
" <u>maricopa</u>	<u>Camponotus</u> <u>festinatus</u>
" <u>rugosus</u>	" <u>ocreatus</u>
<u>Aphaenogaster</u> <u>boulderensis</u>	" <u>papago</u>
<u>Novomessor</u> <u>cockerelli</u>	" <u>sansabeanus</u>
<u>Pheidole</u> <u>clydei</u>	" <u>savi</u>
" <u>desertorum</u>	<u>Paratrechina</u> sp. A
" <u>hyatti</u>	<u>Myrmecocystus</u> <u>mendax</u>
" <u>rugulosa</u>	" <u>mexicanus</u>
" <u>sciophila</u>	" <u>mimicus</u>
" <u>tucsonica</u>	" <u>navajo</u>
<u>Crematogaster</u> <u>depilis</u>	" <u>romainei</u>
" <u>larreae</u>	<u>Formica</u> <u>gnava</u>
" <u>opuntiae</u>	" <u>perpilosa</u>

g. Mojave Desert Species: (9)

<u>Neivamyrmex</u> <u>mojave</u>	<u>Myrmecocystus</u> <u>creightoni</u>
<u>Pogonomyrmex</u> n. sp.	" <u>kathjuli</u>
<u>Solenopsis</u> n. sp.	" <u>lugubris</u>
<u>Leptothorax</u> sp. A.	" n. sp.
<u>Paratrechina</u> sp. B.	

h. Colorado Desert Species: (14)

Pogonomyrmex anzensis

Pheidole yaqui

" tenuispinus

Leptothorax sp. B

Aphaenogaster megommatus

Myrmecocystus ewarti

Veromessor pergandei

" flaviceps

Pheidole barbata

" kennedyi

" gilvescens

" tenuinodis

" psammophila

" yuma

During the Miocene and Pliocene periods, the Mojavean region was not differentiated from the Coloradan. The flora consisted primarily of live oak-palm-laurel woodland with a varied sclerophyllic understory. More arid areas were characterized by thorn scrub (Axelrod, 1977). Many ant species presumably were present here. Some elements may have extended into this region from the cooler, forest dominated areas to the north as well as the warm, moist southern tropics. The ant fauna, then, was possibly not much different from that now present in southeastern Arizona.

Tectonic events during the late Pliocene and early Quaternary resulted in drastic changes over western North America. Rainshadows from newly raised mountain ranges created vast areas of increasing aridity. The Great Basin remained relatively high, cool and moist. Uplift and rotation of the Mojavean block accomplished the differentiation of the Mojave from the Colorado Desert. The Mojave acquired a character intermediate between the Great

Basin Desert and the lower, hotter and drier Colorado Desert.

The oak-palm-laurel woodland retreated from the ever more arid conditions. The Salton Sink of the Colorado Desert was depressed and this region lay within the effective rainshadow of the San Jacinto-Santa Rosa-Laguna Mountain ranges, creating an exceptionally arid habitat. While some ant species presumably disappeared entirely from these hot deserts, others persisted in isolated, suitable "islands", especially in the less harsh Mojave Desert.

As the tabulations indicate, our fauna is a diverse one with elements of various origins. For the most part, those species of Neotropic, Continental, Great Basin and Chaparral faunas are marginal and/or relictual with the exceptional case. Since Conomyrma insana is probably a complex, rather than a single species, it perhaps should be excluded from consideration. An important characteristic of these ants is that they are mostly limited to relictual habitats within the Mojave Desert; few seem to have survived within the more rigorous Colorado Desert.

Creighton and Gregg (1955) noted that ". . . a number of xerophilous ants . . . 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." If the San Bernardino-Riverside County line was accepted as the boundary between the two deserts, then there would be ample justification for their

view. If, on the other hand, the long gradient between the Mojave and the Colorado in eastern San Bernardino County is recognized for what it is, then a different view must be taken.

Above, we list 38 species of Sonoran origins. Of these, 19 (50%) have been taken in both the Mojave and Colorado Deserts; 9 (24%) are limited to the Mojave and an equal number to the Colorado. Of these 38 species, only 8 (21%) can be considered common. The remaining Sonoran element is relictual. When these data are expanded to consider the Neotropic, Continental, Great Basin and Chaparral forms, then the distinction is even more pronounced.

Finally, we can consider the forms which we believe to have evolved within these deserts. Ten are indicated above for the Mojave Desert; only one of these (Paratrechina sp. B) extends into the Colorado Desert - barely. There are 14 indicated for the Colorado Desert; six (43%) are shared with the Mojave. Two of these (V. pergandei, M. kennedyi) range widely beyond our area and are clearly quite adaptable. Nor is it surprising to discover that other Colorado Desert species, adapted to that harsh region, are able to invade the less rigorous Mojave Desert. More significant, perhaps, is that the Mojave species seem unable to reciprocate.

