A REVISION OF THE HONEY ANTS, GENUS *MYRMECOCYSTUS* (HYMENOPTERA: FORMICIDAE)

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NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY
SCIENCE BULLETIN 24 • AUGUST 5, 1976

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A REVISION OF THE HONEY ANTS, GENUS *MYRMECOCYSTUS* (HYMENOPTERA: FORMICIDAE)[1]

By Roy R. Snelling[2]

ABSTRACT: The North American genus *Myrmecocystus* is divided into three subgenera: *Myrmecocystus, s. str.* and two new subgenera, *Endiodioctes* (type species, *M. melliger* Forel) and *Eremnocystus* (type species, *M. creightoni* Snelling). The twenty-seven recognized species are placed within these subgenera as follows: *Endiodioctes: depilis* Forel; *flaviceps* Wheeler; *intonsus* Snelling, n.sp.; *kathjuli* Snelling, n.sp.; *kennedyi* Cole (=*semirufus* auctorum); *koso* Snelling, n.sp.; *melliger* Forel (=*comatus* Wheeler); *mendax* Wheeler (=*orbiceps* Wheeler, N.SYN.); *mimicus* Wheeler (=*jesuita* Wheeler=*lomaensis* wheeler); *placodops* Forel; *romainei* Cole; *semirufus* Emery; *nequazcatl* Snelling, n.sp.; *wheeleri* Snelling. *Eremnocystus: colei* Snelling, n.sp.; *creightoni* Snelling; *hammettensis* Cole; *lugubris* Wheeler; *perimeces* Snelling, n.sp.; *tenuinodis* Snelling, n.sp.; *yuma* Wheeler. *Myrmecocystus,* s.str.: *ewarti* Snelling; *melanoticus* Wheeler; *mexicanus* Wesmael (=*hortus-deorum* McCook, N.SYN.); *navajo* Wheeler; *pyramicus* M. Smith; *testaceus* Emery (=*mojave* Wheeler=*idahoensis* Cole). All species are described and illustrated and their distributions are mapped.

Biology for the genus as a whole, and for the individual species, is discussed. This genus inhabits arid and semiarid habitats of western North America. Most, if not all, species develop replete workers for storage of liquiform nutrients in response to superabundance of such foods during certain periods of the year. The existence of repletes has no taxonomic significance within the genus. All species are general predator-scavengers, the diurnal species comprising the subgenus *Endiodioctes* being more prone to predation than members of the other subgenera.

INTRODUCTION

The formicine genus *Myrmecocystus* is exclusively North American and is limited to the Nearctic Region (Fig. 359). The southern limit appears to be at about latitude 19°N in central Mexico. It extends north to southern Washington in the United States at about 46°N. The easternmost limit appears to lie at about 97°W longitude in Texas. The present study is the first major monograph of the genus since the pioneer study of *Myrmecocystus* by W. M. Wheeler (1908).

Within this range *Myrmecocystus* is primarily a genus of arid and semiarid habitats and is most diverse in southern California, where eighteen of the twenty-seven species are present. These ants are a conspicuous part of the formicid fauna of these regions, rivalling in abundance such groups as *Pheidole* and *Pogonomyrmex*. It is the only formicine genus prominent in the deserts of North America. The genera *Pheidole* and *Pogonomyrmex* depend, to a great extent, upon seeds as a food source. The species of *Myrmecocystus* are, for the most part, generalized predator-scavengers, but have been able to utilize a resource only cursorily tapped by other ants in this habitat: the carbohydrate-rich secretions of plants. They gather nectar from floral and extrafloral nectaries, fruit juices and honeydew from aphids and pseudococcids. This food is available only as a liquid and is stored against future need within the crops of workers which remain within the nest. The fully engorged crops greatly distend the gasters, resulting in the essentially immobile "replete" caste (frontispiece). Although repletes are known to be produced by ants of other genera, the phenomenon is most frequently associated with *Myrmecocystus*. Hundreds of repletes may be present within a single colony. Their existence was known to the Amerindians who excavated nests to gather them for food.

Despite the interest which replete development has inspired, the taxonomy of the group has been a shambles. The only previous attempt to monograph the group did not include keys. Subsequently developed keys did little to improve the situation since they were based on faulty characters and included only about half the actual number of species.

There are several reasons for this depressing state of affairs. Wheeler (1908) proposed that there were some "physiological" subspecies; the resultant systematics was a fine example of chaos. Morphological characteristics were studied only in a most cursory manner, with little or no effort given to determining ranges of variation. The latter problem was further complicated by the polymorphism of the ants and by allometry. Finally, many excellent diagnostic features were ignored. All these objections, of course, must

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take into account that these are the defects of an earlier era dominated by the philosophies of Forel and Wheeler. I have no doubt that three-quarters of a century from now this work will seem to be equally inexact.

This revision is an attempt to create a rational systematics based upon the integration of as many characteristics as possible. Much remains yet to be done. In particular, attention should be given to morphological studies of larvae and to pheromone chemistry. Also, detailed ecological studies are called for. There are areas in California where as many as seven species occur, representing all major groups. Detailed comparative ecological studies would prove to be very rewarding.

REFERENCE COLLECTIONS

The following listed institutional and private collections have been utilized throughout this study. Six of these are particularly important sources of *Myrmecocystus*. The collections of the American Museum of Natural History, the Museum of Comparative Zoology and the United States National Museum are important for the large number of specimens of historical significance, including type material of most of the described species. The largest collection of these ants is that of the Natural History Museum of Los Angeles County, with types of nearly all forms, the Creighton collection, the Cole collection, and the material collected by the author during this study. One private collection is sufficiently large to warrant special notice: that of G. C. and J. N. Wheeler. The institutional and individual collections are listed below, together with appropriate abbreviations used to identify them in the systematic portion of this study. The various institutional collections were the most important to this study. But, specimens made available from small, private collections have often contributed significant data. To each of the owners I am much indebted.

AM	Alex Mintzer, private collection
AMNH	American Museum of Natural History
CAK	Carol A. Kay, private collection
CAS	California Academy of Sciences
CDA	California Department of Agriculture
CU	Cornell University
GCW	George C. and Jeanette N. Wheeler, private collection
LACM	Natural History Museum of Los Angeles County
MCZ	Museum of Comparative Zoology
MHNG	Museum d'Histoire Naturelle, Geneva
NDA	Nevada Department of Agriculture
REG	Robert E. Gregg, private collection
RHC	Robert H. Crandall, private collection
RJH	Robert J. Hamton, private collection
RMC	Robert M. Chew, private collection
UCB	University of California, Berkeley
UCD	University of California, Davis
UKAN	University of Kansas
USNM	United States National Museum of Natural History
WFB	William F. Buren, private collection

ACKNOWLEDGMENTS

Throughout the course of this investigation I have had the generous assistance and cooperation of my colleagues. Chief of these has been the late William S. Creighton. He placed at my disposal his very extensive collection of *Myrmecocystus* and all notes pertinent to the collections. I had the benefit, too, of several long, stimulating conversations which drew upon his expertise in the systematics of North American ants.

Special mention must be made, too, of the kind assistance of George and Jeanette Wheeler. In addition to the numerous specimens loaned, they have tested the manuscript keys through several revisions and offered their suggestions for improvements.

My particular thanks must also be extended to Arthur C. Cole, Jr., not only for the loan of material, but for advice based on his long experience in the systematics of ants. The primary types of the several *Myrmecocystus* which he described were deposited in the LACM at his suggestion.

Type material of most previously described forms has been examined during this study. In most cases, the types were sent to me for study at my leisure and it is a pleasure to acknowledge the aid of: C. Besuchet, Museum d'Histoire Naturelle, Geneva; W. L. Brown, Jr. and H. E. Evans, Museum of Comparative Zoology, Cambridge; M. Favreau and J. G. Rozen, Jr., the American Museum of Natural History, New York; D. R. Smith, United States National Museum of Natural History, Washington.

Several individuals, through their interest, have been especially helpful, providing specimens, field data and/or field assistance. In particular I wish to express my gratitude to: Chris and Dorothy Henne, J. H. Hunt, E. L. Fisher and C. A. Kay.

Financial assistance for field work was rendered by the American Philosophical Society, through grant numbers 4494 and 6446 from the Penrose Fund. The same fund provided largely for the preparation of the numerous figures by Ruth Ann DeNicola. The scanning electron photomicrographs were made through the courtesy of Scanning Electron Analysis Laboratories, Inc., Los Angeles, largely through the interest of Gerald E. Garner.

Finally, my appreciation to my colleagues at the LACM who have put up with my seemingly endless musing about *Myrmecocystus:* J. P. Donahue, C. L. Hogue and F. S. Truxal. My thanks to Carmen, Sherry and Terri, for their patience in typing and re-typing various portions of the manuscript.

HISTORICAL RÉSUMÉ

Writing at the time of the Spanish conquest of Mexico, Bernardino de Sahagun described some of the flora and fauna of Mexico. He mentioned the honey

ants and stated that the Aztecs called them "Nequazcatl" (Curran, 1937). According to T. Smith (1807) children in Michoacán, Mexico, were very fond of the repletes and the Mexicans supposed that they contained ". . . a kind of honey collected by the insect . . ." Simmonds (1885) observed that repletes, fastened to squares of paper, were sold in the market places of Mexico City. He also noted that the "honey" was fermented into an alcoholic drink.

The formal history of *Myrmecocystus* begins, however, with the notes by Llave (1832) on the Mexican ant which he called *Formica melligera*. Llave's report was based on specimens which were observed in the vicinity of Mexico City. Had not the existence of repletes been mentioned it would have been impossible to ascertain anything of the identity of these ants. Six years later Wesmael (1838) described the genus and its monobasic type *mexicanus*. Again, the mention of repletes was an important factor, since the descriptions are utterly useless by contemporary standards. In 1850 Foerster described *Cataglyphis*, a Palearctic group, as a subgenus of *Myrmecocystus*.

H.C. McCook (1882) described in detail his observations, mostly made in central Colorado, of the biology and behavior of the ant for which he proposed the name *melliger* var. *hortus-deorum*. No type material was ever designated for this name, though there appear to be specimens of McCook's material extant in the collections of the Philadelphia Academy of Sciences.

August Forel, in 1886, described what he believed to be *melliger* from repletes and normal workers from Mexico and Texas. Forel felt that his ant was the same as that of Llave, to whom he attributed authorship of the species; he also listed *mexicanus* as a synonym. This alone indicates the hopeless inadequacies of the earlier descriptions. Emery (1893), who presumably had before him one of Wesmael's specimens of *mexicanus*, was in an excellent position to set the matter straight. He first recognized the futility of attempting to deal with Llave's *Formica melligera;* he attributed authorship of *melliger* to Forel. Then, from Wesmael's specimen, he redescribed *mexicanus* and demonstrated clearly the distinctness of the two forms. Additional specimens, sent to him by Pergande from the United States, were different from *mexicanus* but were, in Emery's opinion, very similar to *melliger*. These he described as varieties of *melliger*.

A new variety, *melliger depilis*, was added by Forel (1901); another subspecies, *melliger placodops* was described by the same author in 1908. In that year Wheeler (1908) published the first of several papers on the genus. While this paper was purportedly an investigation into the phenomenon of replete production in general, it was largely devoted to the American representatives of *Myrmecocystus*. *Cataglyphis*, which Forel (1866) had suggested should be separated as a genus, was retained as a Palaearctic subgenus of *Myrmecocystus*.

Before discussing the habits of these ants Wheeler first considered their systematics. He was in an excellent situation to do so for he was the first myrmecologist to observe these ants in the field and had amassed a large collection. Furthermore, he had types received from Forel and Emery. Wheeler, instead of putting the systematics of these ants on a firm basis, managed to do precisely the opposite. This, apparently, resulted from certain theoretical considerations with respect to the production of repletes: ". . . both of the North American species of *Myrmecocystus* are sufficiently plastic to have produced several races and . . . these differ from one another more in their habits than in their structure. In the same species, *melliger*, . . . there are forms that produce repletes and seem to feed almost exclusively on sweet juices, and others that are highly carnivorous and are not known to have workers with distended crops. We must conclude, therefore . . . that certain races always and others never develop repletes, or that repletion, which is merely a physiological state, is an inconstant character." Wheeler rejected the notion of physiological inconstancy and this determined his systematic treatment of the ants. Since the merits of each of the forms treated by Wheeler will be discussed in detail in the taxonomic section there is no need to do so here. It is sufficient to state that he recognized two species, *melliger* (with five subspecies and four varieties) and *mexicanus* (with three subspecies and one variety).

The year following, Wheeler (1909) added an additional species, *lugubris*, from California. In 1912 he added a new subspecies of *melliger*, *lomaensis*, and one more species with a variety, *yuma* and *yuma flaviceps*. A key to the various forms recognized by Wheeler was included in the paper. Because of numerous ambiguities, the key is almost impossible to use. One new subspecies, *mexicanus melanoticus*, was described by Wheeler (1914) from Hidalgo, Mexico. At this time the genus had assigned to it four species, eleven subspecies and six varieties, including *melliger placodops* described by Forel in 1908 and evidently overlooked by Wheeler. For some years the systematics of the group remained unchanged except that Wheeler (1922) segregated the Palaearctic *Cataglyphis* as a discrete genus.

Cole (1936) proposed to add to *melliger* one new subspecies and two new varieties, and one new subspecies to *mexicanus;* he described a new species, *hammettensis*, in 1938. By this time the total number of names stood at twenty-five. These were usually based on relatively minor differences in size and color and presumed differences in habits. This mass of forms had achieved a state of unwieldy complexity when Creighton (1950) became involved with the problems of this genus.

At the outset he recognized the wholly unsatisfactory status of the systematics of the group, especially that resulting from a plethora of allopatric subspecies

and varieties. He also questioned the validity of Wheeler's theory of replete versus non-replete subspecies and varieties. With the then prevalent ideas of geographic subspeciation as a philosophical basis, Creighton proposed an arrangement which recognized twelve species. Three subspecies (including the nominate form) were assigned to *melliger* and two (including the nominate form) were attributed to *mexicanus*. In all, fifteen names were considered to be valid. The two subspecies of *melliger, californicus* Cole and *orbiceps* Wheeler, were regarded by Creighton as of questionable validity. At this time, also, Creighton proposed a key to the species basing many of the names on firm, recognizable characters. This admirable work is not without its errors, but these are largely traceable to those made by Wheeler (1908).

M. R. Smith (1951) described a new species, *pyramicus,* from Nevada; T. W. Cook (1953) reverted to the chaotic misarrangement which had existed prior to 1950; Creighton and Crandall (1954) demonstrated that a "non-replete" forming subspecies of *melliger, orbiceps,* does produce repletes and synonymized the name; Creighton (1956) placed *yuma* in the synonymy of *lugubris;* Gregg (1963) returned *mendax* to subspecific status under *melliger;* I (1969) re-examined the status of the members of the *melliger* group. Four species were recognized: *melliger* (= *comatus*), *mendax, placodops* (= *melliger, sensu* Wheeler 1908; = *orbiceps*) and *semirufus; californicus* was transferred to the genus *Formica*. Three additional species were described by Snelling (1971). These changes, made over a period of nearly twenty years, left the genus with sixteen species in the United States and only one subspecies.

The present revision, the first in nearly three-quarters of a century, recognizes twenty-seven species. It reflects a basically conservative approach to the systematics of the group. I have attempted to synthesize data derived from the external morphology of all adult castes, from both behavior and distribution, into a rational system.

BIONOMICS

The production of repletes by some members of a colony is an outstanding feature of these ants, one which attracted literary mention as early as Llave's observations in 1832. Llave's account was followed by that of Wesmael (1838). Several other mentions of these ants appeared during the period between 1840 and 1880 including the translation of Llave by Lucas (1860), but these add little of use and much of confusion and are not worth mentioning. The earliest commentary, that of Llave, is fairly straightforward, being nothing more, in essence, than observation of the fact that peasants in the area of Mexico City excavated nests in order to gather repletes. Error crept into the commentary made by Wesmael, although it must be admitted that the fault was not his. Rather, he was the victim of misinformation. His informant assured him that the ants manufacture the honey and that this is, in turn, stored in special cells similar to those of honeybees.

The first detailed, and reasonably objective investigations of a honey ant are those of H. C. McCook, as published in his oft-quoted "The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains" (1882). Since this account is so well known I think it sufficient to point out the barest essentials. The ant which he observed was *mexicanus* (reported as *melliger* var. *hortus-deorum*) in the Garden of the Gods, near Manitou, Colorado. He found the foraging activity to be nocturnal, and that foraging workers gathered the sweet exudates from cynipid galls on shin oaks, *Quercus undulata*. This honeydew is regurgitated to the developing repletes upon return to the nests. McCook asserted that this sugary exudate seemed to furnish the primary food source for these ants.

The next observer of importance was Wheeler (1908) who presented an excellent résumé of all previous accounts. The reader interested in these is referred to Wheeler's paper. Following this résumé Wheeler reported on the results of his own observations on many colonies in the southwestern United States. In general these observations confirmed much of what McCook had discovered, but Wheeler was able to add some embellishments of his own. He, too, made observations at the Garden of the Gods, but found that site ". . . so overrun by tourists that careful and continuous observation of ant-nests is out of the question!" I can affirm that sixty years later the situation was not improved. Elsewhere in Colorado, however, he found conditions more suitable and repeated much of McCook's work on *mexicanus*. He discovered, as McCook did not, that the ants obtain much of their nectar from coccids and aphids, even in areas where the parasitized shin oaks are abundant. He also found that repletes develop from callow workers.

Finally, with respect to *mexicanus,* Wheeler presented some thoughts on nest construction which he felt were ". . . explainable only as adaptations to the development of repletes." The great hardness of the soil was commented upon as was the propensity of this ant to construct its nests on the summits of ridges. The size of the nest openings, too, seemed related to replete production. Hard soil was speculated to be best suited to the construction of firm ceilings for replete chambers, ridge tops provided for rapid shedding of rain, and large tunnels for complete aeration of the nests to inhibit the development of fungi. These speculations conclude with the supposition that there is ". . . obviously a reciprocal relation between the replete habit and an arid environment; the ants store

honey because they are living in an arid region where moisture and food are precious and the storing of honey in replete workers, in turn, is possible only in very dry soil."

Wheeler also published observations made on many other forms. Those made on other species which he found to produce repletes did not differ greatly from those made on *mexicanus*. He did, however, become aware that certain forms never seemed to develop repletes. This led to the speculation that such is a physiological phenomenon, characteristic of these forms. These physiological forms were, in his opinion, incapable of developing repletes and derived the bulk of their sustenance from predatory activities against other arthropods. This speculation had profound and unfortunate results when applied to the systematics of the genus. In 1908 Wheeler described *melliger mimicus*, an ant in which he noted the lack of repletes even though he excavated many nests. However, a few years later he received samples from San Diego County, California, of *mimicus* which included repletes. Rather than abandon or re-evaluate his theory Wheeler (1912) described these ants as a new subspecies (*lomaensis*) closely allied to *mimicus*. It is true that he made note of some differences to separate the California specimens, but it is equally true, as Creighton (1950) has shown, that these differences will not hold up. Indeed, they do not even exist, for it is quite possible to find specimens in the type series of *melliger mimicus* which differ from *melliger mimicus* in precisely the same manner as does *melliger lomaensis*.

Creighton (1950) ventured the opinion that replete production was a matter of opportunity, rather than an innate, physiological phenomenon. He further offered the idea that replete production is not a response to arid desert conditions but rather that it is the result of a previous xerophile having invaded less rigorous climes. In other words, replete production is the result of the availability of an excessive amount of nectar available in mesophytic environments.

Over a period of several years I have had opportunities to conduct observations on most of our species of honey ants. These are far from complete but they do permit some generalizations. The first of these is that replete production is largely a matter of opportunity and has absolutely no bearing on the systematics of the group.

The first non-replete forming subspecies to fall was *melliger orbiceps* Wheeler. Parks (1929) noted the presence of repletes in nests of this form in the vicinity of San Antonio, Texas, an observation subsequently overlooked in the years which followed. Creighton and Crandall (1954) published the results of excavations by the latter of a colony near Tucson, Arizona. Within this colony were found large workers with orbiculate heads (the structural peculiarity which identified this subspecies) and large numbers of repletes (the physiological peculiarity which identified the nominate subspecies). Obviously, the only sensible recourse was to synonymize the subspecies *melliger orbiceps*.

Another highly insectivorous form which did not, in Wheeler's opinion, develop repletes was *kennedyi* (= *melliger semirufa, sensu* Wheeler). This species is common in exceptionally arid regions of the western deserts, and often constructs its nests in very fine sand. Cole (1938b) reported finding a single replete in a colony 10 mi S of Cameron, Arizona. In 1967 I found many repletes in a colony excavated in Malheur Co., Oregon. Since then they have been recovered from colonies in other areas.

Wheeler, in describing *melliger comatus* (1908) remarked that he was unable to find repletes in the colonies which he studied in the Davis Mountains of Texas. This form is an outright synonym of *melliger* (see discussion in systematic treatment), the lectotype of which is a replete. Furthermore, I managed to find a few repletes in a colony which I excavated in the Davis Mountains on 20 August 1967. Another of Wheeler's highly insectivorous forms was *melliger mendax* Wheeler. Repletes of this ant, which I consider a distinct species, are included in a sample collected by R. H. Crandall in the Santa Rita Mountains, Arizona, and I have taken them from colonies in the Huachuca Mountains, Arizona.