Our view is that the distributional peculiarities of the ants do, indeed, reflect the distinctness of these two deserts.

APPENDIX III

by R. R. Snelling

One of the persistent results of being a systematist specializing in a group such as ants is that one is often called upon to provide identifications. This is a mixed blessing. While some very interesting specimens may be submitted, these are the "reward" for looking at a great deal of very ordinary material. It is hoped that the above keys and figures will enable the non-specialist to sort out some of the ordinary species. Any problematic specimens or species can then be separated and sent to the specialist. In the Southwest the specialist is the senior author of this report. I am usually willing to provide identifications. However, do not send specimens without prior agreement.

In general, the following policies will prevail, but are subject to negotiation. Specimens must be in alcohol and provided with complete collection data. Normally all specimens are retained for LACM collections, so an appropriate system for coding of specimens must be provided; identifications will be reported by code. Representative specimens will be returned to the sender if requested.

If grant funds for identification services are available there is a fee (voluntary): \$6.00/sample if specimens are retained at LACM; \$10.00/sample if specimens are to be returned to sender. The fee is payable to the LACM Foundation and goes into a restricted fund available only to the LACM Entomology Section. Lack of such funds will not adversely affect my decision to provide identifications

nor will it delay service.

An important method for the ecologist in determining the food preferences of vertebrates is the examination of fecal samples. When present in such samples, insects are best represented by head capsules and, for the specialist, specific identifications are often possible. The key which follows is to the genera of California desert ants, workers only, and is based on head capsules devoid of all appendages, their usual state in fecal samples. There will doubtless be deficiencies in the key, but I hope to improve it over time and expand it to cover the sexual forms as well.

The key includes all our native genera. The introduced genus Cardiocondyla, inhabitant of urban areas only, is omitted. Because some genera, such as Pheidole, are very complex they will come out to more than one place in the key. The generic key is followed by one for the species of Pogonomyrmex, one of the commonest groups represented in fecal samples from our area.

It is not always possible for the nonspecialist to recognize that a head capsule is that of a worker ant. In general, if the eyes are quite large (occupying more than half of the side of the head) and ocelli are prominent, the specimen is either a male or a female.

KEY TO GENERA OF CALIFORNIA DESERT ANTS,
BASED ON WORKER HEAD CAPSULES

- 1a. Frontal carinae nearly vertical, separated by less than diameter of antennal socket, not expanded laterad to cover antennal socket (Figs. 27, 37, 52); eye absent (Fig. 26) or consisting of a single facet (Fig. 38a) or very large, covering more than half of area of head in side view (Fig. 51) 2
- b. Frontal carinae broad, usually covering antennal socket in part (Fig. 117) or widely separated (by more than 1.5 x diameter of antennal socket (Fig. 1)); eye usually of more than 10 facets, but not large enough to occupy more than half of side of head 4
- 2a. Eye absent (Fig. 26) or consisting of a single ommatidium (Fig. 38a) 3
- b. Eye very large, consisting of several hundred ommatidia (Fig. 51) Pseudomyrmex
- 3a. Occipital carina continued below posterolateral corner of head; frontal carinae, in profile, abruptly reduced above (Fig. 26); head coarsely and closely punctate, with smooth interspaces Cerapachys
- b. Occipital carina not extended below posterolateral corner of head; frontal carinae gradually reduced above (Fig. 38); head smooth and shiny between sparse punctures or closely punctulate and dull between coarse foveolae Neivamyrmex

- 4a. Frontal carinae not broadened to cover most of lower face, not continued back to occiput; no conspicuous antennal fossa; head often smooth and shiny or rugulose 5
- b. Frontal carinae enormously expanded, covering most of lower face and continued to occiput to form deep fossa for antennal scape (Fig. 183); head dull, minutely granulose . . Cyphomyrmex
- 5a. Posterolateral corners of head rounded or angulate, but without distinct tubercles; no sharp carina between eye and antennal socket, though a number of rugulae or striae may be present. 6
- b. Posterolateral corners of head angulate and with several distinct tubercles (Fig. 186); a curved carina present between eye and antennal socket (Fig. 187) Acromyrmex
- 6a. Clypeus with a carina on either side of middle which terminates in a tooth at apical margin (Fig. 161); integument of head smooth and shiny between well separated punctures 7
- b. Clypeus without a single carina on either side of middle, no conspicuous teeth on apical margin; cephalic integument often variously sculptured 8
- 7a. Clypeal teeth triangular and not flanked by minute lateral denticle (Fig. 159); head blackish or dark brown; HW less than 0.5 mm and eye with about 6-8 facets in greatest diameter Monomorium
- b. Clypeal teeth elongate, often spiniform, flanked by minute denticles (Fig. 161); head yellowish or dark reddish; if HW less than 0.5 mm, greatest diameter of eye with no more than 3-4 facets Solenopsis

- 8a. Without pronounced occipital lobes; in side view, upper eye margin little, if any, below middle, distance between upper eye margin and occiput no more than 2 x OMD; gular teeth absent; face, between eye and antennal socket, various 9
- b. Head massive, with pronounced occipital lobes; in side view, upper eye margin below middle and distance from upper eye margin to occiput 3-4 x OMD; gular teeth often present; face, between eye and antennal socket usually coarsely striate Pheidole, majors
- 9a. Psammophore present and well defined, area enclosed by long setae without erect hairs (Figs. 63, 110, 134) 10
- b. Psammophore weak or absent, gular area without hairs or with irregularly spaced hairs of uneven length 13
- 10a. HW at least 0.65 mm, usually much more; clypeus variously sculptured; dorsum of head conspicuously sculptured, often striate or rugulose and/or punctate 11
- b. HW less than 0.60 mm; clypeus smooth; dorsum of head smooth and shiny with fine, sparse punctures . . Pheidole (q psammophila)
- 11a. Lower eye margin rounded; median lobe of clypeus not produced over apical margin as a tooth; color reddish or yellowish or brownish 12
- b. Lower eye margin angulate (Fig. 112); median lobe of clypeus triangularly produced over apical margin (Fig. 117); color usually blackish brown Veromessor (pergandei)

- 12a. Dorsum of head regularly, coarsely striate, interspaces more or less punctulate (when punctures weak, cephalic rugae form concentric loops over eye); eye, in frontal view, low, flattened Pogonomymex
- b. Dorsum of head finely, very irregularly striate, interspaces finely punctulate, punctulae often very weak; striae not form loops over eye; eye, in frontal view, strongly bulging (Fig. 113) Veromessor (lariversi)
- 13a. Head, in frontal view, not strongly narrowed above eyes, width at occipital margin usually at least equal to distance between eyes; HW various 14
- b. Head, in frontal view, strongly narrowed above eyes, width at occipital margin, no more than 0.7 x distance between eyes; HW no more than 0.8 mm Pheidole, workers
- 14a. Head elongate, usually distinctly longer than broad and at least lower part with longitudinal striae or rugulae, some up to level of eye, interspaces more or less punctulate (Figs. 101, 107) 15
- b. Head usually quadrate, but if elongate then lower part without longitudinal rugulae or striae; head often smooth and shiny between scattered fine punctures 16

- 15a. HW at least 1.3 mm, usually more than 1.6 mm; frons conspicuously longitudinally rugulose between eyes, rugulae extending above level of upper eye margin (Fig. 107); integument reddish Novomessor
- b. HW less than 1.1 mm; median area of frons at level of eyes with few or no longitudinal striae or rugulae and those weak, none extending above level of upper eye margin; integument yellowish Aphaenogaster
- 16a. Head with evenly spaced longitudinal rugulae or striae which extend onto occiput 17
- b. Cephalic rugulae or striae, when present, irregular and not covering entire dorsum of head, rarely extending to occiput 19
- 17a. Lateral lobe of clypeus forming ridge in front of antennal socket, not triangularly produced (Figs. 60, 115) 18
- b. Lateral lobe of clypeus somewhat compressed and triangularly produced in front of antennal socket (Fig. 77) Pogonomyrmex (imberbicus)
- 18a. Striae along midline of dorsum finer and closer than those of area near eye; median lobe of clypeus convex and much higher than lateral lobes; antennal fossa deep Manica
- b. Rugulae on middle of dorsum neither finer nor closer than those near eye; median lobe of clypeus not notably convex and not elevated above lateral lobes; antennal fossa shallow Veromessor (andrei)

- 19a. Head usually as long as broad or a little longer; area between eye and antennal socket often without longitudinal rugulae; cephalic dorsum usually smooth and shiny between sparse, fine punctures; clypeus seldom longitudinally striate 20
- b. Head broader than long; area between eye and antennal socket with at least a few longitudinal rugulae; cephalic dorsum irregularly punctulate between sparse coarse punctures, often with extensive smooth areas; clypeus with several longitudinal striae on each side Crematogaster
- 20a. OMD with at least a few striae, some of which may curve inward over or into antennal fossa; cephalic dorsum usually shiny between sparse fine punctures, but may be extensively punctulate 21
- b. OMD without striae or a few very short striae present near mandibular base, none between eye and antennal fossa; cephalic dorsum more or less tessellate between sparse punctures . . 22
- 21a. Dorsum closely punctulate (except along midline in one species) though punctulae may be weak; EL less than OMD; head longer than broad, with posterolateral angles, occipital margin straight or nearly so Leptothorax
- b. Dorsum smooth and shiny between sparse, fine punctures; if extensively punctulate, with broad median impunctate area; EL usually greater than OMD; head about as broad as long, with posterolateral angles, occipital margin often concave; if elongate, posterolateral angles absent . . . Pheidole, workers