The above cases have one thing in common: all are forms which Wheeler believed to be strictly insectivorous and therefore physiologically unable to produce repletes. These cases are not proof, of course, that all species form repletes, but they do demonstrate that several forms for which this was claimed as a character do, under suitable conditions, develop them. The production of repletes can be demonstrated for most of our species, and I see no reason why we should doubt that all are capable of doing so. One more interesting case might be cited at this point: repletes were found in a nest of *flaviceps* Wheeler, excavated near Shorty's Well, Death Valley National Monument −100 feet elevation. Death Valley is, of course, considered to be one of the more arid, inhospitable areas of our deserts.

Haskins (1939) addressed himself to the question of why certain individuals within the colony become repletes while others do not. He postulated that these individuals ". . . quite independently take to storing nourishment . . . ," that such action is a "mental differentiation" or mental mutation. While this is an intriguing speculation, I do not consider that there exists any evidence to support it.

Repletes develop from callow individuals, usually the largest available. That small individuals within the nest may become repletes was shown by Parks (1929), so size is obviously not the sole factor. My own belief is that all callows will accept any quantity

of food offered them and that the actual number of repletes developed, and, therefore, which individuals become repletes, is determined solely by the amount of food and the number of callow workers available. Observations made on developing colonies of *creightoni* and *testaceus* are pertinent. When food supply was limited to a small excess, only a few largest individuals were developed as repletes. When, however, the excess was large enough, all available callows, irrespective of size, were filled to repletion. Because of these observations, I cannot accept the notion that some ants become repletes because of "mental mutation" while other callows are endowed with normal instincts which do not allow such development.

Misconceptions exist on the nature of the fluids which repletes store. The sweet fluid commonly stored is not true honey. It consists rather of simple sugars, unmodified from their original state, *i.e.*, nectar from flowering plants, exudates from galls and the secretions of aphids and other homopterans.

Nectar and honeydew are not the only fluids which these ants store. The first to point this out to me was W. S. Creighton *(personal communication)* who commented on water-filled repletes of *mexicanus*, for which he coined the term "aquapletes." These specimens were secured by M. A. Cazier in Arizona. I have since recovered these "aquapletes" from colonies of this species in Arizona, and from *testaceus* Emery in California. A third type of replete has been found, also in nests of *mexicanus*. While I have not identified the fluid, it is my guess that it consists, in large part, of the body fluids of insect prey. Following this discovery, I found similar appearing repletes in preserved samples of *testaceus* and *navajo* Wheeler. Since these are now preserved, I doubt that the usual procedure (*i.e.*, tasting) would be of much avail in attempting to determine their nature. They are, however, similar to the repletes of *mexicanus* in that the stored fluid is opaque, whitish to gray, with a considerable amount of sedimentary material. Obviously, too, a detailed chemical analysis of the fluid should be made to determine its composition. If the stored fluid proves to consist largely of proteins, *i.e.*, insect fluids, then it is important to note that such repletes are thus far known only within a single complex of species, the nominate subgenus.

While Wheeler was incorrect in his assumption that some species are almost exclusively insectivorous and others derive their sustenance entirely from nectar, it is correct to state that some apparently are less strongly insectivorous than others. The *Myrmecocystus, s. str.*, species are a case in point. If one observes returning foragers of *placodops*, a member of the subgenus *Endiodioctes*, the quantity of insects and insect fragments carried into the nest is impressive. Excavation of the nests of this species reveals chambers packed with fragments. Not so in the case of *mexicanus* or others of this group. Most returning workers seem to be carrying nothing, although a somewhat swollen gaster belies this. On several occasions I have observed *mexicanus* and *testaceus* workers feeding on a freshly dead insect. However, the insect was not carried back to the nest; its severely masticated corpse remained where the ant dropped it when through feeding.

It seems timely to diverge to the subject of larval feeding. The larvae of *Myrmecocystus* have a very characteristic appearance for formicines. Instead of being rather short and uniformly stout for their entire length (as is usually the case of formicine larvae in this region), *Myrmecocystus* larvae have small heads and the body becomes progressively broadened caudad, so that the larva appears to possess a long, slender neck. Normally, formicine larvae are fed directly by the adult workers (trophallaxis), but this does not appear to be true of *Myrmecocystus*. In excavating colonies of the supposedly wholly insectivorous species such as *kennedyi* I have been impressed by the large number of insect fragments present in the chambers containing larvae. Observations on captive colonies confirmed what seemed a logical assumption. The insect fragments are placed among the larvae and these must fend for themselves. I have seen no indication that larvae of these species are fed by trophallaxis. Colonies of members of the subgenera *Myrmecocystus, s. str.*, and *Eremnocystus* differ significantly from the above. Insect particles are seldom found in the larval chambers and there is some evidence, though by no means proof, that larvae may be fed by trophallaxis, at least in part. If, as I suppose, the bulk of the insect protein utilized by members of these groups is carried to the nests in liquid form and stored within the bodies of repletes, then certainly trophallaxis must take place. More observations and experiments on captive colonies may provide answers.

Some further observations on captive colonies, even though fragmentary, are pertinent to the point at hand. I wish to stress the incomplete nature of these observations which have been to date on but three species: *testaceus, creightoni* and *kennedyi*. Observation colonies of all of these had been maintained on three different diets. The first consisted of a strictly honey-water diet (A), the second of insect fragments and water (B), the third of a combination of the two (C). In all cases, colonies were supplied with all the food material they would accept, and some callow workers in all instances developed the replete conditions. Some repletes of both *testaceus* and *creightoni* fed on diet B were filled with an opaque, whitish fluid, but none were seen in the single colony of *kennedyi* maintained on diet B. The colonies fed on diet A did not thrive. Larvae developed very slowly and often died prior to pupation. Most of those which pupated failed to mature. A few pupae did mature and these

appeared to be normal in all respects. It is obvious, in these cases, that the colonies were not thriving. The larvae in the colonies fed on diets B and C developed rapidly and normally. The colonies previously restricted to diet A were ultimately converted to diet C. Of these, one colony of *testaceus* immediately began to improve, but all the other colonies continued to decline and finally expired. These data, albeit fragmentary, seem to indicate that protein, such as that derived from the tissues of other insects, is essential for larval development. It should be pointed out that the adults of the colonies fed on diet A did not seem adversely affected by their restricted diet.

Earlier I noted the limited quantity of insect fragments carried back to the nest by species of *Myrmecocystus, s. str.* This appears to be true of those of *Eremnocystus* as well. Further the nests of these species conspicuously lack chambers filled with insect fragments. This, of course, may also indicate that useless bits of integument, not suitable for food purposes, are removed from the nest to the surface of the ground. This latter seems more reasonable to me, but should be verified by further observation.

The nectar sources of these ants are varied. The observations by McCook (1882) on *mexicanus* in Colorado indicated that this species utilizes the exudates of galls on *Quercus undulata,* while Wheeler (1908) recorded this species soliciting aphids and "coccids" in the same state. No doubt the latter belong to the so-called mealy-bugs, now placed in the family Pseudococcidae. Recently, McKenzie (1968) indicated several species of mealy-bugs with which were associated species of *Myrmecocystus.* I have observed most of our species, at one time or another, soliciting aphids for honeydew. Wheeler (1908) expressed doubt that pseudococcids (and aphids) could be considered an important adjunctive food source for the *Myrmecocystus* of arid regions. I am inclined to disagree, although I cannot offer proof to the contrary. At the time Wheeler wrote pseudococcids were a poorly known group with a very sparse representation in desert areas. As McKenzie's study of the California pseudococcids has shown, however, the family is surprisingly well represented in arid regions. Furthermore, many of the genera found in the deserts are those with which ants have been found. And, I doubt that the apparent sporadic occurrence of mealy-bugs in desert areas adequately reflects the true situation, but that it does reflect on the inadequacy of the collecting techniques. Mealy-bugs simply are not the sort of thing that casual collectors turn up. Many species feed on roots while others are found in tightly compacted basal clusters of blades of grasses and such plants as *Yucca,* or on the underside of cactus pads.

Shields (1973) reported finding *kennedyi* tending larvae of *Philotes rita pallescens* (Lepidoptera: Lycaenidae) on flowers of *Erigonum kearneyi* var. *kearneyi* in Nye Co., Nevada. He also noted that the ants ". . . fed in the flowers." At this location, *Philotes* larvae were also tended by *Conomyrma insana* (Buckley) [reported as *Dorymyrmex pyramicus* (Roger)] and *Camponotus nearcticus* Emery. Whether all three ant species competed on the same plants was not indicated, nor did Shields mention ants transporting the lycaenid larvae back to their nests.

Another source of nectar, and one which I believe to be very important, was completely overlooked by Wheeler. During the early spring months much of our desert areas are covered with an incredible profusion of perennial and annual flowering plants. Other areas exhibit similar profusions of blossoms during the summer and autumnal months. *Myrmecocystus* workers may often be found in large numbers exploiting this abundant, though short-lived, food source. In many areas, especially on mountain slopes and in small canyons, there are, in addition, some species of perennials (such as *Eriogonum* and *Euphorbia* spp.) which persistently maintain blossoms through much of the year. I believe it safe to say that there is an abundance of plant-source food, either directly or indirectly (mealy-bugs, aphids, etc.), in even the more arid parts of the range of *Myrmecocystus.*

My own field work has indicated still another factor involved in the food problems which these ants face. During the driest parts of the season, rather few larvae are present in the colonies. However, shortly after plant growth begins a revival and flowering period, larvae become more plentiful in the nests. Growing plants naturally result in an upsurge in insect populations directly dependent upon plants as a food source. Hence, more insects are available as prey to be fed to growing larvae. The maintenance of small larval populations during the dry periods is advantageous since it imposes a small drain on the food procurement capabilities of the foragers at a period when insects, as a food source, are scarce. But, it also provides potential callows to function as repletes shortly after the plant growth cycle enters the active phase.

Shortly following the initiation of this phase of desert existence, larvae are to be found abundantly in *Myrmecocystus* nests and the number of larvae remains high until the cycle begins to decline. This is a normal and necessary adjustment to accommodate the rigors the arid environment imposes on all organisms. And, honey ants are equaled only by the harvester ants of the genus *Pogonomyrmex* in their successful adaptation to survival in this harsh habitat. It is interesting that the North American component of *Pogonomyrmex,* in number of species, is about the same as *Myrmecocystus:* twenty-two species for the former, twenty-seven for the latter. Both groups are basically inhabitants of arid and semi-arid habitats and in the arid regions are about equally common. Each group has proven successful in desert regions largely through

the ability to utilize and store large amounts of food. In *Myrmecocystus,* however, this stored food seems to be largely for consumption by the adults and colony reproduction is curtailed during periods of limited prey availability.

Colony Foundation

The reproductive forms of *Myrmecocystus* may be found in the nests up to three months, perhaps more, in advance of their mating flight, so it is difficult to set limits on this function. In most, if not all, species mating flights occur following a light rain. The favored time seems to be late afternoon or early evening. In arid habitats, with their unpredictable rainfall, it is obvious that the alates may have a wait of some duration before a suitable rainfall occurs. But, once it does come, the males and females swarm from the nests and fly forth. Males generally precede the females by several minutes and mating is evidently consummated in flight. Females quickly search out a suitable site and dig to a depth of from six to eighteen inches before constructing a brood chamber. While some species are haplometrotic others are pleometrotic (Wheeler 1917). It is interesting, though, that I have yet to find more than a single gravid female in a fully developed nest.

Nests

Wheeler (1908) speculated on the physical conditions of the microhabitat possibly necessary for replete development. For example, he felt that very hard soil was necessary, or at least highly desirable, for the formation of replete chambers ". . . whereas soft or friable soil would be most disadvantageous." That this is not correct is readily demonstrated by the colonies in which I have found replete chambers in very fine, soft sand. The same may be said of his observation with regard to nesting on ridge summits, for most of the nests from which I have taken repletes were on relatively flat, or very flat, terrain. Wheeler's observations are at sharp variance with mine in another respect. He commented (1908) that ". . . the storing of honey in replete workers . . . is possible only in very dry soil." While I will not maintain that precisely the opposite is true, I will state that it has never been my experience to find replete chambers, in use, in very dry soil. Rather I have found them invariably to be at a depth, or in a circumstance, in which the soil remains perceptibly damp and cool to the touch.

A colony of *mexicanus* which I excavated near Pearblossom, Los Angeles Co., California, was located in the middle of a wide, sandy dry stream bed. The excavation was made in early October and there had been no rain of consequence for the preceding five or six months, so the soil was quite dry. At a depth of about four and one-half feet, there was sufficient moisture present so that the sand could be squeezed together in a mass and retain its shape until it dried out. At a depth slightly in excess of five feet the first replete chamber was discovered. This has been a common experience for me, and when excavating a colony I have never found repletes above what I believe to be the level of permanent soil moisture.

My own assumption is that replete chambers must be located at depths which ensure permanent moisture. Wheeler felt that this would favor the development of molds, but I have yet to see a moldly replete. In observation nests I have seen repletes being constantly groomed by other workers and I suspect that a thorough grooming operation would be sufficient to inhibit mold development. In areas such as Death Valley a lump of wet sand (sufficiently wet that it dampens the hand) will desiccate almost totally in a matter of seconds when exposed to the air. Under such circumstances a replete can rapidly lose important body moisture through the large areas of exposed gastric membrane. While surface soil may be very dry I believe that replete chambers are, and must be, located in circumstances which will favor the retention of a humid microenvironment.

Wheeler noted the large size of the passages leading into the nest and surmised that they are concomitant to maintaining a dry state within the nest. Aeration tion undoubtedly is important to the maintenance of a healthy environment, but low humidity within the nest cannot be anything but detrimental. Among life forms within desert regions, the conservation of moisture is essential. The repletes of honey-ants are subject to desiccation and the larvae even more so. It should be noted that larvae, even when abundant in the nest, are seldom to be found in the dry upper chambers except in the evening and during early morning when these chambers are cool. As soon as the upper levels begin to warm, the larvae and pupae are removed to the depths of the nest presumably to prevent excessive drying.

Nest tunnel and chamber construction seems to reflect the all important concept of moisture conservation. Few chambers are constructed at those levels which remain almost perpetually dry. The bulk of the excavation is carried on in the depths of permanent moisture. Those tunnels providing access to replete chambers are usually constricted at the entrance to the gallery. These certainly would impede the outward flow of humid air. The main gallery into the nest is usually surprisingly large, considering the size of the ants, and it is seldom closed even in the hottest part of the day. It is, however, frequently constricted at some point between the surface and the first level of galleries. This is a common condition in the nests of those species inhabiting areas normally characterized by a long dry season, such as southern California and western Arizona. In such areas as eastern Arizona, the summer months are also the period of greatest rainfall and here the tendency to constrict tunnels is less pronounced; nests may not extend to very great depths.

But, in areas of long dry summers, nest depths often exceed three meters, except when the level of permanent moisture is no more than one meter below the surface.

With respect to nest construction, *romainei* in particular seems especially interesting. Colonies of this ant are fairly common in New Mexico at the White Sands National Monument and on the Jornada Experimental Range north of Las Cruces. They are also abundant east of El Paso, Texas. Those which I have observed were all situated in very deep dune sand. Nest entrances are small and the main gallery leading into the nest is usually no more than 5-8 mm in diameter. Normally this gallery, in a honey ant the size of *romainei,* would be at least twice that diameter. No nest of this species has been fully excavated, but I have gone to depths of about 1.5 meters without encountering chambers of any significance, other than a few small ones a short distance from the surface, usually within the upper 15 to 25 cm.

Excavation of nests of this species are greatly hampered by the very fine texture of the sand particles and their loose arrangement. Collapse of the excavation is common and hence tracing the single, fine gallery is difficult. Because of the fine, loose nature of this material, soil moisture dissipates rapidly, and I surmise that the main body of the nest lies at considerable depths in which conditions are more stable.

The above considerations apply equally to all groups except the subgenus *Eremnocystus*. The species in this subgenus construct nests in which the tunnels are, by comparison with those of species of the other groups, relatively quite small. The nests are rather shallow and often do not penetrate deeply into the level of permanent moisture. Full repletes seem to be exceptional although semirepletes are common. These ants, though the smallest of the genus, are assiduous foragers. The nests are commonly closed entirely during the hottest summer months. They may be opened from time to time for short periods of nocturnal foraging. These species forage diurnally during the cooler months, and the workers seem to be largely scavengers, as the insect remains carried back to the nest consist largely of already dead insects. Foraging is carried out on low vegetation, and leafhoppers form a conspicuously large percentage of the material collected.

Thermal Physiology

The thermal physiology of some honey ant species near Las Cruces, New Mexico, was investigated by Kay (1974). Working principally with three diurnal (*depilis, mimicus* and *romainei*) and one nocturnal (*mexicanus*) species, she studied the relationships between temperature, humidity and O_2 consumption among the various species.

Critical thermal minima for all species observed were close to the minimum temperatures for surface activity. This suggests that temperature does set lower limits to activity. While diurnal species were never out of the nest at temperatures below 12°C, the lower limit for the nocturnal species was 2°C. In each case, these are close to the critical thermal minima noted by Kay: 11.2° (±0.5)-12.0°(±0.3)C for the three diurnal species and 0.4°(±0.7)C for the nocturnal species.

Workers of the diurnal species demonstrated upper lethal temperatures, after two hours of exposure, ranging between 40° and 45°C. However, these ants forage on surfaces at temperatures up to 60°C; air temperatures, measured 0.5 mm above the surface, may be as high as 46°C. The ants have developed behavioral responses which enable them to forage under these potentially lethal conditions. When foraging at high surface temperatures, the body is elevated as much as possible and the ants move rapidly over short distances and climb onto pebbles, twigs or other objects. By repeating this process they are able to progress long distances over surfaces otherwise too hot.

The nocturnal species, according to Kay's studies, have critical thermal maxima which are at the lower end of the range of the diurnal species. These species, however, do not forage above about 30°C, well below the critical thermal maximum. While temperature sets upper limits on surface activity for the diurnal species, this is apparently not true for such nocturnal species as *mexicanus*. The limiting factor for the nocturnal species may well be light intensity, possibly coupled with temperature, as noted by Kay. The nocturnal species, which probably rarely, if ever, encounter lethal high temperatures, have not acquired the behavioral reaction noted for the diurnal species.

In studying preferred temperatures of the several diurnal species, Kay noted that ". . . differences in preferred temperatures corresponded to differences in critical thermal maxima among the three species and may reflect small physiological differences." The preferred temperature during summer of *mexicanus* was well below that of the diurnal species. In all species, preferred temperature was higher during the hot summer months than at other seasons, suggesting some acclimation.

Kay was unable to determine conclusively whether or not O_2 consumption is increased in dry air to gain metabolic water. Her data suggest that this may be true, but that further studies must be made. Curiously, the nocturnal *mexicanus* seemed less adversely affected by desiccation than workers of the diurnal species. Females of the diurnal species *romainei* also showed good tolerance for high vapor pressure deficits.

Myrmecophiles

Nest symbionts appear to be rare in *Myrmecocystus*. This is surprising, since nest associates are most often found with ants having populous nests. The ubiquitous thysanuran, *Mirolepisma deserticola* (Silvestri) is common in the nests of ants over the arid Southwest, associated with many genera of ants and often very

abundant in some nests. Records from *Myrmecocystus* nests are rare; I have found this species several times with *flaviceps* in California and Baja California and with *mendax* once in Arizona. In each instance, the thysanuran was decidedly uncommon within the nest. Similarly, the cricket genus *Myrmecophila* is a common nest associate which may be taken, often in large series, from nests of other ants adjacent to those of *Myrmecocystus*. There is but one record of an ant cricket associated with honey ants; a single specimen of *M. manni* Scudder was taken from a colony of *mendax* which I excavated in the Huachuca Mts., Arizona. Mites, too, are often associated with ants, but I have once more only a single record: *Gigantolaelaps* sp., taken with *mendax* in the Huachuca Mts.

The scarabaeid beetle genus *Cremastocheilus* has been found associated with *Myrmecocystus* on several occasions. In addition to the records given below, I have taken *C. puncticollis* Cazier from a nest of *mexicanus* in California. Especially worthy of note are the accounts of Cazier and Statham (1962) and Cazier and Mortenson (1965). The 1962 paper contains little conclusive information regarding the interrelationship of the ants and beetles, but does include some interesting observations on the ants themselves. There is also a list of the various Nearctic *Cremastocheilus* and the ants with which they have been associated. The species of *Cremastocheilus* and associated *Myrmecocystus* listed are: *C. stathamae* Cazier with *mimicus; C. lengi* Cazier with *mimicus?* (this is probably *depilis* Forel); *C. constricticollis* Cazier with *mimicus*.

The later paper contains a great deal of fascinating information and is well worth reading by anyone interested in ants, myrmecophiles or interspecies relationships. It was found that *Cremastocheilus* adults exhibit variable behavior patterns so that at different times they can be considered to be synecthrans (persecuted intruders), synoeketes (indifferently tolerated guests), symphiles (amicably received guests) or predators. In this study the honey ant host was *mexicanus* and the associated beetle *C. stathamae*. The beetles are either steered or dragged into the host nest by the foraging ant workers. Once the beetle had entered the nest, its activities, unfortunately, remained obscure. Unanswered is the question of benefit to the host species. Presumably the ants feed upon glandular secretions exuded by the beetle, but there is no real confirmation of this. The beetles remain within the nests for varying lengths of time, but frequently overwinter in them. Adults feed seldom, but when they do, they move to the brood chambers of the host species and feed on the ant larvae. The adult beetles are ultimately expelled from the nests by the ants for an undetermined reason. Mating of the *Cremastocheilus* seems to occur outside the nests, and eggs presumably are laid outside the ant nests. No *Cremastocheilus* larvae have been found in ant nests.