- 22a. Laterobasal margin of clypeus deflected downward by lower margin of antennal socket and anterior tentorial pit above level of lower margin of antennal socket (Figs. 191, 203) 23
- b. Laterobasal margin of clypeus not deflected, lower margin of antennal socket usually well separated from clypeus, occasionally contiguous (extending over clypeal margin of Brachymyrmex); anterior tentorial pit below level of lower margin of antennal socket (Figs. 1, 210) 26
- 23a. Anterior tentorial pit situated on clypeal margin; OMD about equal to EL; distance between eyes less than EL (Figs. 199, 203); HW 0.92 mm or less 24
- b. Anterior tentorial pit situated above clypeal margin (Fig. 191) OMD 1.4 or more EL; INOD about 3 x EL (Fig. 191); HW at least 1.05 mm, usually much more Liometopum
- 24a. Apical margin of clypeus straight or convex; in full frontal view, outer margin of eye well removed from lateral margin of head (Figs. 199, 203) 25
- b. Apical margin of clypeus weakly concave in middle (Fig. 195); in full frontal view, outer margin of eye nearly coincident with lateral margin of head, or slightly overlapping it (Fig. 195) Tapinoma

- 25a. HW less than 0.6 mm; apical margin of clypeus distinctly convex (Fig. 201); psammophore absent Forelius
- b. HW at least 0.7 mm, usually about 0.8 mm; apical margin of clypeus nearly straight (Fig. 203); psammophore present on lower one-third of gular area (Fig. 6) Conomyrma
- 26a. HW at least 0.7 mm, usually much more; lower margin of antennal socket separated from or contiguous with laterobasal clypeal margin but not overlapping it (Figs. 210, 229) 27
- b. HW 0.42 mm or less; lower margin of antennal socket overlapping laterobasal margin of clypeus (Fig. 208) Brachymyrmex
- 27a. Frontal lobes marked by prominent, sharp lateral carinae, often more or less distinctly divergent above (Figs. 210, 269) . . 28
- b. Frontal lobes without lateral carinae (Figs. 229, 232) . . . 29
- 28a. Antennal socket removed from laterobasal clypeal margin by at least 0.5 x maximum diameter of antennal socket (Fig. 210) Camponotus
- b. Antennal socket contiguous with laterobasal clypeal margin or nearly so (Fig. 269) Formica
- 29a. Apical clypeal margin moderately concave in middle; eye below middle of side of head (Fig. 229) Paratrechina
- b. Apical clypeal margin convex in middle; eye at or above middle of side of head (Fig. 232) Myrmecocystus

1. The first of these is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

2. The second is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

3. The third is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

4. The fourth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

5. The fifth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

6. The sixth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

7. The seventh is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

8. The eighth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

9. The ninth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

10. The tenth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

11. The eleventh is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

12. The twelfth is the fact that the material is of a very fine grain and is therefore very soft and easily deformed.

KEY TO CALIFORNIA DESERT SPECIES OF POGONOMYRMEX

BASED ON WORKER HEAD CAPSULES

- 1a. Psammophore present, well developed, most of ventral surface of head smooth, shiny 2
- b. Psammophore weak, most of ventral surface sculptured and with scattered erect hairs imberbiculus
- 2a. Rugulae of cephalic dorsum turning laterad to form concentric loops above eyes (Fig. 65); lateral lobes of clypeus not projecting forward beyond level of median lobe (Fig. 68) . . . 3
- b. Rugulae not forming concentric loops above eye; lateral lobe of clypeus variable, but often somewhat compressed and projecting beyond level of median lobe (Figs. 66, 67) 6
- 3a. Posterolateral corner with rugulae all about equally sharp and high; interrugal spaces of frons definitely, though often weakly, punctulate 4
- b. Posterolateral corner with one rugule which is conspicuously higher and sharper than others (Fig. 73); interrugal spaces of frons shiny, with few or no punctulae anzensis
- 4a. Eye small (OI 18-24), EL less than OMD (figs. 65, 68) 5
- b. Eye large (OI 29-31), EL usually at least 1.5 x OMD (Fig. 64) magnacanthus

- 5a. Interrugal punctulae absent to weak, interspaces distinctly shiny (Fig. 65) californicus
- b. Interrugal punctulae moderate to strong, interspaces slightly shiny to dull (Fig. 68) maricopa
- 6a. Rugulae of middle of frons coarse, widely spaced, about 3-4 rugulae/0.10 mm, distance between rugules greater than their width; rugulae between eye and antennal fossa often much finer than those of middle of frons 7
- b. Rugulae of middle of frons very fine, dense (surface appears "silky"), about 5-6 rugulae/0.10 mm, separated by about rugule width; rugulae between eye and antennal fossa about equal to those of frons 8
- 7a. Color dark reddish to blackish; rugulae between eye and antennal fossa much finer and closer than those of middle of frons; OMD about $1.3 \times EL$ rugosus
- b. Light to medium red; rugulae between eye and antennal fossa little finer than those of middle of frons; sometimes more widely spaced; OMD about $1.5 \times EL$ subnitidus
- 8a. Lateral lobe of clypeus compressed and angularly projecting in front of antennal socket (Fig. 67); area between eye and frons with striae distinctly finer than those of middle of frons; OMD $1.65-1.70 \times EL$ tenuispinus
- b. Lateral lobe of clypeus rounded, very weakly projecting (Fig. 63); area between eye and middle of frons with striae little, if any, finer than of middle; OMD less than $1.5 \times EL$ desertorum

1. The distance between the eye and the ear is approximately 10 cm.

2. The distance between the ear and the mouth is approximately 15 cm.

3. The distance between the mouth and the nose is approximately 5 cm.

4. The distance between the nose and the eye is approximately 10 cm.

5. The distance between the eye and the ear is approximately 10 cm.

6. The distance between the ear and the mouth is approximately 15 cm.

7. The distance between the mouth and the nose is approximately 5 cm.

8. The distance between the nose and the eye is approximately 10 cm.

9. The distance between the eye and the ear is approximately 10 cm.

10. The distance between the ear and the mouth is approximately 15 cm.

11. The distance between the mouth and the nose is approximately 5 cm.

12. The distance between the nose and the eye is approximately 10 cm.

13. The distance between the eye and the ear is approximately 10 cm.

14. The distance between the ear and the mouth is approximately 15 cm.

15. The distance between the mouth and the nose is approximately 5 cm.

16. The distance between the nose and the eye is approximately 10 cm.

17. The distance between the eye and the ear is approximately 10 cm.

18. The distance between the ear and the mouth is approximately 15 cm.

19. The distance between the mouth and the nose is approximately 5 cm.

20. The distance between the nose and the eye is approximately 10 cm.

21. The distance between the eye and the ear is approximately 10 cm.

22. The distance between the ear and the mouth is approximately 15 cm.

23. The distance between the mouth and the nose is approximately 5 cm.

FIGURES

LEGENDS FOR FIGURES

Figures 1-4. Cephalic characters. 1-2, Myrmecocystus semi-rufus, worker head in frontal view. 3, same, head in lateral view. 4, Camponotus semitestaceus, male, head in frontal view. See text for explanation of abbreviations.

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Figures 11-15. Thoracic structures of: 11, Myrmecocystus semi-rufus, worker, dorsal view; 12, Formica sp., worker, lateral view; 13, Solenopsis sp., female, dorsal view; 14, same, lateral view; 15, Manica mutica, male, dorsal view. See text for explanation of abbreviations.

Figures 16-19. Abdominal structures of workers: 16, Hypoponera opaciceps; 17, Crematogaster depilis; 18, 18a, Conomyrma bicolor; 19, Myrmecocystus mendax. Abbreviations: ac, acidopore; as, anal slit; gc, gastric constriction; 4, ppt, postpetiole; pt. petiole.

Figures 20-21. Genitalic structures of male Camponotus semitestaceus: 20, genitalic capsule, dorsal view; 21, same, ventral

THEORY OF THE EYE

Figure 1-1. Diagram of the eye showing the main parts of the eye.

Figure 1-2. Diagram of the eye showing the main parts of the eye.

Figure 1-3. Diagram of the eye showing the main parts of the eye.

Figure 1-4. Diagram of the eye showing the main parts of the eye.

Figure 1-5. Diagram of the eye showing the main parts of the eye.

Figure 1-6. Diagram of the eye showing the main parts of the eye.

Figure 1-7. Diagram of the eye showing the main parts of the eye.

Figure 1-8. Diagram of the eye showing the main parts of the eye.

Figure 1-9. Diagram of the eye showing the main parts of the eye.

Figure 1-10. Diagram of the eye showing the main parts of the eye.

Figure 1-11. Diagram of the eye showing the main parts of the eye.

Figure 1-12. Diagram of the eye showing the main parts of the eye.

Figure 1-13. Diagram of the eye showing the main parts of the eye.

Figure 1-14. Diagram of the eye showing the main parts of the eye.

Figure 1-15. Diagram of the eye showing the main parts of the eye.

Figure 1-16. Diagram of the eye showing the main parts of the eye.

Figure 1-17. Diagram of the eye showing the main parts of the eye.

Figure 1-18. Diagram of the eye showing the main parts of the eye.

Figure 1-19. Diagram of the eye showing the main parts of the eye.

Figure 1-20. Diagram of the eye showing the main parts of the eye.

Figure 1-21. Diagram of the eye showing the main parts of the eye.

Figure 1-22. Diagram of the eye showing the main parts of the eye.

Figure 1-23. Diagram of the eye showing the main parts of the eye.