The tenebrionid genus *Araeoschizus* consists of about fourteen species restricted to arid and semiarid regions of western North America. The species were last revised by Casey (1907). Although little is known of their habits, most appear to be myrmecophilous, but adults may be taken under boards, cow chips, or stones on the soil. Possibly ants are associated with the beetles under these circumstances, but this may not necessarily be the case. Large numbers have been taken in can traps in Joshua Tree National Monument, California, by E. L. Sleeper (*pers. comm.*).

Unpublished data gathered by the author indicates that species of *Araeoschizus* are most often taken in association with seed gathering ants, especially of the genera *Pogonomyrmex* and *Pheidole*, but I have also taken them from nests of *Conomyrma* and *Solenopis*, and Tanner (1945) recorded *A. airmeti* Tanner from nests of *Aphaenogaster*. There are three records of *Araeoschizus* from nests of *Myrmecocystus:*

Araeoschizus sp.; with *mimicus;* 7 mi E Robles Jct., Pima Co., Ariz., 24 Feb. 1968 (G. C. & J. Wheeler; Ariz. 87). This specimen was incomplete and desiccated and possibly was scavenged elsewhere.

Araeoschizus sp. near *armatus* Horn; with *kathjuli;* Big Rock Wash, Los Angeles Co., Calif., 1 Apr. 1972 (J. P. & K. E. Donahue). This specimen was taken alive from the nest and the association is certainly a legitimate one.

Araeoschizus sp. near *decipiens* Horn; with *romainei;* 12.5 mi SE El Paso, El Paso Co., Tex., 23 Apr. 1973 (R. R. Snelling; #73-47). Two specimens, both living and certainly associated with the ants, were removed from small debris chambers near the surface. Other nests of this ant in the vicinity did not yield any *Araeoschizus*, but one specimen was taken from a nearby nest of *Pogonomyrmex rugosus* Emery.

Since *Araeoschizus* species possess modified clumps of setae ("trichomes") on the thorax, the myrmecophilous nature of these beetles seems certain, but their relationship to the ants is not clear. Although larvae have not yet been found, I assume that these must feed in the debris chambers of the ants. As far as *Myrmecocystus* are concerned, it is possibly significant that all *Araeoschizus* associations are with members of the subgenus *Endiodioctes*. In this subgenus considerable amounts of debris, consisting largely of insect fragments but including some vegetable material, are stored in upper chambers of the nest.

Predators

Hunt (1973) found undetermined *Myrmecocystus* to be the prey of two lizard species, *Sceloporus occidentalis* and *Uta stansburiana*, in San Diego Co., Calif. based on examination of stomach contents. Four other lizard species, including one *Phrynosoma*, were found not to feed on *Myrmecocystus* at the same site.

Parks (1929) noted that there is a definite association between *placodops* (reported as *melliger orbiceps*) and the coyote, *Canis nebrascensis texensis* Bailey, throughout southwestern Texas. According to Parks, careful observation has proven that the nests of the honey ant are regularly dug out by the coyote. I know of no other published notes on this matter, but I was shown a dug-out nest of *mexicanus* in New Mexico by Dr. Carol Ann Kay. This was a marked nest in one of her study areas and had been destroyed early in the spring of 1973. In this case the identity of the animal which destroyed the nest was unknown, but it certainly must have been a vertebrate, quite possibly a coyote.

Comparative Aspects

The above is a more or less general survey of the bionomics of these ants. There remains now an accounting of the various groups and species. I feel that these should be taken up at this time for convenience of comparison rather than under each group of pertinent species in the systematic portion of this revision. The various species groups are fairly consistent within themselves insofar as their behavior is concerned and, at the same time, quite distinctly different from the patterns exhibited by the other groups.

Myrmecocystus s. str., consists of five species which are superficially similar and are indisputably *the* honey ants since all the species consistently produce repletes in large numbers, and are assiduous gatherers of sweet secretions. I have observed all the species in the field.

The nests of these ants are surmounted by characteristic crateriform tumuli. These tumuli may consist of coarse pebbles (Fig. 350) or very fine grains of sand (Fig. 348). Those of *mexicanus* may attain a large size. Two species, *pyramicus* and *ewarti*, commonly nest in fine sand, although I have found colonies of *ewarti* in very hard "desert pavement." However, even in these the "desert pavement" overlaid a bed of fine sand at a depth of about six inches.

The colonies of *mexicanus* are located usually on slopes and in areas in which the soil is coarsely sandy. Such sites commonly may contain numerous small to large size stones. I have rarely found nests of this species in open desert terrain, and still less often in fine sand. The habitat preferences of *navajo* Wheeler seem to be much the same as those of *mexicanus*.

By far the most variable in habitat selection is *testaceus*. In southern California nests frequently are constructed in very hard soil at lower elevations of the chaparral zone. Other nests may be located in the coarse sand and gravel of stream beds. Still others may be found in alkali "hard pan." In the Sage Brush Deserts of the Great Basin, nests are common in flat areas of coarse sand.

Although the workers may forage on cool or cloudy days, these species are typically active outside the nest from shortly before sunset until shortly after sunrise. I previously have mentioned the limited quantities of insect fragments carried back to the nests. In addition to my own observations of *mexicanus* and *testaceus* masticating prey, I can add the following: while trapping rodent specimens in the Kingston Range, San Bernardino Co., California, Mr. L. A. Lester, Natural History Museum of Los Angeles County, found *mexicanus* actively feeding on dead rodents in the traps. The damage by the ants was sufficiently severe to completely ruin the rodents for specimen purposes.

It has been my own experience that these ants are not aggressive predators on other arthropods but that they are, perhaps, more correctly considered scavengers. Certainly they will attack and kill small insects, such as leafhoppers, when the opportunity presents itself, but most of the identifiable insect parts carried back to the nest consist of dry fragments. On several occasions I have seen *mexicanus* collecting dry headcapsules from the chaff piles of *Pogonomyrmex* spp.

The mating flights of *ewarti* in southern California takes place during the spring months, usually in February and March. In Butte Co., Idaho, alate females of *pyramicus* were found in the nests on 15 July and female larvae were found in nests in Malheur Co., Oregon, a week later, suggesting that there may be mating flights in late summer or early fall. The flights of *testaceus* evidently follow a similar pattern. Little is known of the flight season of *navajo*, except that alate females have been taken at Van Horn, Texas, on 10 July at lights. The flights of *mexicanus*, in eastern Arizona, New Mexico and Colorado, occur during the rainy summer months. In southern California, because of the usually dry summers, these flights are postponed until the first fall rains. Males of *melanoticus* taken in July at Pachuca, Hidalgo, indicate that the flight most likely takes place at the end of the dry season in that southern latitude.

The members of the *melliger* group of the subgenus *Endiodioctes* are a more homogenous group. Preferred nest sites are in hard, stony soil, frequently on hill slopes. Most commonly, too, these species do not extend beyond the lower limits of the Piñon-Juniper habitat. The nests lack the crateriform tumulus so conspicuously present in the nests of the previous group (Figs. 357, 358). Rarely is there a small, irregular tumulus present. It is not unusual for a nest to possess more than one entrance.

Foraging activity is almost entirely diurnal and the workers are aggressive predators, bringing back to the nests great quantities of freshly killed insects. Repletes are known definitely for *melliger*, *mendax* and *placodops*. None have been seen of *semirufus*, although I have found semi-repletes and there is no reason to suppose this species does not produce repletes. Replete production is, however, a less consistent feature within this group than with the preceding. This seems strange,

since the species exhibit much the same habitat preference. However, it may be that here lies the explanation of Wheeler's errors regarding replete production and insectivorous forms. The species of *Endiodioctes* and of *Myrmecocystus s. str.* occur together and the species of both groups tend to have very populous nests. The possibility of interspecific competition is, however, reduced by two important factors: diurnal versus nocturnal foraging habits and largely insectivorous versus largely succivorous feeding habits. The latter factor may not be a valid one, though, since the larvae of both groups require protein obtained from other arthropods. But, it is true that the *Endiodioctes* species rely more heavily on insect prey as a food source.

Mating flights within this group apparently occur during the summer rainy season for *melliger, mendax* and *placodops*. Those of *semirufus,* a species restricted to southern California, take place immediately after the fall rains, usually in November.

The *mimicus* group species of *Endiodioctes* superficially resemble those of the *melliger* group but are usually much smaller. Their nests, constructed in a variety of situations are normally surmounted by low, flattened crateriform (Figs. 352, 353) or semicircular (Fig. 355) tumuli. The only species which is consistently found in the same habitats as the *melliger* group species (i.e., the Piñon-Juniper association) is *mimicus,* which is also the largest member of the group. This species is also the most widely distributed member of the group. In the southern parts of its range *depilis* is found in Piñon-Juniper associations, but in the northern extremes is found most commonly in the ecotones between the Piñon-Juniper and Creosote Bush habitats. One species is found in the open, arid deserts of southern California: *flaviceps.*

Both *mimicus* and *depilis* nest in moderately fine-grained to coarse-grained sandy soils. In some areas, such as the San Joaquin Valley of California, *mimicus* may be found in hard, clayey soils. This species frequently has the entrance to the nest situated at the base of a grass clump. The nests of *flaviceps* may be located in fine dune sand or in coarse-grained sands.

As usual, the diet of these species is mixed. The workers forage diurnally for small insects and other arthropods which are carried back to the nests. Floral and extrafloral nectaries are commonly visited. These species probably exploit aphids and pseudococcids but there is no positive evidence for this.

The mating flights of *mimicus* and *depilis* occur in the months of August and September, while those of *flaviceps* take place in October, November and December.

The *kennedyi* group includes several species of similar habitus. The most common species is *kennedyi* which nests most frequently in fine sand, but is found in coarser sand as well. The nests of this species are surmounted by a conspicuous crateriform tumulus. *Wheeleri* nests in similar habitats and a crateriform or, less often, semi-circular, tumulus is present.

These ants are aggressive diurnal foragers which collect large quantities of small insects. Both *kennedyi* and *wheeleri,* the only species I have studied in the field, are also commonly found at flowers taking nectar. The secretions of homopterans are also utilized. I have taken *kennedyi* with membracid nymphs in Arizona and this species (as *semirufus*) has been reported by McKenzie (1967) tending *Phenacoccus gossypii* Townsend and Cockerell in southern California.

Mating flights of *kennedyi* occur during late summer and early fall. Those of *wheeleri* take place during late fall to early spring. The sexual forms of *nequazcatl* have been taken from nests in early February.

The last group is the subgenus *Eremnocystus* which has been partially discussed on an earlier page. Nests may be in fine or coarse sand, depending upon the species, and are marked by a low, irregular crateriform tumulus. Mating flights apparently take place late in fall or early spring.

METHODS AND TERMINOLOGY

All measurements were made from fully dry, mounted specimens under a binocular microscope fitted with 15× oculars. Most were made at a magnification of 45×, though those of females and larger species were taken at 15×. Measurement was made with an ocular micrometer of 50 units and converted to millimeters.

The keys and descriptions, for the most part, employ terminology conventional to formicid systematics. When that conventional terminology has been at variance with usage elsewhere among the Hymenoptera, the wider usage has been followed.

Allometry. Disproportionate size relationship between two organs or body parts.

Allopatric. Populations occupying mutually exclusive ranges.

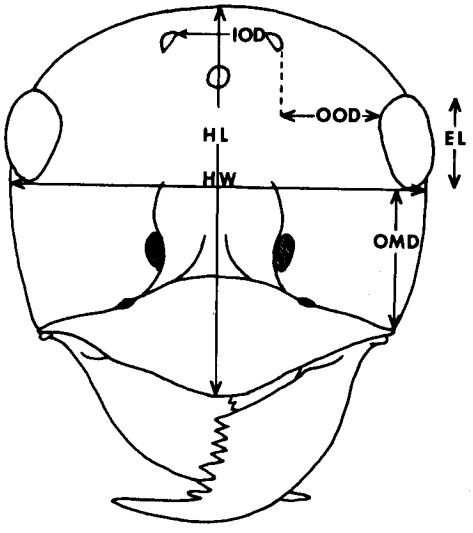
Antenna. The antenna of the female and worker consists of twelve segments; the basal segment (*scape*) is much elongated. That of the male is composed of thirteen segments, of which the *scape* is the longest. The first segment beyond the *scape* is the *first flagellomere* (IF).

Cephalic Index (CI). Head width × 100/head length.

Eye Length (EL). Maximum length of the eye with the head in full face view (Figs. 1, 2).

Head Length (HL). The maximum measurable length of the head, positioned in perfect full face view, from the midpoint of the anterior clypeal margin to the midpoint of the occipital margin (Figs. 1, 2).

Head Width (HW). *Worker and female:* the maximum width of the head, positioned in perfect full face



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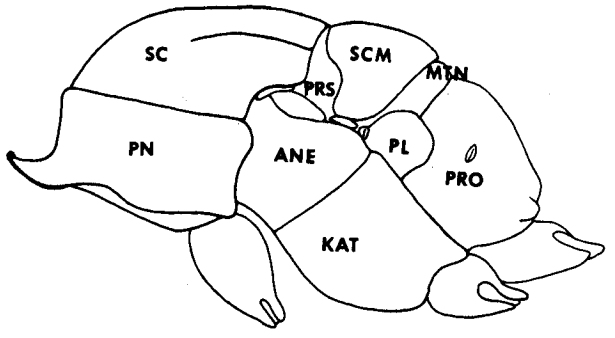

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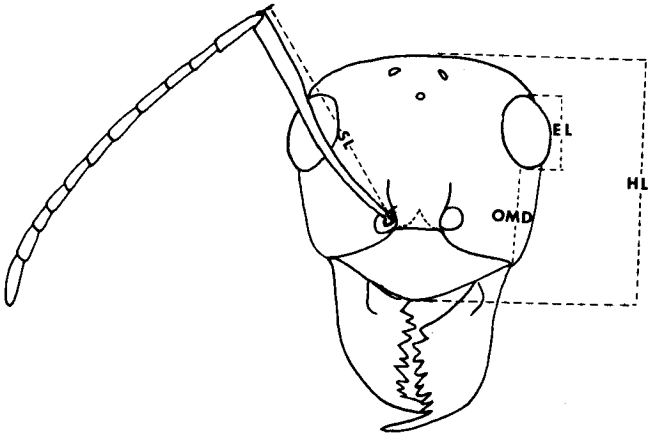

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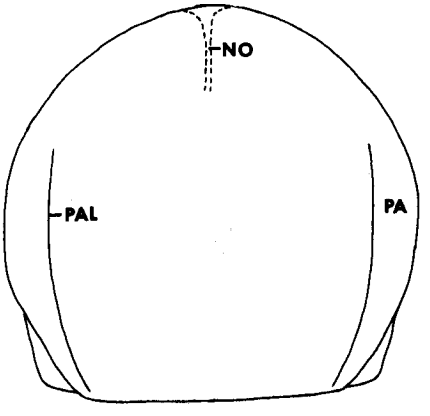

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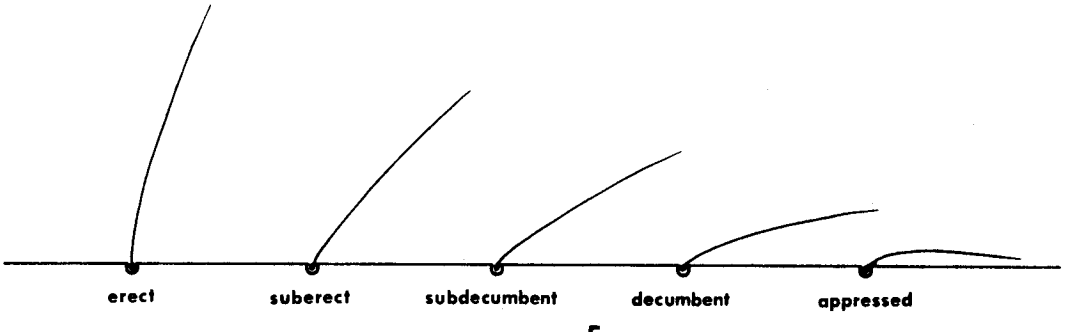

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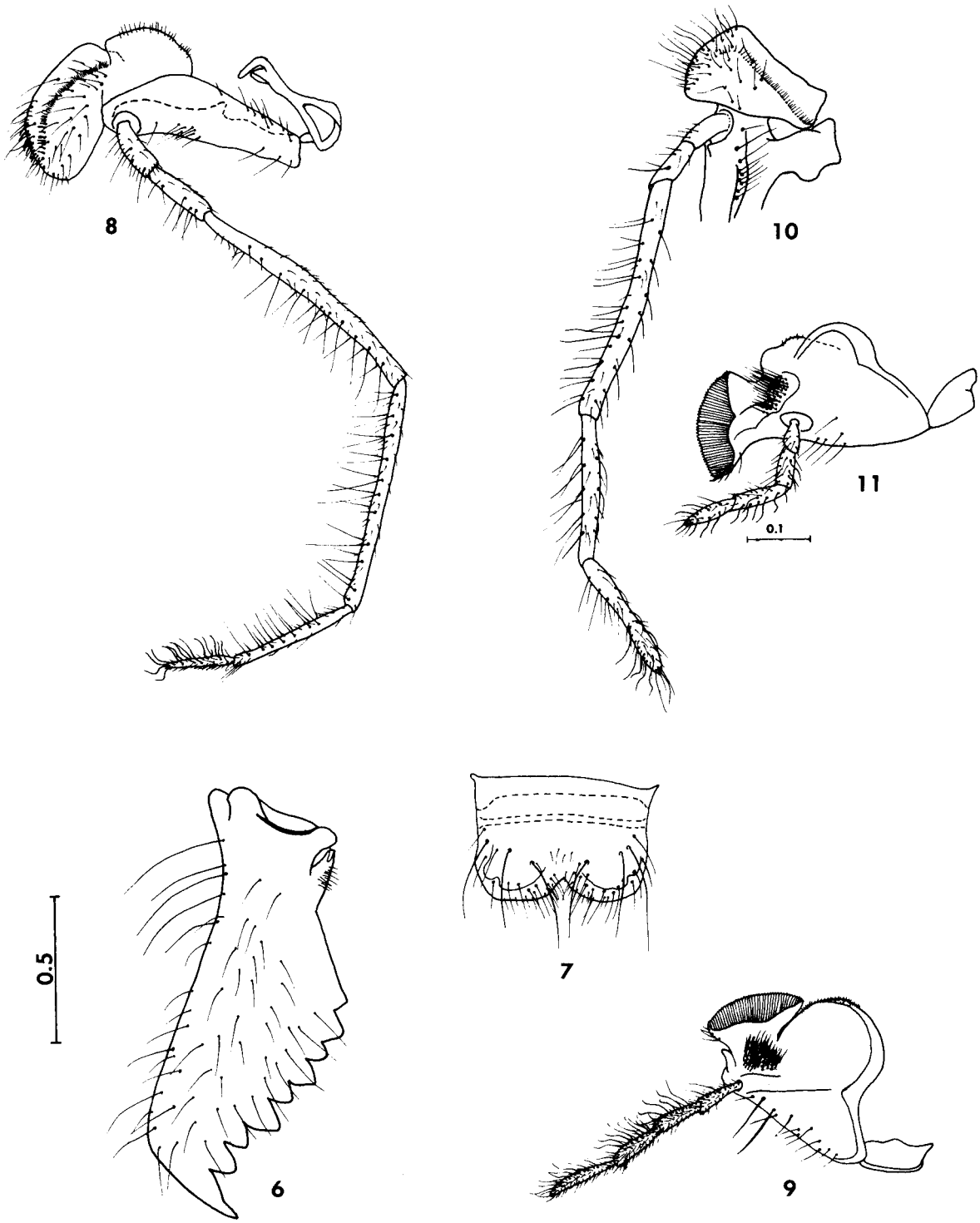
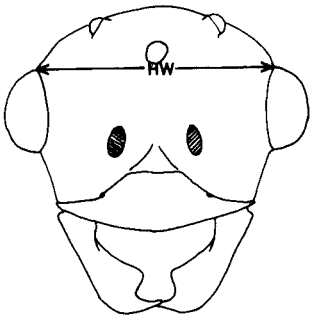
FIGURES 1–5. Terminology. 1, *M. koso*, n. sp., female, frontal view of head; 2, *M. mexicanus*, worker, same; 3, *M. koso*, female, lateral view of thorax; 4, same, dorsal view of mesoscutum; 5, schematic representation of terminology of angle of declination of vestiture (after Wilson 1955). See text for explanation of abbreviations.



FIGURES 6–11. Mouth parts. 6–9, mandible, labrum, maxilla and labium, respectively, of *M. mexicanus* worker, all to same scale; 10–11, maxilla and labium, respectively, of *M. koso* male, to same scale.



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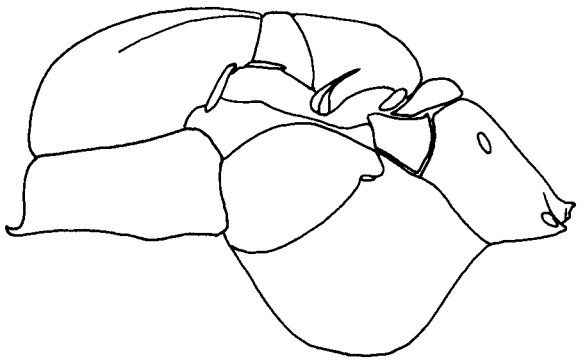

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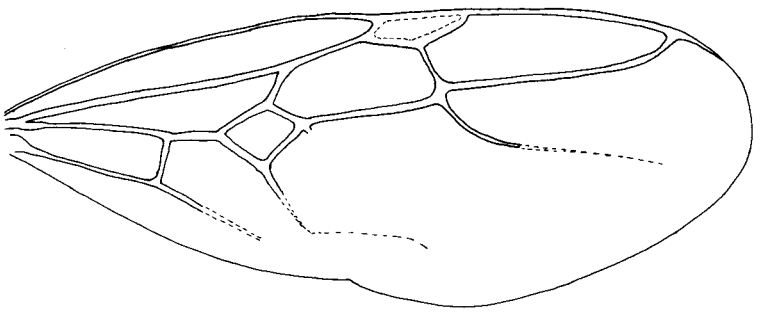

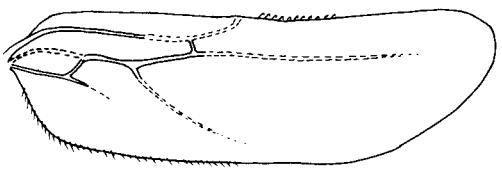

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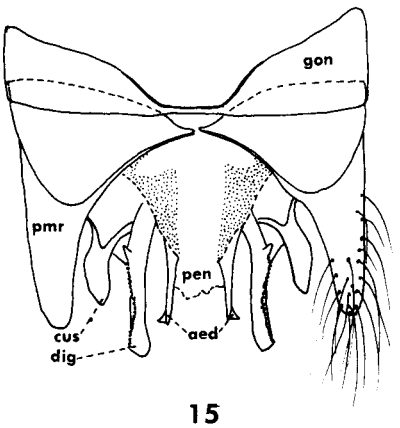

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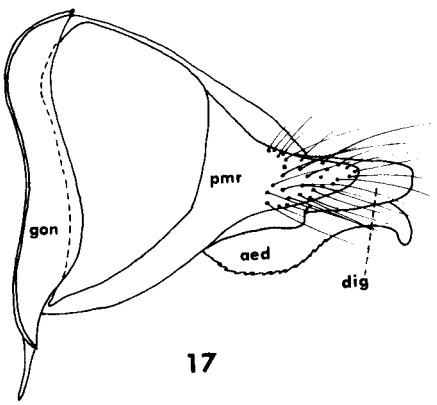

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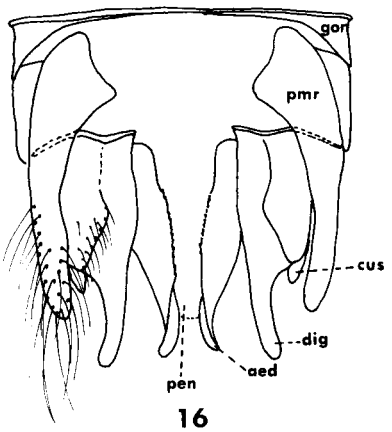

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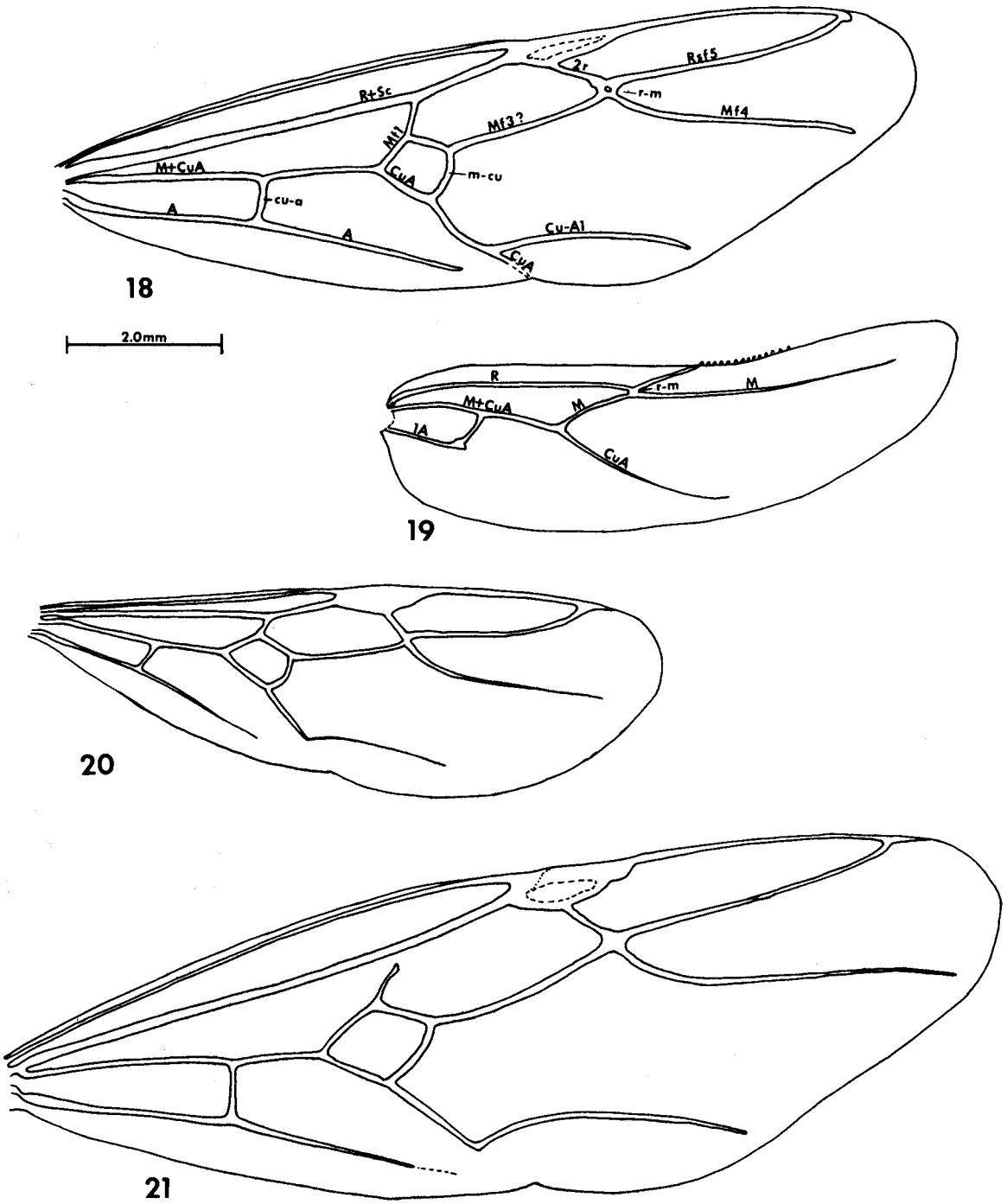
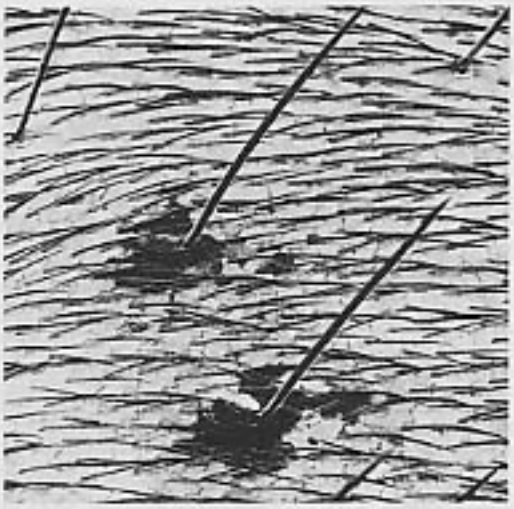
FIGURES 12–17. *M. koso*, male. 12, head in frontal view; 13, thorax in lateral view; 14, fore and hing wings; 15, genital capsule, dorsal view; 16, genital capsule, ventral view; 17, genital capsule, lateral view. See text for explanation of abbreviations.



FIGURES 18–21. Wings of females. 18, *M. mimicus* fore wing; 19, same, hind wing; 20, *M. creightoni,* fore wing; 21, *M. mexicanus,* fore wing. All drawn to same scale.



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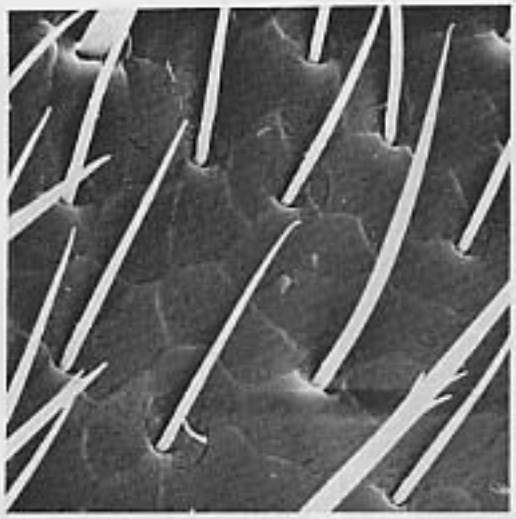

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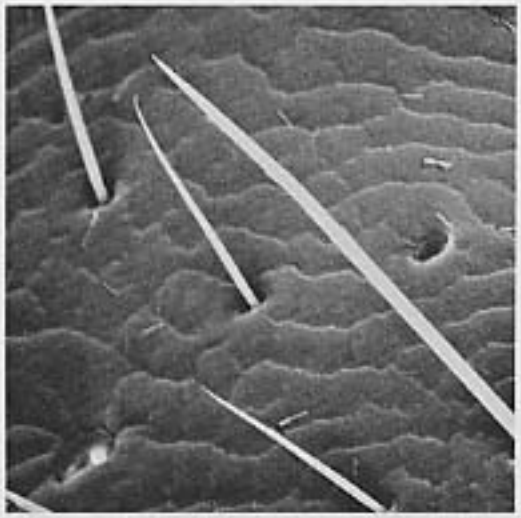

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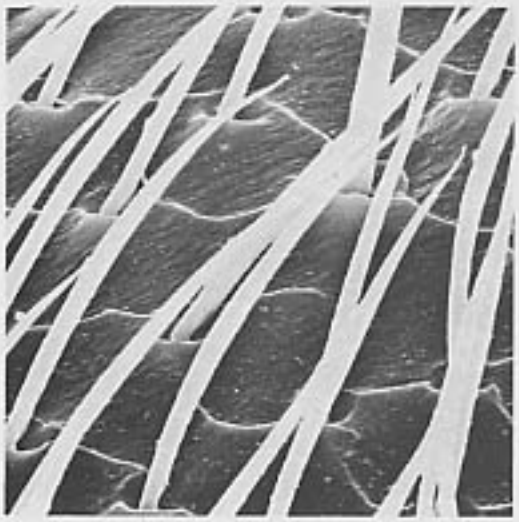
FIGURES 22–25. Scanning electron microscope (SEM) photomicrographs of *M. mendax* worker. 22, discal area of second tergum, showing appressed pubescence and erect setae, × 300; 23, base of one seta on second tergum, × 2000; 24, vestiture and integument of frontal lobe, × 100; 25, vestiture and integument of side of clypeal lobe, × 600. Courtesy of Scanning Electron Analysis Laboratories, Inc., Los Angeles.



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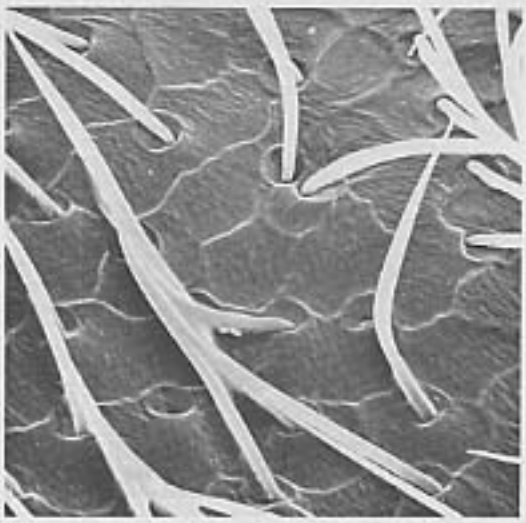

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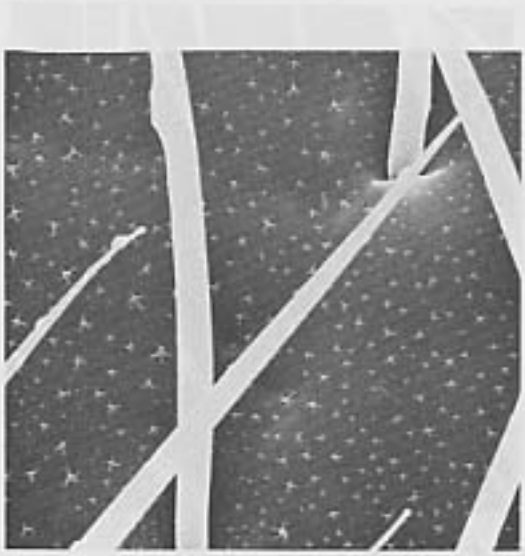

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FIGURES 26–29. SEM photomicrographs, *M. mendax*. 26, worker, vestiture and integument of pronotal dorsum, × 100; 27, worker, vestiture and integument of propodeal base, × 1600; 28, male, vestiture and integument of lower face, × 200; 29, male, vestiture and integument of propodeal base, × 3000. Courtesy of Scanning Electron Analysis Laboratories, Inc., Los Angeles.

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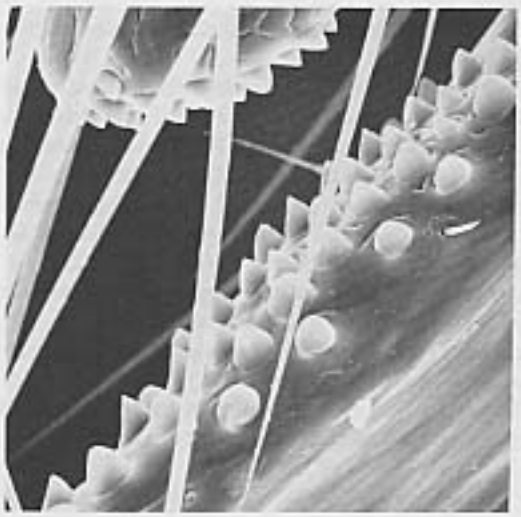

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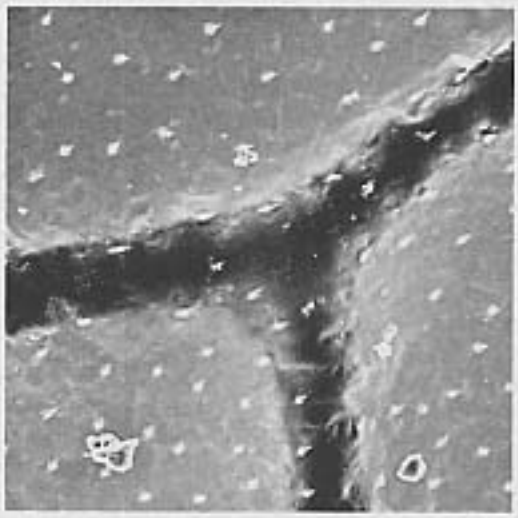

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FIGURES 30–33. SEM photomicrographs, *M. mendax* male. 30, apex of gaster, incl. genital capsule, dorsal view, × 70; 31, aedeagus in profile, × 140; 32, sensilla of digitus and cuspis, × 700; 33, portion of wing membrane, × 200. Courtesy of Scanning Electron Analysis Laboratory, Inc., Los Angeles.

view, at a level below lower eye margin. *Male:* the same, but measured *above* upper eye margin (Fig. 12).

Integument. The surface appearance of the integument varies from smooth and polished to dull and nonreflective. In those areas where the integument is highly shiny, the surface is smooth and without obvious surface irregularities. Such surface areas are here described as polished.

On most areas, however, the surface is more or less irregular. Examination shows that the surface is made up of minute plates, varying in size from about 5 to about 20 microns in minimum width or diameter. Depending upon the size of these plates, the extent of marginal effacement and upon the density of micropunctures, the integument may appear to be "tessellate," "shagreened" or "coriaceous."

The propodeal and pronotal dorsa of *mendax* workers appear coriaceous when examined under an ordinary dissecting microscope at high magnification. Scanning electron photomicrographs show that the surface is made up of minute plates about 10 microns in diameter and with close piligerous micropunctures (Figs. 26, 27). Because the plates appear to overlap, the surface must be described as shagreened; for comparative descriptive purposes, this is termed *coarsely shagreened.*

Regularly shaped, well-defined plates, 5–10 microns in diameter, are seen on the clypeus and adjacent to the antennal socket of *mendax* male (Fig. 28); this type of sculpture is called *closely shagreened.* In *moderately shagreened* surfaces the plates are about 10 microns in diameter, regular in shape and with well-defined margins. The example in Figure 24 is from the frontal lobe of a *mendax* worker. The least dull in appearance is termed *lightly shagreened;* the plates are large (10–20 microns), often irregular in shape, usually with one or more margins effaced; the plates are often arranged in rows, as on the side of the clypeus of the *mendax* worker (Fig. 25).

An exceptional type of surface was found on the propodeum of *mendax* males. The surface is dull and there are no obvious plates at all. Scattered over the surface, however, are very small, more or less stellate structures (Fig. 29).

Interocellar Distance (IOD). *Female and male only:* minimum distance between inner margins of posterior ocelli, from above (Fig. 1).

Malar area: With the head in full face view, that part of the side which lies between the lower eye margin and the base of the mandible; commonly called "cheek" in myrmecological literature. Herein, when used as a measurement, referred to as *oculomandibular distance* q.v.

Minimum Ocular Diameter (MOD). The minimum diameter of the eye as measured with the head in full lateral aspect.

Notauli (sing. notaulus). *Female and male only:* the pair of parallel longitudinal furrows extending *posteriorly* from the anterior margin of the mesoscutum. These furrows, more commonly called "Mayrian furrows" by myrmecologists, are apparently remnants indicating the former existence of a defined prescutum. In *Myrmecocystus* these are commonly fused to form a median line, but may be clearly separated as two lines on either side of the middle. Both conditions may occur in the same species. (Fig. 4).

Ocellar Diameter (OD). *Female and male only:* maximum measureable diameter of anterior ocellus.

Ocellar-ocular Distance (OOD). *Female and male only:* minimum measureable distance between outer margin of posterior ocellus and inner eye margin, from above (Fig. 1).

Oculomandibular Distance (OMD). In perfect full face view, the distance from the lower eye margin to the mandibular insertion (Figs. 1, 2).

Parapsidal Furrows. Female and male only: the pair of parallel longitudinal furrows extending *anteriorly* from the posterior margin of the mesoscutum (Fig. 4).

Parapsides (sing. parapsis). *Female and male only:* lateral region of the mesoscutum, between the parapsidal furrow and the tegula (Fig. 4).

Perfect Full Face. Frontal view of the head, so positioned as to attain maximum length, with anterior clypeal margin and posterior occipital margin horizontally aligned.

Pilosity. The longer, stouter, hairs or setae, outstanding from the cuticular surface. Terminology to indicate degree of inclination after Wilson (1955) (Fig. 5).

Poriform punctures. Creighton (1950) stated in his key that three forms (*melliger, mendax* and *orbiceps*) possess small conical papillae from which arise the erect setae of the gastric terga. These papillae are illusory, as I discovered by use of a scanning electron microscope. The gastric setae arise from shallow depressions which are distinctly margined (Fig. 22); discoloration of the integument suggests the possibility that these setae arise from secretary pores (Fig. 23). Because of their appearance they are here termed *poriform punctures.*

Pronotal Width (PW). Maximum measurable width of the pronotum, as seen from above, at right angles to the longitudinal axis of the thorax.

Propodeum. The morphological first abdominal segment, fused with the thorax in higher Hymenoptera. This is the "epinotum" of conventional formicid systematics, but see Wilson 1955; Wing 1968.

Pubescence. The short, fine, appressed hairs underlying the pilosity.

Punctation. There are, on specimens of any species, punctures of two distinctly different sizes and types. The first of these, *micropunctures,* consists of the minute, round punctures from which emerge the appressed hairs comprising the pubescence. Punctures of the second type, referred to simply as *coarse punctures,*

are those distinctly larger punctures from which the hairs comprising the pilosity emerge. These coarse punctures may be round, ovoid or elongate; their margins may be sharp throughout or may be partially effaced especially in the elongate punctures of the malar area.

Scape Index (SI). Scape length × 100/head length. *Note:* This is a departure from conventional usage (as, for example, Wilson 1955) in which SI = SL × 100/HW. The conventional index method appears to offer less significant figures for this genus than the modification utilized herein.

Scape Length (SL). The maximum measurable length of the scape, excluding the basal condyle.

Sympatric. Populations of which ranges are partially or wholly overlapping.

Thorax. The middle body region, the pro-, meso- and metasomites + propodeum. Equivalent to "alitrunk" of Wilson (1955), Wing (1968) and others. Inasmuch as worker ants do not possess wings, use of alitrunk seems inappropriate and is contrary to general usage within the higher Hymenoptera (Fig. 3). The terminology used here is that of Tulloch (1935).

Weber's Length (WL). *Worker:* With thorax in side view, maximum diagonal length of thorax, from anterior pronotal margin to apex of propodeal valvule. *Female and male:* With thorax in side view, maximum diagonal length of thorax, from dorsal margin of pronotal collar to apex of propodeal valvule.

Male terminalia. The last exposed segments of the abdomen are tergum VIII and sternum IX. Tergum IX is a concealed transverse plate at the base of tergum X; the latter is reduced, largely membranous and bears a pair of elongate, setose pygostyles (*pgs*) on either side. Sternum IX, the subgenital plate, is largely exposed and with reduced setation; the shape of its apical margin is of some diagnostic value, but is sufficiently variable that it must be used with caution.