Figure 1-24. Diagram of the eye showing the main parts of the eye.

Figure 1-25. Diagram of the eye showing the main parts of the eye.

view; 21a, aedeagus, lateral view; 21b, volsella (= digitus + cuspis). Abbreviations: aed, aedeagus; bpmr, basiparamere (= gonocoxite); br, basal ring (=gonobase); cus, cusps; dig, digitus; pen, penis; pmr, paramere (=gonostylus). Scale line = 0.50 mm.

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Figures 48-50. N. nigrescens. 48, lateral view of female; 49, lateral view of male; 50, forewing of male.

Figures 51-58. Pseudomyrmex spp. 51-55, P. apache: 51-52, worker, lateral view and frontal view of head; 53, female, frontal view of head; 54-55, male, lateral view and frontal view of head. 56-58, P. pallidus: 56-57, worker, lateral view and frontal view of head; 58, female, frontal view of head.

Figures 59-62. Manica mutica. 59-60, worker, lateral view and frontal view of head; 61-62, male, lateral view and frontal view of head.

Figures 63-68. Pogonomyrmex spp., workers, lateral view of head: 63, P. desertorum; 64, P. magnacanthus; 65, P. californicus and detail of sculpture; 66, P. rugosus; 67, P. tenuispinus; 68, P. maricopa and detail of sculpture.

Figures 69-71. Pogonomyrmex spp., workers, lateral view of thorax, petiole and postpetiole: 69, P. tenuispinus; 70, P. desertorum; 71, P. rugosus.

Figures 72-77. Pogonomyrmex spp., workers, lateral view of thorax, petiole and postpetiole and of head: 72-73, P. anzensis; 74-75, P. subnitidus; 76-77, P. imberbicus.

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front of thorax: 81, P. californicus; 82, P. maricopa.

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Figures 100-105. Myrmicinae, Aphaenogaster spp. Lateral view worker, frontal view of worker head, frontal view of male head, respectively, of: 100-102, A. boulderensis; 103-105, A. megommatus.

Figures 106-109. Myrmicinae, Novomessor cockerelli. 106, lateral view of worker; 107, frontal view of worker head; 108, frontal view of male head; forewing of male. Figure 106 by R. A. DeNicola.

Figures 110-112. Myrmicinae, Veromessor spp., lateral view of worker: 110, V. lariversi; 111, V. andrei; 112, V. pergandei.

Figure 100-101. Encephalartos sp., male, 10-15, lateral view.

Figure 100-102. Encephalartos sp., male, 10-15, lateral view.

Figure 100-103. Encephalartos sp., male, 10-15, lateral view.

Figure 100-104. Encephalartos sp., male, 10-15, lateral view.

Figure 100-105. Encephalartos sp., male, 10-15, lateral view.

Figure 100-106. Encephalartos sp., male, 10-15, lateral view.

Figure 100-107.

Figure 100-108. Encephalartos sp., male, 10-15, lateral view.

Figure 100-109. Encephalartos sp., male, 10-15, lateral view.

Figure 100-110. Encephalartos sp., male, 10-15, lateral view.

Figure 100-111. Encephalartos sp., male, 10-15, lateral view.

Figure 100-112. Encephalartos sp., male, 10-15, lateral view.

Figure 100-113. Encephalartos sp., male, 10-15, lateral view.

Figure 100-114. Encephalartos sp., male, 10-15, lateral view.

Figure 100-115. Encephalartos sp., male, 10-15, lateral view.

Figure 100-116.

Figure 100-117. Encephalartos sp., male, 10-15, lateral view.

Figure 100-118. Encephalartos sp., male, 10-15, lateral view.

Figure 100-119. Encephalartos sp., male, 10-15, lateral view.

Figure 100-120.

Figure 100-121. Encephalartos sp., male, 10-15, lateral view.

Figure 100-122. Encephalartos sp., male, 10-15, lateral view.

Figures 113-118. Myrmicinae, Veromessor spp., frontal view of worker head and male head, respectively, of: 113-114, V. lari-versi; 115-116, V. andrei; 117-118, V. pergandei. Scale = 1 mm.

Figures 119-128. Pheidole spp., minor workers, frontal view of head: 119, P. clydei; 120, P. sciophila; 121, P. desertorum; 122, P. hyatti; 123, P. vistana; 124, P. tucsonica; 125, P. gilvescens; 126, P. paiute; 127, P. yaqui; 128, P. barbata. Scale = 1 mm.

Figures 129-135. Pheidole spp., minor workers. 129-134, lateral view of head and thorax: 129, P. rugulosa; 130, P. paiute; 131, P. barbata; 132, P. vistana; 133, P. desertorum; 134, P. psammophila. 135, P. sciophila, lateral view of thorax. Scale = 1 mm.