The male genital structures are very similar to the relatively simple, generalized *Formica* type described and figured by Snodgrass (1941). The aedeagus (*Aed*, Fig. 15) appears slender in dorsal or ventral view, but the two plates are deep dorsoventrally (Fig. 17); the lower margin is strongly convex (except in *wheeleri*) and finely or coarsely serrate. In some groups the aedeagal plates possess fine, sparse setae. The digital (*dig*) cuspidal (*cus*) lobes of each volsella (*vol*) are large; each is beset with small tubercule-like sensilla, the relative number of sensilla varying among species. The digitus also has a variable number of setae. The paramere (*pmr*) is simple in outline and provided with numerous long, simple setae.

The genitalic capsule and subgenital plate are removed from a preserved specimen or one which has been relaxed overnight. Removal of the capsule is effected by means of a 000 insect pin with the tip bent to form a minute hook; the pin is inserted into the apex of the gaster between the last tergum and the capsule, then rotated so that the hook extends partially over the base of the capsule which is then gently eased out. Following this, the subgenital plate is removed using two pair of Dumont No. 5 forceps. The plate is grasped from behind with one pair of forceps along its entire length, the tips of the forceps extending basad for several millimeters; the second pair of forceps is then used to carefully sever all membranes.

Once these structures are removed, they are placed in a concentrated solution of cold KOH, one part of volume of crystalline KOH to three parts of water, for about three hours, or until they are sufficiently cleared. Once cleared they are washed in a 70% solution of ethyl alcohol for a few minutes. From alcohol they are transferred to glycerine. Muscular and other tissues are removed from the subgenital plate. The structures may then be placed in a microvial with a drop of glycerin and the vial pinned with the specimen from which the structures were removed.

Some samples were mounted on slides. The subgenital plate requires no special treatment, but the genitalic capsule is dissected. The gonobase is removed and the parameres, volsellae and aedeagus are separated from one another. The parameres are mounted with their outer sides up, the volsellae with their inner sides up (so that the cuspis and digitus and their sensilla are visible), the two plates of the aedeagus are separated and mounted with their outer sides uppermost.

All permanent mounts were made into Euparal from absolute ethyl alcohol and were not stained. The specimens were placed into a minimal amount of Euparal, oriented in the desired manner and the slide placed in a drying oven overnight. Orientation is checked the next day and any drift corrected by pressure with an insect pin on the surface of the medium. Occasionally it is necessary to insert a pin into the Euparal, first wetting the pin with Euparal essence. This process is continued until, after several days the position of all parts has stabilized. Enough Euparal is added to accommodate the cover slip, which is then put in place.

Wings. The basic venation of fore and hind wings is shown in Figures 18, 19. Venation is fairly stable throughout the genus. The small amount of variation found crosses specific and group lines and is not considered significant. The most common variant is loss of m-cu in the forewing so that the discoidal cell is opened. Terminology of the veins is that of Brown and Nutting (1950).

In some species short hairs are present along the apical and/or posterior wing margins. In most species the presence or absence is consistent. Members of the subgenus *Eremnocystus* all possess short erect hairs on the wing membrane. In the other subgenera these are replaced by minute papillae.

The keys are my best attempt at synthesizing morphological data based on the populations studied. Those

for the males will probably be least useful, due to the great morphological conservative nature of this caste. For some species there have been too few males available to provide an adequate idea of variation. Worker keys for the subgenera *Myrmecocystus s. str.* and *Eremnocystus* should present few problems. Workers in the subgenus *Endiodioctes* will often prove more troublesome and isolated strays may not key at all well, especially if they are minor workers. Ideally, one should have a nest series reflecting a full gamut of size variation; the key to *Endiodioctes* is constructed assuming that this is the case.

The descriptions are more or less uniform in order to facilitate comparisons. The parenthetical figure for the variates indicated is the appropriate figure for the primary type (worker) and for the allotype (male).

Since there is a great range of interspecific size variation, I have had the illustrations of females of the species drawn to approximately the same size. The drawings of workers and males are all in scale to their respective females. The drawings of male mandibles and terminalia are all to the same scale.

To the greatest extent feasible, I have cited full data for the material studied, including: location, elevation (when given), date (collector; specimen source). For localities within the United States, records are given under their respective counties within the state; in some instances I have been unable to do so and these records are cited at the end of the appropriate state listing under *County unknown*. Some localities have been relatively frequently collected and records are lumped together: "Garden Cyn. (5400′), Carr Cyn. (5200–7100′), Miller Cyn. (5000–6100′), Huachuca Mts., numerous dates and collectors (AMNH, GCW, LACM, MCZ, USNM)." This seems preferable to listing individually the twenty-seven separate collections of *mendax* from the Huachuca Mts.; I have used this alternative when there are more than six records from a single, well-defined area.

Some records are taken from literature sources and I have not studied the specimens involved, but accept the records as probably valid for the indicated taxon. These records are enclosed in brackets with reference to the literary source: "*Grand Co.:* [Thompson, 5150′, no data (Titus?). Cole, 1942]." In this case, *mexicanus* was recorded from Thompson, 5150′, Grand Co., Utah, by A. C. Cole (1942), and I have no reason to doubt its authenticity.

Ecology. Under this general heading I have presented such general and specific data as are available relevant to each species: nest site preferences, nest superstructure, foraging periods, food, etc. General habitat preferences are indicated in terms of defined phytocenoses. Phytocenological terms are based on the work of Küchler (1964).

THE GENUS *MYRMECOCYSTUS*

Myrmecocystus Wesmael 1838. Bulletin Academie royale des Sciences, des lettres et des beaux-artes de Belgique 5:766–771.

Type species: Myrmecocystus mexicanus Wesmael 1838. Monobasic.

Diagnosis: Female and *worker:* Formicinae: monomorphic to moderately polymorphic; antenna twelve-segmented, slender, without apical club; antennal socket adjacent to basal clypeal border; frontal carinae subparallel; eye convex, lateral, slightly above middle of head; ocelli present or absent, often greatly reduced; psammophore present but often irregular. Thorax elongate, moderately constricted in mesopropodeal area; legs slender, tarsal claws simple; petiolar scale compressed to moderately thick from front to back, crest blunt to sharp in profile; fine appressed pubescence and long erect hairs present, often abundant. *Male:* Formicinae: Antenna thirteen-segmented; scape longer than following four segments; antennal socket adjacent to basal clypeal border; if slightly wider than following segment.

Mouth parts: Labrum (Fig. 7) deeply emarginate medially, but not cleft. Mandible (Fig. 6) broad, triangular; lateral groove present, dorsal groove absent; with distinct basal and masticatory margins, the latter with five to nine subapical teeth; trulleum and mandalus distinct. Maxillary palpi six-segmented in female and worker (Fig. 8), five-segmented in male (Fig. 10), segments three and four greatly elongated and flattened, penultimate segment as long as, or longer, than, two basal segments; stripes broadest in middle, tapering basally and apically, without conspicuous long setae; galeal crown flattened; lacinia rounded apically, comb present, continuous, but inconspicuous. Labial palpus (Figs. 9, 11) four-segmented; premental shield and epimeral sclerites sclerotized; raquette-like membranous expansions present; subglossal brush present; paraglossae absent.

Proventriculus: Eisner (1957) illustrated the proventriculus of *mexicanus*, which is of the sepalous formicine type. Essentially very similar to the proventriculus of such genera as *Camponotus, Formica, Lasius,* that of this genus is distinguished by the reflexed sepals.

Larvae. Larvae of several species are characterized by Wheeler and Wheeler (1968): "Slender. Anus ventral. Antennae small. Head hairs moderately numerous, short and denticulate. Labrum without anterior swellings. Mandibles subtriangular in anterior view; lateral border feebly convex." They are very similar to those of *Lasius*, as described by Wheeler and Wheeler (1953), but are more slender, the cephalic hairs are shorter and body hairs are shorter and none are deeply bifid or conspicuously branched. Some spe-

cific differences were noted in the samples which they studied, but may be, in part, due to differences in instars. I provided some erroneous identifications to the Wheelers. These may be corrected: *"lugubris"* = *creightoni; "mojave"* = *testaceus; "semirufus"* = *kennedyi* (Calif.) and *depilis* (Ariz.).

Myrmecocystus belongs to the Section Euformicinae of Emery (1925) which includes such allied Nearctic genera as *Lasius, Acanthomyops* and *Formica*. Although not closely related to any of these *Myrmecocystus* is apparently nearest *Lasius* and may be derived of the same ancestral type. The two genera are superficially quite different in habitus, but share many characters. The antennae are similar in placement and the flagellar segments are much the same. The antennal scapes of *Myrmecocystus* are usually much longer than the median head length, but are shorter in most *Lasius*. Mandibular dentition and clypeal shape are similar. The shape and position of the eyes differ, however. In *Lasius* the eyes are small, flattened and located on the frontal surface of the head, but in *Myrmecocystus* they are larger, strongly convex and laterally situated. The thorax of *Lasius* workers is compact and there is no mesopropodeal constriction. One exceptional species is *L. (Chthonolasius) atopus* Cole, of California, in which the thorax is elongate and slender, superficially similar to that of *Myrmecocystus*. In this species, too, the appendages are slender and elongate, enhancing the resemblance to *Myrmecocystus*. *Myrmecocystus* differs from *Lasius*, and all other Nearctic genera of Formicinae, in all castes in the elongated maxillary palpi, of which the fourth segment is as long as, or longer than, the combined lengths of the two following segments.

The mandibles of the males are similar to the derived *Lasius niger* type of Wilson (1955). There is an elongate acute apical tooth basad of which is a preapical cleft. Basad of this cleft the margin is normally convexly rounded toward the basal angle (Fig. 12). Rarely there is a second cleft, so that a preapical tooth is thus demarked (Fig. 159). Still more rarely there may be one or more minute denticles along the apical margin. These variants are infraspecific, and frequently infranidal, and are of no significance in species-level segregation. However, they do appear most commonly within *Myrmecocystus, s. str.*, and most commonly in *mexicanus*. Males of species belonging to the more derived groups rarely exhibit variation from the *niger*-type mandible.

SUBGENERA

Creighton (1950) recognized that *Myrmecocystus* contains several diverse elements and suggested that further study would result in the recognition of subgeneric divisions. The use of subgenera in myrmecology has come under question in recent years, most notably by Brown (1958, 1973) and Ettershank (1966). Brown in 1973 published a list of the World generic and subgeneric names, indicating his interpretation of their taxonomic status. In this list virtually all subgeneric categories disappear into synonymy; a very few survive as genera.

Aware of this trend of thought I have been forced to consider more fully my own position with regard to subgenera and to present here some general considerations. Certain large ant genera, such as *Aphaenogaster, Pheidole, Leptothorax, Crematogaster* and *Camponotus* have traditionally been divided into series of subgenera. All too often these subgenera were never adequately studied and were founded upon a single unusual characteristic. Subsequent investigators continued to add species to these various subgenera, generally without any serious attempt to definitively characterize the subgenera. Thus, the subgenera grew, and were often continued in use long after it became obvious that the original characters would not hold for all the included species. Often, too, species were added to a subgenus which had little to do with other species in that unit. *Camponotus yogi* Wheeler, for example, was originally assigned by Wheeler to the subgenus *Colobopsis*. As shown by Creighton and Snelling (1964) this species belongs to *Myrmophaenus* where it is clearly related to other species, both structurally and ethologically. As long as the ant was forced into *Colobopsis* the subgeneric distinctions between these two very different groups would be indefensible. Once the species is removed to its proper place, subgeneric homogeneity becomes possible. There are many such instances throughout the Formicidae. Ferreting out these problematic cases and taking the necessary actions will be a long, arduous process and one apt to tax the patience of a myrmecological Job.

This process will not save all subgeneric names and the loss of many of these will present no hardships. Many were based on unusual characteristics at a time when the World ant fauna was much less known than it now is. Subsequent discoveries have, for the most part, not been considered in regard to their effect on subgenera and these have survived largely due to inaction. The formicine genus *Acropyga* has four subgenera assigned to it, even though one of these runs the full gamut of characters of the other three.

Subgenera, when adequately handled, may be useful elements within the taxonomic system and a boon to anyone dealing with large complex groups. The day is past, however, when the use of subgeneric names can be taken for granted. Subgenera, in order to be an effective tool of the systematist, must reflect major evolutionary trends within the genera. Obviously such a criterion requires that the vast amount of material now

available be utilized. In the case of the large and complex genera such a study will require many years and considerable taxonomic acumen. One objection to subgenera has been that often a species, or series of species, is found which is intermediate between two subgenera and thus tends to break down the separation between the units. The existence of such species, troublesome though they may be, is to be expected. The use of the subgeneric category as a reflection of supposed major evolutionary trends within the genus presumes the possible existence of annectant species. Indeed, the absence of such species would perhaps justify elevation of the subgenera to full genera.

An added difficulty is that of evaluating the significance of a given character variant. I have here divided *Myrmecocystus* into three subgenera. The nominate subgenus includes those species in which the basic number of mandibular teeth is nine. There are, however, species with eight or seven teeth. The two remaining subgenera include those species in which the basic number of mandibular teeth is seven. In one of these subgenera there is a species which consistently possesses eight mandibular teeth and another in which the number varies from six to eight.

The argument may, and doubtless will, be advanced that this is evidence that the mandibular character is of no value in separating these subgenera. I would accept that argument only if it can be shown that the "annectant" species are more closely related to those of other subgenera than they are to species in their own subgenera. Since this is not the case, in my opinion, I do not believe the argument valid. I am not at all discomfited by the fact that some *Endiodioctes* and some *Myrmecocystus, s. str.*, possess octodentate mandibles. These groups are evolutionarily divergent and have independently arrived at the same point in expressing a single character. For, even though now evolving along independent lines, the same basic potentials for character state development must persist in both.

There have been two evolutionary divisions within *Myrmecocystus*. The earliest of these produced one line which comprises the nominate subgenus and one representing the two subgenera *Endiodioctes* and *Eremnocystus*. This early schism may have been one based on diurnal *versus* nocturnal habits. It resulted in the nominate group having become depigmented, developing enlarged eyes and reduced ocelli.

The second division occurred when the *Eremnocystus* line became divergent from that of *Endiodioctes*. These smaller species may have become competitively displaced toward matinal and crepuscular foraging. The nocturnal niche was already well occupied by the species of the nominate subgenus. Adaptations for the crepuscular/matinal niche include reduced vestiture and aposematic coloration.

It is my intention to treat these major evolutionary lines as subgenera. Each represents an identifiable divergent element, evolving independently. Since many potential character states must be shared, it is not surprising that species in one line may acquire, or retain, the same character state as species in another.

Subspecies

When Creighton (1950) treated *Myrmecocystus*, he was confronted with a confusing array of twenty-one inadequately defined forms; twelve of these were then held to be subspecies or varieties of a single species. He ultimately recognized twelve species; one of these was thought to be represented by two subspecies and another by three. One of these subspecies *(californicus)* was so recognized only because he had seen no material assignable to it and, therefore, was not able to pronounce an opinion on its status. He also correctly predicted that another subspecies *(orbiceps)* would ultimately prove to be invalid.

Subsequent research has disposed of all the subspecies; none are recognized in this work. Although the several widely distributed species are subject to variation, these variants do not, in my opinion, satisfy any objective criteria necessary for their recognition as subspecies.

An excellent example is that of *mexicanus*, a species ranging from Colorado to California and south to central Mexico. The northern populations were thought to represent a distinct subspecies, *hortideorum*, distinguished by its uniformly yellow color. There are difficulties with this concept. First, as samples are examined from north to south, it is apparent that the pale, northern form grades gradually into the darker, southern form through such a broad area that it is impossible to determine a discrete range for either. Any attempt to do so must be wholly arbitrary and must ignore the existence of numerous populations which may wholly or partially reverse trends in any area. Alternatively, one might recognize two subspecies of very restricted distribution and an intervening blend zone greater than the combined ranges of the two nominate forms. Neither alternative appears rational to me.

Further, it must be realized that the populations of Colorado and California, superficially similar as they are, are very different from one another. Workers of the Colorado form are more hairy and have a thicker petiole than those from California. In the worker, some California populations are about as hairy as those of Colorado and have a similarly shaped petiole. But the males in these populations are very different from those from Colorado. The Colorado males are more like those of the "typical" form of southern Arizona and central Mexico. Under circumstances such as these, it seems unwise to attempt to recognize the traditional subspecies of *mexicanus*. Some characters may prove to be clinal and others are not consistent from one population to the next.

An exception might be the species of the subgenus *Eremnocystus* which pose a peculiar problem. The sev-

eral species recognized here are remarkably similar to one another. This is particularly true of *creightoni, lugubris, tenuinodis* and *yuma*. Creighton (1956) recorded samples of all of these as *lugubris* when he synonymized *yuma* under that species. I have nonetheless chosen to recognize four very similar species. The differences which separate them are slight, but consistent.

For the most part these forms are wholly allopatric; so far as presently known only *tenuinodis* and *yuma* become sympatric, around Yuma, Arizona. Samples from Yuma show no evidence of hybridization. The distribution pattern of this group of species is about what could be expected of true subspecies, but because the forms appear to be stable, I do not believe they may be treated as such. Instead I believe that the group is one of relatively recent origin, possibly derived from a single, once more uniformly distributed form, such as *colei*. The increasing aridity and development of extensive mountain barriers, in the post-Tertiary period, may have isolated populations. These evolved their present characteristics in the absence of homogenizing gene flow from adjacent, but allopatric, populations. The present sympatry of *tenuinodis* and *yuma* in one area may be a phenomenon of relatively recent origin subsequent to their development of genetic incompatibility.

KEY TO SUBGENERA

Workers

1. Integument either: (a) bicolorous, head and thorax ferruginous, gaster black; (b) unicolorous ferruginous or orange; (c) unicolorous blackish or dark brown; mandibles six or seven toothed; eye small, maximum diameter less than to slightly exceeding length of first flagellomere; ocelli present, sometimes obscure in small individuals; diurnal, matinal or crepuscular 2
   Integument light yellow or brownish yellow; mandibles eight to ten toothed; eye large, maximum diameter much exceeding length of first flagellomere; ocelli absent or much reduced; nocturnal *Myrmecocystus, s. str.*
2. Small (HL not exceeding 1.26 mm), uniformly blackish or dark brown, usually with anterior one-third of head paler; erect hairs very reduced on head and thorax (two exceptions); pubescence sparse on head; usually crepuscular or matinal ..... *Eremnocystus*, n. subg.
   Larger (HL exceeding 0.83 mm), either bicolorous or ferruginous; usually abundantly hairy, erect hairs numerous on head and thorax, appressed pubescence usually dense on third tergum; diurnal *Endiodioctes*, n. subg.

Females

1. Integument either (a) uniformly blackish or dark brown or (b) mainly ferruginous on head and thorax, latter often with black markings, gaster ferruginous or black; mandible seven-toothed 2
   Uniformly yellowish, thorax and gater often with brownish infuscations; mandible eight- or nine-toothed; wing membranes without short, erect hairs, marginal fringe present/absent ..... *Myrmecocystus, s. str.*
2. Integument uniformly blackish or dark brown, anterior one-third of head sometimes lighter; small species, HL not exceeding 1.63 mm; wing membrane with numerous short, erect, white hairs *Eremnocystus*, n. subg.
   Integument of head and thorax largely ferruginous, gaster blackish (except in *M. wheeleri*); larger species, HL exceeding 1.43 mm; wing membrane without short, erect, white hairs ..... *Endiodioctes*, n. subg.

Males

1. Integument either (a) uniformly blackish or dark brown or (b) mainly ferruginous on head and thorax, latter often with black markings, gaster ferruginous or black; mandible seven-toothed 2
   Uniformly yellowish, thorax and gaster often with brownish infuscations; mandible eight- or nine-toothed; wing membranes without short, erect hairs, marginal fringe present/absent ..... *Myrmecocystus, s. str.*
2. Integument uniformly blackish or dark brown, anterior one-third of head sometimes lighter; small species, HL not exceeding 1.63 mm; wing membrane with numerous short, erect, white hairs *Eremnocystus*, n. subg.
   Integument of head and thorax largely ferruginous, gaster blackish (except in *M. wheeleri*); larger species, HL exceeding 1.43 mm; wing membrane without short, erect, white hairs ..... *Endiodioctes*, n. subg.

ENDIODIOCTES new subgenus

Diagnosis. Worker and female with septemdentate mandibles; eyes slightly longer than second antennomere; bicolored, head and thorax reddish, gaster blackish (except one unicolorous orange species); wing membranes of sexuals without erect whitish hairs, but marginal fringe often present.

Description. Worker: Mandible with seven teeth; ocelli distinct; eye small, a little longer than second antennomere; erect hairs usually abundant, at least on vertex, thoracic dorsum and gaster, often on malar area, scape and legs as well; pubescence usually extensive, often sufficiently dense to obscure the integument on the first two or three terga; bicolored, head and thorax reddish (though often extensively infuscated)

and gaster blackish (except in *wheeleri* which is uniformly orange-colored). *Female.* Similar to worker except for usual caste characters; IOD less than OOD; wings without erect whitish hairs on membrane; marginal fringe hairs often present. *Male.* Wings as in female; aedeagus with at least a few setae; mandible usually without defined denticles basad of apical tooth.

Type Species. Myrmecocystus melliger Forel 1886.

Etymology. Endio (Gr., at midday) + *dioktes* (Gr., hunter), in allusion to the diurnal foraging activities of the included species.

Included Species. M. depilis Forel 1904; *M. flaviceps* Wheeler 1912; *M. intonsus* Snelling n. sp.; *M. kathjuli* Snelling n. sp.; *M. kennedyi* Cole 1936; *M. koso* Snelling n. sp.; *M. melliger* Forel 1886; *M. mendax* Wheeler 1908; *M. mimicus* Wheeler 1908; *M. placodops* Forel 1908; *M. romainei* Cole 1936; *M. semirufus* Emery 1895; *M. nequazcatl* Snelling n. sp.; *M. wheeleri* Snelling 1971.

The species assigned to this subgenus are all diurnal foragers, often highly predaceous on small arthropods. Except for one wholly orange-ferruginous species, all possess blackish gasters which contrast with ferruginous head and thorax in the worker. The head and thorax are often extensively infuscated in some species and may appear to be brown.

There are several species groups, but their definition is not easy.

Melliger Group

Species belonging to the *melliger* group are large, densely pubescent, with numerous erect hairs on the malar area as well as elsewhere on the body. The erect hairs on the first three gastric terga arise from conspicuous poriform punctures (Fig. 23) which, in some lights, appear to be small conical papillae. Males of this group may possess one or two minute denticles basad of the apical mandibular tooth and a broad, longitudinal, median area of the first three terga is without erect hairs, or with the hairs much sparser than near the sides. To this group are assigned *intonsus, melliger, mendax, placodops* and *semirufus.*

Although in Texas one species *(placodops)* occurs in non-montane situations, the species of this group are most often found at low and moderate elevations of desert mountain ranges. Nests are commonly located in stony soil and the entrance may be partially concealed by a stone. Only one nest of *intonsus* has been observed and that was situated in coarse-grained sandy soil at the edge of a large wash. Whether this is typical for the species is unknown. The placement of this species in the *melliger* group is provisional pending discovery of the male.

Two species, *intonsus* and *semirufus,* make conspicuous crateriform tumuli, but nests of the other species are most often without superstructures of any sort (Figs. 357, 358). The workers disperse the soil at random, well away from the entrance. Occasionally, low, semicircular mounds are built up.

The species of the *melliger* group are all active predators and scavengers. They have also been observed at flowers taking nectar. Repletes are known for all except *intonsus.*

Mimicus Group

The *mimicus* group consists of two species, *depilis* and *mimicus.* These are medium-sized species in which the head and thorax of the worker are extensively brownish, the frons and occiput are smooth and shiny and the third tergum is without conspicuous appressed pubescence. The malar area has few or no erect hairs.

This group ranges from Trans-Pecos Texas to California and south to central Mexico. The two species appear to be largely scavengers and also gather large quantities of nectar and honeydew; repletes are known for both.

These are primarily lowland species, but follow alluvial fans onto the lower slopes of desert mountain ranges. Nests are often situated at the base of a shrub or amidst a clump of grasses (Fig. 354). Tumuli thus are often somewhat irregular. When nests are located in open areas, the tumulus is most often a low, broad, regular crater (Figs. 352, 353).

Kennedyi Group

Four species comprise the *kennedyi* group: *kathjuli, kennedyi, nequazcatl* and *wheeleri.* In these species the head and thorax are bright ferruginous; rarely is the posterior part of the thorax infuscated; the gaster is black, black and ferruginous or simply ferruginous. The frons is smooth and shiny, with no more than a few widely separated, obscure punctures. There are no more than five erect hairs on the malar area, usually fewer and the third tergum is conspicuously pubescent (except in *kennedyi*). Females of two species *(kathjuli* and *wheeleri)* have the penultimate segment of the maxillary palp much wider near the base than preapically; females of three species *(kathjuli, nequazcatl* and *wheeleri)* have the micropunctures of the first two terga irregularly spaced, often with the median area of the disc sparsely punctate.

This is a wholly western group and ranges from southern Oregon and Idaho to central Sonora and northern Baja California. Nests are populous and the species are aggressive predators on small arthropods. They also gather large quantities of nectar and honeydew; repletes are known for two species. The nests are often found in fine, but well compacted sand, in clear areas. A large, crateriform tumulus is present (Fig. 355).

Flaviceps Group

The *flaviceps* group includes a single species, *flaviceps.* It is closely related to species of the foregoing group and perhaps should be included there. Workers

differ, however, in being duller. The head and thorax may be dull ferruginous, but often extensively infuscated. The frons is usually closely, finely punctate. The female is extensively infuscated on the head and thorax and has the first four terga shiny, with scattered coarse, setigerous punctures on the discs.

This ant ranges from southwestern Utah, southern Nevada and adjacent California south to Sonora and central Baja California Sur. It is largely a scavenger and regularly visits flowers for nectar. Repletes are known. Nests are found in a wide variety of situations, from loose sand to dense, clayey soil. A low, circular crateriform tumulus is present (Fig. 356).

Romainei Group

The last group is the *romainei* group with two species: *koso* and *romainei*. This group is close to both the *kennedyi* and *flaviceps* groups, but the workers possess six or more erect hairs on the malar area. Erect body hairs are more numerous than in species of the other two groups. The frons has conspicuous rather coarse punctures, except in the smallest workers. The two basal terga of the male are without pubescence on the discs, but with sparse pubescence laterad.

The group ranges from western Kansas and Oklahoma to southern Nevada and adjacent California. The more widely distributed species, *romainei*, is found in a wide variety of habitats. This species may locate nests in fine, deep sand or in compact clayey soil. Nests of *koso* are usually in compact, rocky soils. Both species construct large, crateriform tumuli.

Little is known of the habits of these species. They are predators and scavengers. Probably, too, they visit flowers for nectar. Repletes are not known.

The most widely distributed group is the *melliger* group and it is possible to derive the remaining groups from it. One divergent line may have given rise to the *romainei* group. Another line may have given rise to the *mimicus-flaviceps* and *mimicus-kennedyi* series. Much additional study will be necessary before evolutionary patterns are clarified.

KEY TO SPECIES OF *ENDIODIOCTES*

Workers

1. Abundantly hairy species: 20+ erect hairs on malar area in frontal view; scape, femora and tibiae with numerous suberect to erect hairs on all surfaces; first three (usually four) terga with dense pubescence (except *intonsus*); HW of major usually in excess of 1.7 mm 2
   Less hairy species: fewer than 20 erect hairs on malar area in frontal view, usually fewer than 6; scape and femora often sparsely hairy; third tergum often sparsely pubescent; HW of major less than 1.7 mm 6
2. Longest occipital hairs usually shorter than EL; longest pronotal hairs as long as or (usually) shorter than EL; longest discal hairs of second tergum less than EL; head of major often strongly orbiculate 3
   Longest occipital, pronotal and discal hairs of second tergum exceeding EL; head of major not orbiculate ..... *melliger* Forel
3. Third tergum, and usually fourth as well, densely pubescent; pronotal hairs variable, but often more than 0.5 × MOD; HW of major in excess of 1.7 mm; head of major orbiculate or not 4
   Third and fourth terga with scattered pubescence only; pronotal hairs stiff, uniform, less than 0.5 × MOD; HW of major less than 1.7 mm; head of major orbiculate ..... *intonsus*, n. sp.
4. Longest hairs on pronotal dorsum and disc of second tergum no more than 0.5 × MOD, usually less; head of major orbiculate or not 5
   Longest hairs on pronotal dorsum and disc of second tergum at least 0.6 × MOD, usually about 0.75 × MOD; head of major with margins, in frontal view, nearly parallel ..... *mendax* Wheeler
5. Frontal lobes shiny, closely, sharply punctate, punctures round or weakly ovoid; frons usually with distinct, coarse punctures greater in diameter than hairs arising from them; head of major not, or weakly, orbiculate (Calif., Baja Calif.) ..... *semirufus* Emery
   Frontal lobes dull, irregularly, weakly punctate, punctures often elongate; frons weakly punctate, if at all, punctures, when present not exceeding diameter of their hairs; head of major strongly orbiculate (Tex. to Ariz.) ..... *placodops* Forel
6. Malar area, in frontal view, with six or more erect hairs evenly distributed between eye and base of mandible 7
   Malar area, in frontal view, with not more than four erect hairs, these confined to lower half, near base of mandible 11
7. First three terga uniformly, densely pubescent; clypeus moderately shiny to polished, lightly tessellate to smooth; frontal lobes shiny, sparsely to closely punctate; HW variable 8
   Third tergum apubescent or at least conspicuously less pubescent than first two; clypeus slightly shiny, distinctly tessellate; frontal lobes slightly shiny, distinctly tessellate, with scattered coarse punctures and dense micropunctures; HW of majors 1.03–1.63 mm ..... *intonsus*, n. sp.

8. Tergum IV conspicuously pubescent in specimens with PW in excess of 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 10
Tergum IV with pubescence, when present, very widely scattered; erect hairs present only adjacent to inner eye margin, not extending more than 0.25 of distance between eye and antennal socket; punctures of frontal lobes and frons uniformly minute, evenly distributed 9
9. Longest pronotal hairs more than 0.5 × MOD; malar area usually with 12–16 erect hairs; vertex usually conspicuously, though finely, punctate toward sides ..... *romainei* Cole
Longest pronotal hairs less than 0.5 × MOD; malar area usually with fewer than 12 erect hairs; vertex without punctures at sides ..... *flaviceps* Wheeler
10. Longest occipital hairs 0.75–0.96 × MOD; longest pronotal hairs at least 0.6 × MOD; petiole, in profile, thickly cuneate, length, at lower margin of spiracle, exceeding height from spiracle to summit .. *koso*, n. sp.
Longest occipital hairs 0.59–0.65 × MOD; longest pronotal hairs less than 0.5 × MOD; petiole, in profile, higher than thick, measured as above ..... *semirufus* Emery
11. Longest occipital hairs at least equal to MOD in majors 12
Longest occipital hairs no more than 0.6 × MOD usually about 0.5 15
12. Longest pronotal hairs about equal to EL, always exceeding MOD; hind femur with numerous suberect hairs on dorsal surface 13
Longest pronotal hairs less than MOD; hind femur with only very short subappressed hairs on dorsal surface 14
13. Hairs on dorsal face of hind femur less than half as long as longest hairs on disc of second tergum; CI commonly over 89; head, thorax and legs distinctly brown ..... *depilis* Forel
Hairs on dorsal face of hind femur at least half as long as longest hairs on disc of second tergum; CI less than 89 in 90% of specimens; head, thorax and legs ferruginous ..... *nequazcatl*, n. sp.
14. Hairs on dorsal face of hind femur appressed to subappressed; frontal lobes and frons finely, closely and uniformly punctate; mandible septemdentate; abdomen usually wholly orange-ferruginous .. *wheeleri* Snelling
Hairs on dorsal face of hind femur suberect, conspicuous; frontal lobes finely and very irregularly punctate, with large impunctate areas; mandible octodentate; abdomen usually black, often with basal two or three terga extensively yellowish ..... *kathjuli*, n. sp.
15. Tergum III with little or no pubescence 16
Tergum III with dense pubescence ..... *flaviceps* Wheeler
16. 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
Pubescence abundant on face; head usually distinctly tessellate, not notably shiny; side of head straight in frontal view; head, thorax and legs ferruginous (top of head may be slightly brownish) ..... *kennedyi* Cole

Females

1. Penultimate segment of maxillary palp more than twice wider in basal third as at apex, the remaining segments very broad; gaster ferruginous 2
Penultimate segment of maxillary palp slender, more or less parallel-sided, never more than 1.5 × wider in basal third than at apex, remaining segments slender; gaster brownish or blackish 3
2. Punctures of frontal lobes separated by a puncture diameter or more; scutellum with median area punctate, interspaces mostly about one to two times a puncture diameter; longest scutal hairs exceeding EL ..... *kathjuli*, n. sp.
Punctures of frontal lobes uniformly dense, separated by less than a puncture diameter; scutellum, along midline, impunctate or very sparsely punctate, interspaces mostly three to five times a puncture diameter; longest scutal hairs less than EL ..... *wheeleri* Snelling
3. Parapsis closely, uniformly punctate; malar area with abundant standing hairs; HW usually in excess of 2.0 mm 4
Parapsis with punctures usually of two sizes and variably spaced, never uniformly dense; malar area usually with few or no standing hairs; HW usually less than 1.9 mm 8
4. Smaller species, HW less than 1.9 mm; if more, malar area with fewer than 10 erect hairs; disc of mesoscutum finely, sparsely punctate, usually broadly impunctate in center 5
Larger species, HW more than 2.0 mm; if as little as 1.9, malar area with at least 15 erect hairs; disc of mesoscutum closely, coarsely punctate, often with median impunctate area 6

5. Malar area with fewer than 10 erect hairs, those present usually restricted to area near mandibular base; frons, on either side of midline, convexly raised, impunctate or nearly so ..... *romainei* Cole
Malar area with more than 10 erect hairs, evenly distributed along entire length; frons not notably raised on either side of midline, uniformly, though sparsely, punctate ..... *depilis* Forel
6. Longest occipital hairs 0.5–1.0 × MOD, usually in excess of 0.7; longest mesoscutal hairs at least 0.5 × MOD, usually more; longest scutellar hairs at least 0.9 × MOD; scutal punctation variable; HW less than 2.3 mm 7
Longest occipital and scutal hairs 0.6, or less, × MOD; longest scutellar hairs 0.8, or less, × MOD; scutum with large anteromedian impunctate area; HW 2.3 mm ..... *placodops* Forel
7. Mesoscutum uniformly punctate, sometimes with small anteromedian impunctate area ..... *mendax* Wheeler
Mesoscutum with median impunctate area extending nearly entire length of disc ..... *melliger* Forel
8. Median area of first two terga very sparsely punctate 9
Median area of first two terga uniformly, densely micropunctate 11
9. Median area of third and fourth terga nearly impunctate, similar to first two terga; scutellum very sparsely punctate; HW less than 1.9 mm 10
Median area of third and fourth terga closely and uniformly micropunctate; scutellum abundantly, finely punctate; HW 2.0 mm or more ..... *semirufus* Emery
10. Frontal lobes closely micropunctate and with scattered coarse punctures; hairs along inner eye margin about as long as on scape; inner face of fore femur with numerous erect hairs along entire length, hairs about as long as those of scape ..... *koso*, n. sp.
Frontal lobes sparsely, coarsely punctate; hairs inconspicuous or absent along inner eye margin; when present, shorter than those of scape; inner face of fore femur with few erect hairs, and these on apical half and much shorter than those of scape ..... *flaviceps* Wheeler
11. Face, between eye and frontal lobe, with punctures irregularly distributed, with large impunctate areas; vertex usually with conspicuous areas of sparse punctation between ocellus and eye 12
Face, between eye and frontal lobe, uniformly punctate, interspaces usually no more than twice a puncture diameter; vertex with numerous evenly distributed punctures ..... *kennedyi* Cole
12. Longest hairs of mesoscutum, pleura and second tergum less than MOD, often less than 0.5 × MOD ..... *mimicus* Wheeler
Longest hairs of mesoscutum equal to EL, longest of pleura slightly exceeding MOD, longest of second tergum about equal to MOD ..... *nequazcatl*, n. sp.

MALES

1. Lower margin of ventral lobe of aedeagus strongly convex in profile, teeth small 2
Lower margin of ventral lobe of aedeagus concave or straight in profile, teeth coarse (Fig. 195) ..... *wheeleri* Snelling
2. Disc of second tergum moderately to slightly shiny, uniformly micropunctate and pubescent, first and third terga usually similar; mesoscutum dull, densely, uniformly tessellate 3
Discs of first two or three terga polished, impunctate and apubescent, at least in middle; mesoscutum wholly, or in part, polished and shiny 5
3. Posterior margin of hind wing with fringe hairs along basal half, at least; if fewer, longest occipital hairs less than 0.5 × MOD; HW often less than 0.90 mm 4
Posterior margin of hind wing without fringe hairs; longest occipital hairs at least 0.60, usually 0.75 or more, × MOD; HW in excess of 0.90 mm ..... *melliger* Forel, *mendax* Wheeler, *placodops* Forel
4. 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*, n. sp.
Longest occipital and mesoscutal hairs less than MOD, usually less than 0.5 × MOD; entire face dull, closely tessellate; dorsum of first tergum uniformly, closely micropunctate; HW 0.83–0.97 mm ... *semirufus* Emery
5. Posterior margin of hind wing without fringe hairs 6
Posterior margin of hind wing with fringe hairs 8
6. Longest occipital hairs not less than 0.75 × MOD; second and third terga with or without conspicuous pubescence laterad 7
Longest occipital hairs not exceeding 0.50 × MOD; second and third terga at sides apubescent or very sparsely pubescent ..... *kennedyi* Cole
7. Longest occipital and mesoscutal hairs about equal to MOD; first three terga with little or no pubescence laterad ..... *nequazcatl*, n. sp.

Longest occipital and mesoscutal hairs no more than 0.75 × MOD; first three terga often conspicuously pubescent laterad (especially Mexican populations) ..... *depilis* Forel

8. Longest occipital and mesoscutal hairs no more than 0.5 × MOD 9
   Longest occipital and mesoscutal hairs at least 0.75 × MOD, often equal to MOD ..... *koso*, n. sp.
9. First three terga without conspicuous appressed pubescence or with apubescent median areas of first and second segments larger than lateral, pubescent areas . *mimicus* Wheeler and *romainei* Cole (see DISCUSSIONS)
   First tergum largely apubescent, second and third with numerous appressed hairs over a larger area than median, apubescent area ..... *flaviceps* Wheeler

Melliger Group

Myrmecocystus (Endiodioctes) intonsus new species

Figures 70–72

Diagnosis. Worker: Abundantly hairy, with ten or more fully erect hairs on malar area in frontal view and on scape, femora and tibiae; erect pronotal hairs blunt, stiff, short, longest hairs less than 0.5 × MOD; HW of majors less than 1.7 mm, head of majors orbiculate; third tergum shiny, with scattered pubescence. *Female* and *male* unknown.

WORKER. *Measurements.* HL 1.00–1.70 (1.70); HW 0.86–1.63 (1.63); SL 1.06–1.60 (1.60); WL 1.3–2.2 (2.2); PW 0.63–1.06 (1.06).

Head: Longer than broad to broader than long in larger workers, CI 86–102 (96); shorter, to longer, than scape, SI 96–131 (98). In frontal view widest at lower eye margin in small workers, the sides straight and slightly convergent toward mandibular bases; in progressively larger workers widest point becomes lower and sides more convex, largest workers with strongly orbiculate head. Occiput, in frontal view, flattened in middle, broadly rounded onto sides, not at all angulate. Eye small, barely longer than first flagellomere; OMD 1.50–2.00 (1.91) × EL. Mandible septendentate.

Thorax: Moderately robust, PW 0.44–0.56 (0.46) × WL. Smaller workers with distinct, flattened basal propodeal face, broadly rounded into longer posterior face; larger workers with basal face convex and merging into posterior face.

Petiole: In profile, thick, posterior face flat, anterior face abruptly sloping toward crest in upper third, crest narrowly rounded; in frontal view crest flat or slightly convex; from above, about 1.5 × wider than long.

Vestiture: Pubescence sparse on most of head, a little denser on occiput, conspicuously denser on frontal lobes; dense on thorax; dense and conspicuous on discs of first two terga; sparse on sides of first two terga and on all of remaining segments.

Erect hairs abundant on head, with ten or more present on malar area in frontal view; longest occipital hairs half, or more, as long as minimum eye diameter. Erect thoracic hairs abundant on all dorsal faces and posterior face of propodeum; longest pronotal hairs less than half minimum eye diameter; mesonotal hairs about as long as those of propodeum. Petiolar scale with numerous short hairs on marginal surfaces. Terga with abundant discal hairs, progressively longer on succeeding segments, those of first segment shorter than hairs of hind tibia. Appendages abundantly hairy; scape with hairs on all faces; fore femur with at least ten erect hairs on inner face.

Integument: Head moderately shiny, all areas, including clypeus, lightly shagreened; frontal lobes densely and finely punctate; clypeus with sparse, coarse, setigerous punctures; head elsewhere with scattered fine, shallow punctures. Thorax slightly shiny, closely and coarsely shagreened, propodeum duller. First two terga slightly shiny, densely shagreened, with scattered setigerous punctures and coarse poriform punctures; third and following segments shiny, subpolished, very lightly shagreened, with sparse fine punctures.

Color: Head and alitrunk dark brownish ferruginous; mandibles and lower half, or less, of face yellowish; propodeum often more infuscated; gaster blackish; appendages lighter than thorax.

FEMALE and MALE unknown.

Type Material. Holotype and 151 worker paratypes: 12.4 mi S La Paz, 100′, Baja California Sur, MEXICO, 2 March 1969 (R. R. Snelling; No. 69–71); holotype and most paratypes in LACM; three paratypes to each of the following: AMNH, GCW, MCZ, USNM.

Distribution. Known only from southern Baja California Sur (Fig. 360).

Additional Localities (not paratypes). MEXICO. *Baja California Sur:* 72 mi NW La Paz, 100′, 1 March 1969 (R. R. Snelling; No. 69–66; LACM); 27 km NE Todos Santos, 700′, 8 October 1975 (R. R. Snelling; No. 75–59, 60, 61; LACM); La Burrera, 17 October 1968 (E. L. Sleeper; LACM); 3.7 mi W La Burrera, 1400′ (R. R. Snelling; LACM).

Etymology. L., *intonsus,* unshaved, having reference to the abundance of erect hairs on all surfaces.

Ecology. The type series was taken from a nest in sandy soil at the edge of an arroyo in a dense stand of mixed cardón, mesquite and palo blanco. The crateriform tumulus was about 4½″ diam. Workers were actively foraging at midday, ambient temperature approximately 70°F, returning with miscellaneous insect fragments. Other ant species taken at this station: *Pogonomyrmex californicus* (Buckley), *Pheidole vistana* Forel, *Solenopsis xyloni* McCook, *Conomyrma bicolor* (Wheeler) and *Forelius foetidus* (Buckley).