Figures 136-140. Pheidole spp., major workers, frontal view of head: 136, P. hyatti; 137, P. vistana; 138, P. clydei; 139, P. desertorum; 140, P. rugulosa.

Figures 141-148. Pheidole spp., major workers. 141-142, frontal view of head: 141, P. paiute; 142, P. yaqui. 143-144, lateral view of head: 143, P. yaqui; 144, P. gilvescens; 145-147, thoracic dorsum: 145, P. gilvescens; 146, P. yaqui; 147, P. tucsonica. 148, lateral view, thorax, petiole and postpetiole, P. barbata.

1. General - The purpose of this study is to determine the effect of the various factors on the rate of growth of the plant. The factors studied are: (a) the amount of light, (b) the amount of water, (c) the amount of soil, and (d) the amount of fertilizer.

2. Materials - The materials used in this study are: (a) a variety of plants, (b) a container for the plants, (c) a source of light, (d) a source of water, (e) a source of soil, and (f) a source of fertilizer.

3. Procedure - The procedure for this study is as follows: (a) the plants are placed in the container, (b) the container is placed in the source of light, (c) the container is placed in the source of water, (d) the container is placed in the source of soil, and (e) the container is placed in the source of fertilizer.

4. Results - The results of this study are as follows: (a) the rate of growth of the plants is affected by the amount of light, (b) the rate of growth of the plants is affected by the amount of water, (c) the rate of growth of the plants is affected by the amount of soil, and (d) the rate of growth of the plants is affected by the amount of fertilizer.

5. Conclusion - The conclusion of this study is that the rate of growth of the plants is affected by the amount of light, water, soil, and fertilizer. The amount of light, water, soil, and fertilizer should be controlled in order to obtain the best results.

Figures 149-152. Cardiocondyla ectopia, dorsal and lateral views: 149, 150, worker; 151, 152, male. Figures by R.A. DeNicola.

Figures 153-157. Crematogaster spp., workers. 153-154, C. depilis, lateral view of head and thorax and frontal view of head. 155, C. californica, lateral view of head and thorax. 156-157, lateral view of thorax: 156, C. mormonum; 157, C. hespera.

Figures 158-165. 158-159, Monomorium minimum, worker: 158, lateral view; 159, head, frontal view, scale = 0.25 mm. 160-165, Solenopsis spp., workers: lateral view of head and thorax of major, frontal view of head of major and of minor, respectively: 160-162, S. aurea; 163-165, S. maniosa. Scale = 0.50 mm. Figure 158 by R. A. DeNicola.

Figures 166-169. Solenopsis spp., workers: Lateral view of head, thorax, petiole and post petiole and frontal view of head of: 166-167, S. molesta; 168-169, S. new species. Scale = 0.25 mm.

Figures 170-173. 170-171, frontal view of head of male: 170, Monomorium minimum; 171, Solenopsis maniosa; scale = 0.25 mm. 172, S. maniosa, male, lateral view; scale = 1 mm. 173, S. maniosa, male, forewing; scale = 1 mm.

Figures 174-176. Leptothorax spp., workers, lateral view of thorax, petiole and postpetiole: 174, L. sp. B.; 175, L. andrei; 176, L. sp. A. Scale = 0.50 mm.

Figures 177-181. Leptothorax spp. 177-179, frontal view of worker head and detail of sculpturation: 177, L. sp. A.; 178, L. andrei; 179, L. sp. B. 180, L. sp. B., male, lateral view; 181, L. sp. B., male, frontal view of head. Scale = 0.50 mm.

Figure 182-187. Cyphomyrmex and Acromyrmex workers, lateral view and frontal view of head: 182-183, C. rimosus; 184-185, C. wheeleri; 186-187, A. versicolor. Figures 182-186 by R. A. DeNicola.

Figures 188-192. 188-190, Cyphomyrmex spp., males: 188, C. rimosus, frontal view of head; 189, C. wheeleri, same; 190, C. rimosus, forewing. 191-192, Liometopum occidentale, worker: 191, head in frontal view; 191a, base of mandible, anterior view; 192, lateral view.

Figures 193-197. 193-194, L. occidentale, male: 193, head, frontal view; 194, lateral view. 195-197, Tapinoma sessile: 195, worker, head in frontal view; 195a, base of mandible, anterior view; 196, worker, lateral view; 197, male, head in frontal view.

Figures 198-206. 198-201, Forelius spp.: worker, lateral view:

198, F. foetidus; 200, F. pruinus. Frontal view of head:
199, F. foetidus; 201, F. pruinus. 202-206, Conomyrma spp.
202, C. bicolor, worker, lateral view; 203, same, head in
frontal view; 204, C. insana, worker, head in frontal view;
205, same, male, lateral view; 206, same, male genitalia in
lateral view, penis inflated.