At 72 mi NW of La Paz, the site was an alkali playa with mesquite and cholla. A single worker was found here, shortly before sunset, at secretory glands on cholla. Other ant species encountered were: *Pseudomyrmex* sp.; *Veromessor juliana* (Pergande), *Crematogaster californica* Emery?, *Xiphomyrmex spinosus* Pergande, *Acromyrmex versicolor* (Pergande), *Camponotus mina* Forel and *C. festinatus* (Buckley).

Workers were observed also near La Burrera and Todos Santos. Nests were situated in sandy soil and were surmounted by low, regularly crateriform tumuli. One exceptional nest had the entrance sited in a clump of grass. Foragers were active during the hot part of the day in early October, with ambiant midday temperatures in excess of 90°F. Many workers were seen at the flowers of a prostrate *Euphorbia*.

Discussion. This ant appears to be a depauperate derivative of *placodops* which it closely resembles, especially in the strongly orbiculate head of the major workers. In addition to the much smaller size it differs from *placodops*, and other species in the *melliger* group, by the sparsely pubescent third and fourth terga. There is also a resemblance to such species as *koso* and *romainei* in the *romainei* group, but these have far fewer erect hairs on the malar area and the longest pronotal hairs are, in the major workers, more than 0.5 × MOD. The sexual forms are unknown and, until they become available, the relationships of this species will remain obscure.

Myrmecocystus (Endiodioctes) melliger Forel

Figures 34–42

? *Formica melligera* Llave 1832. Reg. Trim. Collect. Mem. Hist. Lit., p. 463; Lucas 1860. Rev. Mag. Zool., pp. 269–280 *(in part)*.

Myrmecocystus melliger Forel 1886. Ann. Soc. Entomol. Belg. 30:201–202. ♀ *(in part)*; Emery 1893. Zool. Jahrb. Syst. 7:666–667; Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:348–349. ♀ *(in part)*, Wheeler 1912. Psyche 19:175 *(in part)*; Creighton 1950. Bull. Mus. Comp. Zool. 104: 444–445 *(in part)*; Cook 1953. Ants of Calif.; Palo Alto, pp. 341–342; Wheeler and Wheeler 1968. Ann. Entomol. Soc. Amer. 61:211–213 *(larva)*; Snelling 1969. Contr. Sci., L.A.C.M. 170:4, 8, 9.

Myrmecocystus melliger mendax var. *comatus* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:352; Wheeler 1912. Psyche 19:173; Smith 1936. Journ. N.Y. Entomol. Soc. 44:170.

Myrmecocystus comatus Creighton 1950. Bull. Mus. Comp. Zool. 104:442.

Diagnosis. Worker: HW 0.8–1.8 mm; malar area with numerous erect hairs; longest hairs of occiput, pronotum and disc of second tergum exceeding EL; long pronotal hairs flexuous and somewhat curled apicad. *Female:* HW 2.0 mm; malar area with numerous fully erect hairs; hairs of occiput and scutal disc equal to or exceeding MOD; malar area uniformly finely punctate. *Male:* Apparently inseparable from those *mendax* and *placodops*.

WORKER. *Measurements.* HL 0.95–1.90; HW 0.88–1.87; SL 1.25–2.05; WL 1.5–3.1; PW 0.6–1.3.

Head: Distinctly to slightly longer than broad, CI 75–97 (88), distinctly shorter than scape, SI 111–147; in frontal view sides straight to slightly convex, slightly convergent toward mandibular insertions. Occiput evenly convex, broadly rounded at sides. Eye small, 0.92–1.00 × first flagellomere; OMD 1.54–2.14 × EL. Mandible with seven teeth.

Thorax: Slender to moderately robust, PW 0.38–0.48 × WL. Propodeum, in profile, about as high as long, basal face sloping and broadly rounded into posterior face.

Petiole: In profile, thick, not at all cuneate, summit broadly rounded; crest, in frontal view, narrow, evenly rounded from side to side, without median notch.

Vestiture: (Based on workers with PW in excess of 0.8 mm). Cephalic pubescence general, but sparse, especially on malar area, densest on frontal lobes and occiput. Thoracic pubescence least abundant on dorsum, concealing surface only on propodeum, as a rule. First three (minors) or four terga densely pubescent.

Malar area with 15+ fully erect, short hairs; longest occipital hairs distinctly exceeding EL, in large workers often with apices of some distinctly curled; area between eye and frontal lobe with numerous short, fine, erect hairs. Pronotum with abundant erect hairs, longest exceeding EL and some curled at apex; mesonotum with shorter, flexuous hairs, slightly shorter than MOD; basal face of propodeum with numerous flexuous hairs, longest about equal to EL. Petiole with numerous flexuous hairs on sides and crest, longest more than 0.5 × MOD. Abdominal terga with abundant slender flexuous hairs, longest on disc of second tergum in excess of MOD, often equal to EL. Scape, all surfaces of femora and tibiae with abundant erect hairs, longest hairs on middle and hind tibiae equal to, or exceeding, maximum width of respective segments.

Integument: Head moderately shiny, lightly shagreened; frontal lobes sharply, uniformly micropunctate, interspaces 0.5–1.0 × puncture diameter; face with abundant micropunctures, separated by 1.5–2.5 × puncture diameter; malar area more distinctly shagreened, more sparsely punctate; vertex and occiput densely micropunctate. Frontal triangle and clypeus shiny, sparsely, coarsely punctate. Entire head with scattered coarse punctures and some occipital hairs arising from poriform punctures. Thorax slightly shiny, closely shagreened, densely micropunctate and with numerous coarse punctures; propodeum duller, more densely shagreened and micropunctate. First three (minors) or four terga moderately shiny, densely shagreened and micropunctate, with numerous setigerous poriform punctures, especially first two segments.

Color: Brownish ferruginous, head, pronotum and scape more reddish; gaster blackish brown.

FEMALE. *Measurements.* HL 1.93–1.98; HW 2.0–2.03; SL 1.87; WL 4.2–4.3; PW 2.6–2.8.

Head: Slightly broader than long, CI 102–103; in frontal view, sides barely concave and moderately convergent toward mandibular bases; a little longer than scape, SI 94–97. Occiput in frontal view, low, evenly convex, evenly rounded at side. Eye small 1.15–1.19 × first flagellomere; OMD 1.48–1.53 × EL. OOD 4.3–5.7 × OD; IOD 2.8–4.0 × OD. Mandible with seven teeth. Penultimate segment of maxillary palp slender, nearly parallel-sided, only slightly wider just beyond base than at apex.

Thorax: Robust, PW 0.62–0.65 × WL. Posterior half of mesoscutum and scutellum, in profile, forming a nearly continuous slope. Basal face of propodeum narrow, strongly sloping, broadly rounded into posterior face. Petiole compressed in profile, summit sharply angulate; crest deeply, angularly incised in frontal view.

Vestiture: Cephalic pubescence general but sparse, not concealing surface, most abundant on frontal lobes and occiput. Mesoscutum with pubescence very sparse on disc, more abundant on parapsis. Pubescence long, but very sparse, on scutellum. Pronotum and sides of thorax with abundant long pubescence, denser on propodeum. First four terga with abundant long pubescence, densest on third tergum, but not concealing surface.

Malar area with about 18 fully erect hairs, longest about 0.5 × MOD; face with sparse, short, erect hairs, including area between eye and frontal lobe; longest occipital hairs subequal to MOD. Mesoscutum with sparse suberect hairs about equal to MOD. Scutellar hairs sparse, longest exceeding MOD. Pleural hairs sparse, suberect, about 0.5 × MOD. Propodeum with sparse, suberect and erect hairs, about 0.5 × MOD, across basal face; laterally, hairs longer, 0.75–1.0 × MOD. Crest and side of petiole with erect hairs about 0.5 × MOD. Terga with sparse, erect hairs, longest on disc of second tergum about 0.8 × MOD. Scape with abundant suberect to erect short hairs; femora and tibiae, on all surfaces, with abundant longer, subdecumbent to suberect hairs. Wings without fringe hairs on apical and posterior margins.

Integument: Cephalic integument similar to worker but clypeus distinctly shagreened; malar area densely punctate with micropunctures and coarse punctures, some of latter elongate. Broad median area of mesoscutal disc, but not reaching posterior margin, shiny, lightly shagreened and with scattered micropunctures, becoming much denser laterad and caudad; with sparse coarse punctures only slightly larger than micropunctures, more abundant laterad; parapsis densely micropunctate. Scutellum uniformly micropunctate, interspaces 0.7–1.5 × puncture diameter, and with sparse coarse punctures. Mesopleura dull, densely shagreened; micropunctures of anepisternum largely obscured by shagreening; micropunctures of katepisternum sharply defined, subcontiguous. Propodeum dull, densely shagreened and contiguously micropunctate. Terga moderately shiny, lightly shagreened, closely micropunctate and with sparse coarse punctures and setigerous poriform punctures; no impunctate discal areas.

Color: Head and thorax ferruginous; propodeum, petiole and gaster medium brownish; scape ferruginous, flagellum brownish; fore leg ferruginous, mid and hind legs light brownish. Wings slightly brownish, veins dark brown, stigma yellowish brown.

MALE. *Measurements.* HL 0.97; HW 0.97; SL (not measured); WL 2.4; PW 1.4.

Head: As broad as long, CI 100; antennae absent from the one specimen seen; in frontal view, sides slightly concave and convergent toward mandibular insertions. Occiput, in frontal view, raised in middle, weakly angulate at sides. Eye large, OMD 0.75 × EL; OOD 2.7 × OD; IOD 3.0 × OD. Apical margin of mandible without preapical cleft or tooth.

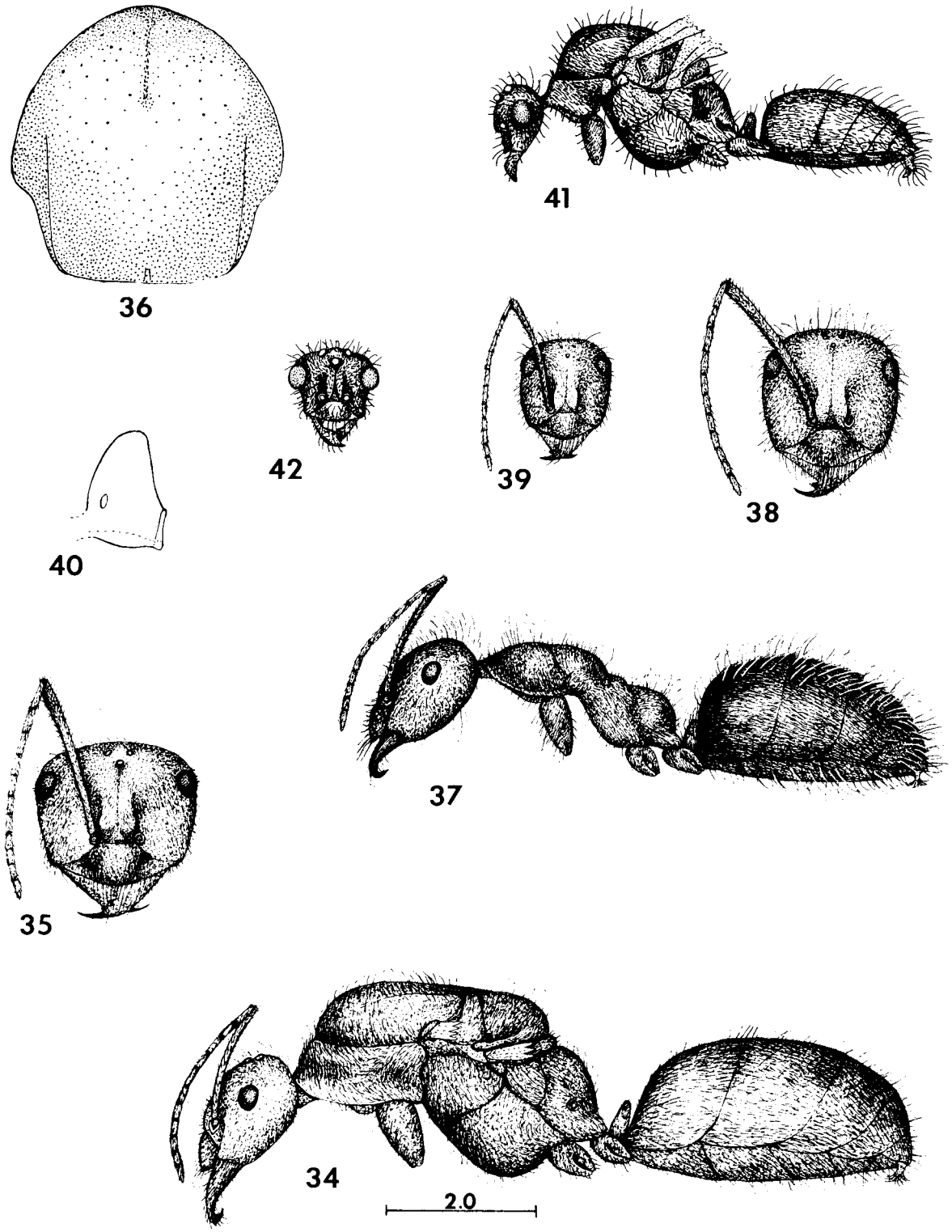
Thorax: Robust, PW 0.57 × WL. Propodeum, in profile, without horizontal basal face.

Petiole: In profile, weakly cuneate, summit rounded; crest, in frontal view, with broad, shallow, angular incision.

Vestiture: Cephalic pubescence dilute, most conspicuous on frontal lobes, vertex and occiput. Thoracic pubescence general, but sparse, especially on dorsum; longest on pleurae and sides and base of propodeum. All terga with conspicuous, but thin, pubescence; first two segments without median apubescent areas.

Malar area with about six long, erect hairs, longest about 0.5 × MOD. Longest occipital hairs about equal to MOD. A few short hairs on face between eye and frontal lobe. Longest scutal hairs equal to MOD; some scutellar hairs longer, about 1.2 × EL. Pleural hairs sparse, long, longest equal to MOD. Longest hairs across base of propodeum subequal to MOD. Sides and crest of petiole with numerous hairs shorter than 0.5 × MOD. Discs of first three terga with longitudinal median area free of erect hairs; terga otherwise with numerous erect hairs, longest on second tergum (exclusive of posterior row), about 0.4 × MOD, those of following segments longer, longest about equal to EL. All femora with numerous short erect hairs on all surfaces; tibiae with numerous subdecumbent to suberect short hairs. Fore and hind wings without fringe hairs on apical or posterior margins.

Integument: Head moderately shiny, distinctly shagreened and with sparse, obscure micropunctures and scattered, obscure, coarse punctures; occiput and middle of vertex duller, closely micropunctate. Mesoscutum moderately shiny, densely shagreened, but with shiny median line; with sparse, obscure, coarse punctures. Scutellum shinier, otherwise similar to scutum. Mesopleura moderately shiny, densely shagreened, with sparse, shallow coarse punctures. Median area of propodeum smooth and shiny, propodeum otherwise lightly shagreened, moderately shiny, with scattered



FIGURES 34–42. *M. melliger*. 34, female, lateral view; 35, head of female, frontal view; 36, mesoscutum of female, distribution of punctures; 37, major worker, lateral view; 38, head of major worker, frontal view; 39, head of minor worker, frontal view; 40, petiole of major worker, lateral view; 41, male, lateral view; 42, head of male, frontal view.

coarse punctures. First three terga moderately shiny, uniformly lightly shagreened, with sparse, obscure micropunctures and scattered coarse punctures; remaining terga shinier, less distinctly shagreened, more sparsely and obscurely punctate.

Color: Blackish brown, legs medium brown. Wings faintly brownish, veins and stigma clear yellowish brown.

Terminalia: Not dissected from the one available specimen.

Type Material. Original series of workers, including repletes, from Mexico City, MEXICO (Flohr). Lectotype and lectoparatypes in MNHG; lectoparatypes in LACM and AMNH.

Distribution. Puebla west to Jalisco, north along mountain ranges to Chihuahua and Sonora (?), entering Texas via Big Bend to Jeff Davis Mts. (Fig. 361).

Localities. MEXICO. Puebla: 1.3 mi W Azumbilla, 6700′, 16 July 1965 (R. R. Snelling; LACM); km 275, Hwy. 150, NE Chapulco, 2 Aug. 1965 (CU). *Distrito Federal.* 67 mi N Ciudad de Mexico, 6900′, 11 June 1956 (H. A. Scullen; OSC). *Hidalgo:* Pachuca, 7900′, no date (W. M. Mann; USNM); same locality, 28 July 1954 (Univ. Kans. Mex. Exped.; KU); 3 mi W Pachuca, 7900′, 24 June 1954 (Univ. Kans. Mex. Exped.; KU); same locality, 15 June 1961 (L. B. Karney; KU); Hwy. 85, 8250′, 6 mi W Pachuca, 13 July 1973 (R. R. Snelling, No. 73–102; LACM); 5 mi N Zimapán, 21 Nov. 1946 (E. S. Ross; CAS); 16 mi SW Jacala, 6500′, 1 July 1970 (E. M. Fischer; LACM). *Querétaro:* Palmillas, 7000′, 1 Apr. 1953 (W. S. Creighton; LACM). *Guanajuato:* Guanajuato, 15 July 1954 (R. F. Smith; UCB). *Jalisco:* Lagos de Moreno, 7300′, 21 Aug. 1954 (C. D. Michener, *et al.;* KU); 13 mi SW Lagos de Moreno, 4 Aug. 1954 (E. G. Linsley & R. F. Smith; UCB); 14 mi S Lagos de Moreno, 6600′, 31 Mar. 1953 (W. S. Creighton; LACM). *Aguascalientes:* 19 mi N Aguascalientes, 6300′, 27 Apr. 1953 (W. S. Creighton; LACM). *Zacatecas:* 9 mi S Fresnillo, various dates and collectors (UCB); 4 mi W Sombrerete, 7900′, 30 Mar. 1953 (W. S. Creighton; LACM); 5 mi E Sombrerete, 7900′, 27 Apr. 1953 (W. S. Creighton; LACM); 15 km E Sombrerete, 28–31 July 1951 (P. D. Hurd; UCB); 20 mi S Calabazál, 8000′, 21 Mar. 1953 (W. S. Creighton; LACM). *San Luis Potosí;* 17 mi W San Luis Potosí, 7600′, 26 Apr. 1953 (W. S. Creighton; LACM); El Huizache, 4500′, 22 Aug. 1954 (Univ. Kans. Mex. Exped.; KU); Ventura, and 3 mi W, 5900′, 26 Apr. 1953 (W. S. Creighton; LACM). *Durango:* 5 mi E San Lucas, 6100′, 25 Mar. 1953 (W. S. Creighton; LACM); 7 mi E Durango, 6200′, 17 Mar. 1953 (W. S. Creighton; LACM); 5 mi W Durango, 6300′, 16 Mar. 1953 (W. S. Creighton; LACM); same locality, 21 July 1964 (J. A. Powell; UCB); San Juan del Río, 7 Aug. 1951 (P. D. Hurd; UCB). *Chihuahua:* San Francisco del Oro, 6100′, 1 May 1953 (W. S. Creighton; LACM); 23 mi S Hidalgo del Parrál, 5500′, 30 Apr. 1953 (W. S. Creighton; LACM); 3 mi W Jiménez, 4400′, 26 July 1952 (Univ. Kans. Mex. Exped.; KU); 11 mi W Gran Morelos, 11 July 1964 (J. A. Chemsak; UCB); 16 mi W General Trias, 5800′, 7 May 1953 (W. S. Creighton; LACM); 13 mi W General Trias, 5600′, 7 May 1953 (W. S. Creighton; LACM); 13 mi E Cuauhtémoc, 12 July 1964 (J. A. Chemsak; UCB); 16 mi E Cauhtémoc, 5900′, 7 May 1953 (W. S. Creighton; LACM); 13 mi W Chihuahua, 5100′, 7 May 1953 (W. S. Creighton; LACM); 17 mi W Chihuahua, 11 July 1964 (J. Powell; UCB); Santa Clara Cyn., 5 mi W Parrita, 6 July 1964, 1 Sept. 1964 (J. W. MacSwain; UCB); 3 mi W Majalca, 5400′, 8 May 1953 (W. S. Creighton; LACM). *Nuevo León:* Km 689, Hwy. 57, Las Margaritas, 11 Aug. 1964 (CU). *Sonora:* Sierra de los Ajos, 31°3′N–109°56′W, 20 July 1971 (V. Roth; LACM). *UNITED STATES. Texas: Jeff Davis Co.:* Ft. Davis, 8–9 June 1902 (W. M. Wheeler; cotypes of *comatus,* AMNH, LACM, MCZ, USNM); same locality, 5 Sept. 1960 (L. A. Stange; LACM); 21 mi NW Ft. Davis, 5900′, 20 Aug. 1967 (R. R. Snelling, No. 67–259; LACM); Davis Mts. State Park, 5000′, 12 May 1953 (W. S. Creighton; LACM); Limpia Cyn., 26 July 1955 (A. C. Cole, No. T-155; LACM); Hospital Cyn., 8–9 June 1902 (W. M. Wheeler; GCW).

Ecology. In central Mexico this ant ranges up to elevations of about 8200 feet; proceeding north, elevation decreases to about 5000 feet in Texas. It is an ant of semiarid mountain habitats, with most records from Oak-Juniper Woodland, a few in Piñon-Juniper Woodland.