Figures 207-212. Brachymyrmex and Camponotus. 207-208, B. depilis, worker, lateral view and frontal view of head. 209-212, lateral view and frontal view of head of major worker: 209-210, C. festinatus; 211-212, C. ocreatus. Scale = 1.0 mm.

Figures 213-218. Camponotus spp., major worker, lateral view of head and thorax and frontal view of head: 213-214, C. hyatti; 215-216, C. sayi; 217-218, C. sansabeanus. Scale = 1.0 mm.

Figures 219-225. Camponotus spp. 219-224, frontal view of head: 219, C. semitestaceus, major; 220, C. vicinus, major; 221, C. sayi, male; 222, C. festinatus, male; 223, C. sansabeanus, male; 224, C. hyatti, male. 225, forewing of C. festinatus male.

Figures 226-231. Paratrechina spp., worker in lateral view and frontal view of head: 226-227, P. longicornis; 228-229, P. sp. A.; 230-231, P. sp. B. Scale = 0.5 mm.

Figures 232-239. Myrmecocystus spp., major workers, frontal view of head and lateral view of thorax and petiole: 232-233,

M. ewarti; 234-235, M. navajo; 236-237, M. mexicanus; 238-239, M. testaceus. Scale = 1.0 mm. Only peripheral pilosity indicated.

Figures 240-251. Myrmecocystus spp., major workers, frontal view of head and lateral view of thorax and petiole: 240-241, M. new species; 242-243, M. lugubris; 244-245, M. creightoni; 246-247, M. yuma; 248-249, M. colei; 250-251, M. tenuinodis. Scale = 1.0 mm. Only peripheral pilosity indicated.

Figures 252-259. Myrmecocystus spp., frontal view of head: 252, M. mexicanus, male. 253-259, major workers: 253, M. mendax; 254, M. flaviceps; 255, M. romainei; 256, M. kathjuli; 257, M. kennedyi; 258, M. wheeleri; 259, M. mimicus. Scale = 1.0 mm, all figures to same scale except 253. Only peripheral pilosity indicated.

Figures 260-266. Myrmecocystus spp. 260-262, penultimate segment of female maxillary palp, setae shown on 262 only: 260, M. navajo; 261, M. wheeleri; 262, M. flaviceps. 263-264, dorsal view, female mesoscutum, distribution of punctures: 263, M. mimicus; 264, M. romainei. 265-266, male aedeagus, lateral view: 265, M. semirufus; 266, M. wheeleri.

Figures 267-275. Formica spp. 267-272, frontal view of head: 267, F. gnava, male; 268, F. perpilosa, male; 269, F. pilicornis

Figures 21-22. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 23-24. Myrmecocystus sp. 1.0 mm. Only paratype is present.

Figures 25-26. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 27-28. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 29-30. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 31-32. Myrmecocystus sp. 1.0 mm. Only paratype is present.

Figures 33-34. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 35-36. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 37-38. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 39-40. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 41-42. Myrmecocystus sp. 1.0 mm. Only paratype is present.

Figures 43-44. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 45-46. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 47-48. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 49-50. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 51-52. Myrmecocystus sp. 1.0 mm. Only paratype is present.

Figures 53-54. Myrmecocystus sp. 1.0 mm. Only paratype is present.
Figures 55-56. Myrmecocystus sp. 1.0 mm. Only paratype is present.

male; 270, F. gnava worker; 271, F. perpilosa worker; 272, F. pilicornis worker. 273-275, lateral view of worker thorax and petiole: 273, F. gnava; 274, F. pilicornis; 275, F. perpilosa. Scale = 1.0 mm. Only peripheral pilosity indicated.

1. The first section of the report is a summary of the work done during the year. It is a brief statement of the results of the work, and is intended to give a general idea of the progress made. It is not a detailed account of the work, but a summary of the main results. It is written in a clear and concise manner, and is intended to be read by those who are not directly concerned with the work.

2. The second section of the report is a detailed account of the work done during the year. It is a full and complete statement of the work, and is intended to give a detailed account of the progress made. It is written in a clear and concise manner, and is intended to be read by those who are directly concerned with the work.

3. The third section of the report is a summary of the work done during the year. It is a brief statement of the results of the work, and is intended to give a general idea of the progress made. It is written in a clear and concise manner, and is intended to be read by those who are not directly concerned with the work.

4. The fourth section of the report is a detailed account of the work done during the year. It is a full and complete statement of the work, and is intended to give a detailed account of the progress made. It is written in a clear and concise manner, and is intended to be read by those who are directly concerned with the work.

- Figure 276. Creosote Bush Scrub, base of El Paso Mtns.
Koehn Dry Lake in distance.
- Figure 277. Creosote Bush Scrub, Desert Flower Rd. near
Adelanto.
- Figure 278. Palm Oasis, Corn Springs, Chuckwalla Mtns.
- Figure 279. Corn Springs Canyon, Chuckwalla Mtns.
Cactus Scrub. Wash Woodland in background.

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