Wheeler (1908) reported on this ant, as *comatus,* in the Davis Mts. of Texas. He observed workers ascending oak trees, possibly to visit aphids, but none of the returning workers had enlarged gasters. Wheeler found no repletes in the nests he examined and, from the large amounts of insect fragments in the detritus piles, concluded that the ant is predatory. According to his field notes, Creighton found workers at Ft. Davis Park ". . . cleaning up an exposed termite colony with zeal and vigor." Semirepletes were found in the colony.

Nests are located on rocky slopes, sometimes with the entrance adjacent to a stone. A tumulus may or may not be present (Fig. 357). When present it usually is irregular, not at all regularly crateriform. Although the ants are consistent predators on small insects, they do solicit aphids for honey dew and visit flowers for nectar. I have found repletes in a colony studied in the Jeff Davis Mts. and some of the original series described by Forel are repletes.

Activity of the reproductive forms is shown in Table 1.

Discussion. The synonymy of *comatus* with *melliger* by Snelling (1969) has already been discussed in that earlier paper. It is sufficient to state that there is no characteristic by which *comatus* may be separated.

This largely Mexican species extends north along the Sierra Madre Oriental barely entering the United States through the mountains of the Big Bend of western Texas, as far as the Jeff Davis Mountains. The latter are the type locality for *comatus.* The southernmost records are from the State of Puebla, Mexico. From the Sierra Madre Oriental the species ranges westward onto the central plateau of Mexico at suitable elevations. The incidence of *melliger* decreases sharply in the vicinity of the Sierra Madre Occidental. Extensive collecting in these ranges has produced few records. A single record exists for the State of Sonora, based on a single specimen which may prove to be *mendax.*

TABLE 1

Activity of Reproductives of:

Locality	Date	Activity
M. melliger Forel		
ZAC., 9 mi S Fresnillo	24 June 1956	♂♂, ♀♀ in nest
HGO., 5 mi N Zimapán	21 Nov. 1946	♀♀ in nest
TEX., Ft. Davis	8–9 June 1902	♂♂, ♀♀ in nest
TEX., Crouching Lion, Davis Mts.	22 July 1933	deälate ♀
TEX., 21 mi N Ft. Davis	20 Aug. 1967	♀♀ in nest
M. mendax Wheeler		
COLO., Mt. Washington	19 July 1903	♂♂, ♀♀ in nest
COLO., 5 mi NE Cañon City	24 Aug. 1967	♂♂ in nest
TEX., 6 mi W Austin	21 Apr. 1903	deäl. ♀ —on ground?
N.MEX., Santa Fe	26 July 1968	♂♂ in nest
N.MEX., Cimarron Cyn.	29–31 Aug. 1951	♂♂, ♀♀ in nest
ARIZ., S.W.R.S.	29 June 1956	♂♂ in nest
ARIZ., Cave Cr. Cyn.	4 July 1963	♀♀ in nest
ARIZ., Garden Cyn.	10 July 1950	mating flight in afternoon after rain
ARIZ., Forestry Cabin	26 July 1951	mating flight
ARIZ., Madera Cyn.	25 July–5 Aug. 1965	♂♂ in nest
ARIZ., Miller Cyn.	18 Aug. 1971	♂♂ in nest
ARIZ., Carr Cyn.	18 Aug. 1971	♂♂ in nest
ARIZ., 8.1 mi SE Sunnyside	23 Aug. 1971	♀♀ in nest
CALIF., Carson's Well	31 Jan. 1967	♂♂ in nest

The populations of large, long-haired *Myrmecocystus* from New Mexico and Arizona, heretofore thought to be *melliger*, or its junior synonym *comatus*, are now believed to represent a long-haired variant of *mendax*. These are discussed more fully under that species. The species most closely related to *melliger* apparently is *mendax*, for the workers of the two are very similar in details of head shape, punctation, and petiolar shape. The females, also, are very similar. The apparent closeness is further enhanced by the long-haired *mendax* variant which is extremely similar to *melliger*.

The differences are subtle but constant in the material available. They are best appreciated when comparative material of both species is available for direct comparison. The distinctions are based on large workers with head width in excess of 1.5 mm; smaller workers are much more difficult to separate.

The longest occipital and pronotal hairs of *melliger* are longer than the eye length, as are those on the disc of the second tergum (Fig. 37). Those of the pronotal disc are very slender and are prone to curl apicad; the appearance is one of "woolliness." The long-haired variant of *mendax* usually has the longest occipital hairs not exceeding eye length. The pronotal hairs are also usually shorter than, but may be equal to, eye length and the discal hairs of the second tergum are always less than eye length. The pronotal hairs are gently and evenly curved and there seems to be no tendency for these to curl apicad; the appearance, then, is one of "hairiness" rather than "woolliness."

Myrmecocystus (Endiodioctes) mendax Wheeler

Figures 43–51, 155, 167, 179, 187

Myrmecocystus melliger var. *semirufa* Emery 1893. Zool. Jahrb. Syst. 7:667. ♀ ♂ *(in part)*.

Myrmecocystus melliger subsp. *orbiceps* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:349–351. ♀ ♀ *(in part)*; Wheeler 1912. Psyche 19:173, 175 *(in part)*; Creighton 1950. Bull. Mus. Comp. Zool. 104:445 *(in part)*. NEW SYNONYMY.

Myrmecocystus melliger subsp. *mendax* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:351–352. ♀ ♀ ♂. Wheeler 1912. Psyche 19:173. Cole 1942. Amer. Midl. Nat. 28:385; Gregg 1963, Ants of Colorado, p. 645–648.

Myrmecocystus melliger, Wheeler 1912. Psyche 19:173, 174 *(in part)*; Creighton 1950. Bull. Mus. Comp. Zool. 104:444–445 *(in part)*.

Myrmecocystus mendax, Creighton 1950. Bull. Mus. Comp. Zool. 104:445, Cole 1954. Jour. Tenn. Acad. Sci. 29:284; Snelling 1969. Contr. Sci., L.A.C.M. 170:2, 8.

Myrmecocystus semirufa, Creighton 1950. Bull. Mus. Comp. Zool. 104:449–450 *(in part)*.

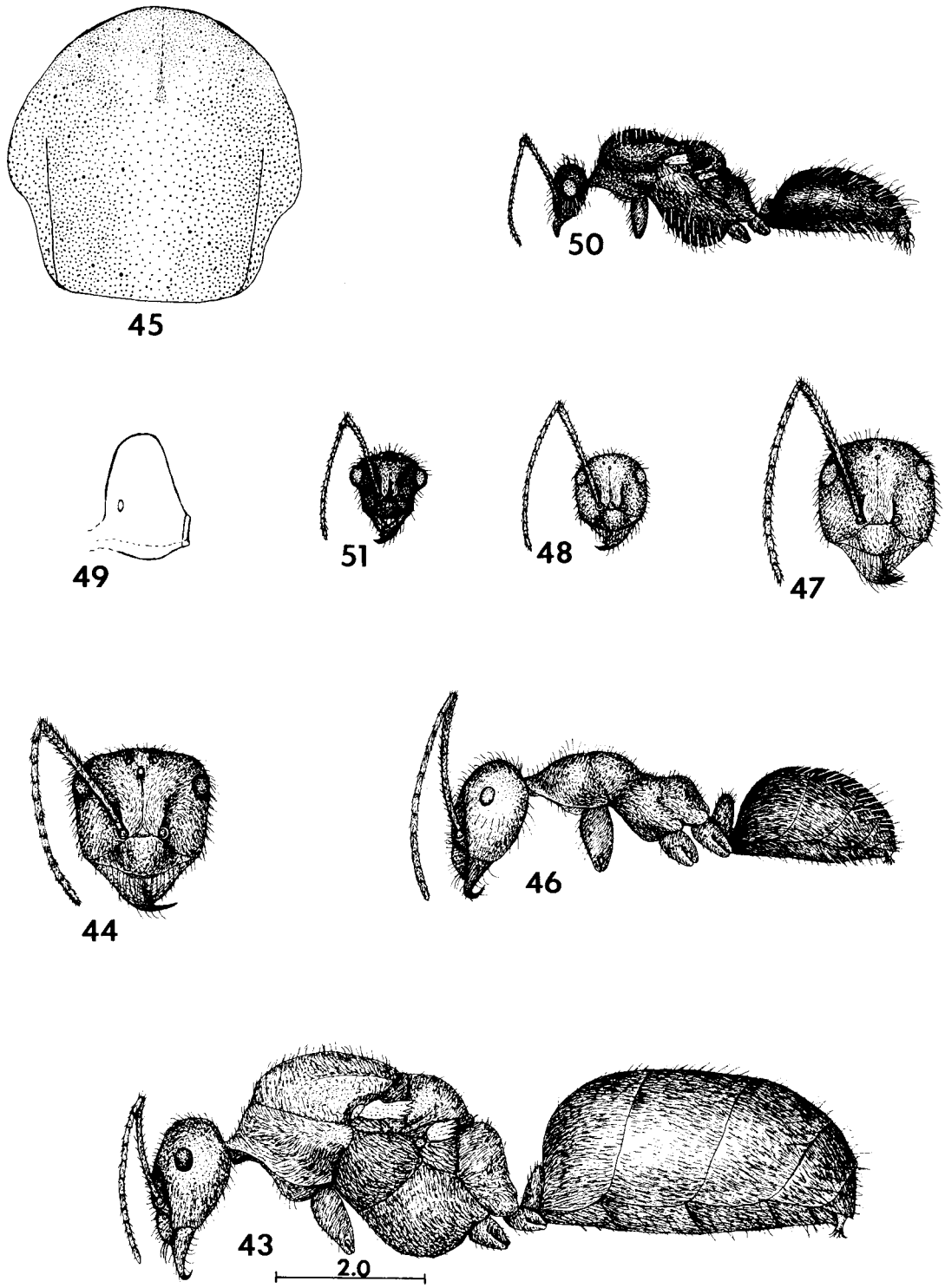
Myrmecocystus semirufus, Cook 1953. The ants of Calif.; p. 345 *(in part)*.

Formica subpolita var. *camponoticeps*, Cook 1953. The ants of Calif., p. 397 *(in part, misident.)*.

Myrmecocystus comatus, Cole 1954. Jour. Tenn. Acad. Sci. 29:284; Gregg 1963. Ants of Colorado, 643–645 *(misident.)*.

Myrmecocystus placodops, Snelling 1969. Contr. Sci., L.A.C.M. 170:6 *(in part)*.

Diagnosis. Worker: HW 0.9–1.9 mm; malar area with numerous erect hairs; longest hairs of pronotum and disc of second tergum of large workers at least 0.6 × MOD, usually longer; long pronotal hairs grad-



FIGURES 43–51. *M. mendax*. 43, female, lateral view; 44, head of female, frontal view; 45, mesoscutum of female, distribution of punctures; 46, major worker, lateral view; 47, head of major worker, frontal view; 48, head of minor worker, frontal view; 49, petiole of major worker, lateral view; 50, male, lateral view; 51, head of male, frontal view.

ually tapering to tip which is not conspicuously curled, but may be gently curved. *Female:* Apparently inseparable from that of *melliger*. *Male:* Apparently inseparable from those of *melliger* and *placodops*.

WORKER: *Measurements.* HL 1.10–1.97 (1.65); HW 0.93–1.92 (1.55); SL 1.37–2.24 (1.90); WL 1.8–3.3 (2.5); PW 0.7–1.4 (1.1).

Head: Distinctly longer than broad to slightly broader than long, CI 85–103 (94), distinctly shorter than scape, SI 110–132 (118); in frontal view, sides straight and hardly narrowed toward mandibular insertions (small workers) to gently, evenly convex and distinctly convergent toward mandibular insertions. Occiput, in frontal view, low and gently convex in small workers, flattened in large workers, broadly rounded at sides. Eye small, 1.10–1.15 × first flagellomere; OMD 1.57–2.36 (2.00) × EL. Mandible with seven teeth.

Thorax: Slender to moderately robust, PW 0.35–0.46 (0.44) × WL. Propodeum, in profile, about as high as long, basal face slightly sloping and broadly rounded into posterior face.

Petiole: In profile, thick, not at all cuneate, summit broadly rounded, but may be flattened, rarely subangulate; crest, in frontal view, usually flat, but may be slightly concave.

Vestiture: (Based on workers with PW in excess of 0.9 mm). Cephalic pubescence general, but sparse, never obscuring integument, most abundant on occiput, vertex and frontal lobes. Sparse on pronotum, more abundant on remainder of thorax, only partially obscuring surface, densest on propodeum. First three terga with conspicuous pubescence, usually notably sparse in small workers; fourth tergum usually not pubescent, except in some large workers of southern populations.

Malar area with 15+ short, erect hairs (sometimes as few as 10 in smallest workers); longest occipital hairs (in large workers) 0.75–1.20 × MOD, hairs curved but not curled, gradually narrowed toward apex; area between eye and frontal lobe with numerous short, erect hairs. Pronotal hairs abundant, often somewhat curved but not curled at apex, gradually tapering to apex, longest hairs 0.75–1.1 × MOD, not exceeding EL; mesonotal hairs shorter, at most 0.6 × MOD; basal face of propodeum with numerous erect hairs, longest 0.7–1.0 × MOD. Petiole with numerous erect hairs on sides and crest, longest not more than 0.5 × MOD, usually less. Abdominal terga with abundant long erect hairs, longest on disc of second tergum 0.9–1.0 × MOD. Scape, all surfaces of femora and tibiae, with abundant short, fine, erect and suberect hairs, longest hairs of hind tibia shorter than maximum width of that segment.

Integument: Head slightly to moderately shiny, lightly shagreened; frontal lobe closely micropunctate and with sparse coarse punctures, punctation more or less obscured by dense shagreening; face, between eye and frontal lobe with abundant obscure micropunctures and scattered coarse punctures; malar area with sparser coarse, shallow punctures; vertex and occiput densely micropunctate and with sparse coarse punctures and a few shallow poriform punctures; punctation extending laterad to sides of head. Thorax slightly shiny, densely shagreened and micropunctate, with sparse coarse punctures; propodeum duller, more densely micropunctate. First two (minor workers) (three in southern populations) or three (major workers) (four in southern populations) terga moderately shiny, closely micropunctate and with sparse shallow poriform punctures.

Color: Head yellowish to brownish ferruginous, often lighter anteriorly; thorax light to medium brownish, pronotum and sides often yellower; gaster medium to dark brownish; legs light to medium brownish; antennae yellowish to reddish brown, apical segments darker.

FEMALE. *Measurements.* HL 1.87–2.13; HW 190–2.16; SL 1.83–2.20; WL 4.0–4.8; PW 2.5–3.2.

Head: Slightly broader than long, CI 102–108; in frontal view, sides straight or slightly concave, a little convergent toward mandibular insertions; a little shorter, to a little longer than, scape, SI 95–103. Occiput, in frontal view, slightly convex, broadly rounded at sides. Eye small, 0.93–1.25 × first flagellomere; OMD 1.60–1.73 × EL; OOD 4.0–6.0 × OD; IOD 2.4–3.3 × OD. Mandible with seven teeth. Penultimate segment of maxillary palp slender, broadest in basal third, evenly tapered toward apex.

Thorax: Moderately to very robust, PW 0.56–0.70 × WL. Scutum flattened behind; scutellum convex in profile, a little flattened in front. Basal face of propodeum strongly sloping and broadly rounded onto posterior face.

Petiole: In profile, thickly cuneate, more compressed above, summit narrowly rounded; crest, in frontal view, deeply angularly incised.

Vestiture: Cephalic pubescence general but sparse, most abundant on malar area near mandibular base, on frontal lobe and on occiput. Mesoscutum with pubescence general but sparse, absent only from median impunctate area; general but sparse on scutellum. Pronotum, pleura and propodeum much more conspicuously pubescent. First four terga uniformly and closely pubescent.

Malar area with 15+ erect hairs, longest less than 0.5 × MOD; face with sparse, short erect hairs, including area between eye and frontal lobe; longest occipital hairs 0.5–0.7 × MOD (up to 1.0 × MOD in Edwards Plateau populations). Longest mesocutal hairs usually about 0.5–0.6 × MOD, but may be as much as 0.9 × MOD (Edwards Plateau populations), hairs sparse, suberect. Scutellar hairs sparse, longest about 0.9 × MOD (northern) to 0.9 × EL (southern). Longest anepisternal hairs 0.55 (northern) to 1.0 (Edwards Plateau) × MOD; longest katepisternal hairs about

0.6–0.7 × longest anepisternal hairs. Propodeum with sparse erect hairs across base and on side, longest hairs about 0.6 (northern) to 1.0 (Edwards Plateau) × MOD. Petiole with numerous erect hairs on sides and crest. Gastric terga with numerous erect hairs, most of which, on first two segments, arise from coarse poriform punctures; longest hairs on disc of second segment from 0.5 (northern) to 1.0 (Edwards Plateau) × MOD. Scape, femora and tibiae with abundant short, suberect to erect hairs, longest on hind tibia equal to, or slightly exceeding, minimum thickness of tibia. Fore and hind wings without fringe hairs on apical or posterior margins.

Integument: Cephalic integument similar to that of worker but clypeus duller, distinctly shagreened; malar area closely punctate with micropunctures and somewhat ovoid coarse punctures. Mesoscutum densely micropunctate and with sparse coarse punctures over entire disc or with impunctate median area of variable extent; parapsis uniformly, closely micropunctate. Scutellum uniformly micropunctate, interspaces usually greater than a puncture diameter, and with sparse coarse punctures. Anespisternum slightly shiny, densely shagreened, obscurely micropunctate and with scattered coarse punctures; katepisternum duller, densely micropunctate and with sparse coarse punctures. Propodeum dull or slightly shiny, densely shagreened and micropunctate, with sparse coarse punctures on basal face and sides; lower half of posterior face smooth and shiny. First four gastric terga moderately shiny, uniformly densely micropunctate, with sparse, coarse, poriform punctures; no impunctate median areas.

Color: Head and thorax ferruginous; propodeum, petiole and gaster medium to dark brownish; scape ferruginous, flagellum light brownish; legs ferruginous to brownish. Wings slightly brownish, veins and stigma light yellowish brown.

MALE. *Measurements.* HL 0.97–1.10; HW 0.93–1.07; SL 1.17–1.37; WL 2.1–2.6; PW 1.3–1.6.

Head: A little longer than broad to a little broader than long, CI 93–102, distinctly shorter than scape, SI 117–141; in frontal view, sides straight or slightly concave, slightly convergent toward mandibular insertions. Occiput, in frontal view, strongly but evenly convex, slightly angulate at sides. Eye large, OMD 0.75–0.90 × EL; OOD 1.67–2.80 × OD; IOD 2.00–3.20 × OD. Apical margin of mandible usually with low preapical tooth.

Thorax: Robust to very robust, PW 0.49–0.67 × WL. Propodeum without distinct basal face, in profile more or less evenly convex from base to apex.

Petiole: Low, strongly cuneate, summit usually sharp but may be narrowly rounded; crest, in frontal view, narrowed above, distinctly, angularly incised.

Vestiture: Cephalic pubescence dilute, densest on frontal lobes, malar area and occiput. Pubescence short, dilute on pronotum, scutum and scutellum; long, dilute on mesopleura, metapleura and propodeal side; long, denser, across base of propodeum. First three terga conspicuously, but thinly, pubescent; remaining terga with scattered pubescence.

Malar area with 6–10 erect hairs, longest about 0.6 × MOD. Longest occipital hairs about 0.75 × MOD. A few short erect hairs on face between eye and frontal lobe. Longest scutal hairs 0.70–0.80 × MOD; scutellar hairs longer than those of scutum, some 1.0 × EL. Pleural hairs sparse, long, longest 0.9–1.1 × MOD. Long hairs across base of propodeum about equal to MOD. Sides and crest of petiole with numerous short hairs, about 0.5 × MOD. Disc of first tergum, behind summit with erect hairs sparse, those at summit about 0.75 × MOD; disc of second tergum similarly sparsely hairy or wholly apilose, but with usual row along apical margin and with sparse hairs along length at sides, where they are about 0.8 × MOD; apical segments with long hairs abundant, longest exceeding EL. Scape, femora and tibiae with abundant suberect to erect short hairs, longest hairs of hind tibia about equal to apical thickness of tibia. Fore and hind wings without fringe hairs on apical and posterior margins.

Integument: Head moderately shiny, distinctly shagreened, with sparse obscure micropunctures, and a few coarse punctures, occiput duller, more densely and sharply micropunctate. Mesoscutum dull, densely and uniformly shagreened with sparse, obscure micropunctures and scattered coarse punctures; scutellum shinier, less closely tessellate than scutum, with similar punctation. Mesopleura slightly shiny, ketepisternum duller and more densely shagreened than anepisternum, both sparsely micropunctate and with scattered coarse punctures. Propodeum shinier than pleura, shagreening less dense, micropunctures equally sparse but more distinct, especially basally; discal area shinier. First two terga slightly shiny, sharply shagreened and sparsely micropunctate, with scattered coarse punctures basally and laterally; remaining terga shinier, less closely shagreened, micropunctures and coarse punctures sparser.

Color: Blackish brown, antennae and legs medium brown. Wings faintly brownish, veins and stigma yellowish brown.

Terminalia: Figures 167, 179, 187.

Type Material. Myrmecocystus melliger subsp. *mendax:* an unspecified number of cotypes of all castes from Mt. Washington, near Colorado Springs, Colorado, July 19, 1903 (W. M. Wheeler). Lectotype worker, by present selection, agreeing with above general description and parenthetical data, in AMNH; lectoparatypes, all castes in AMNH, LACM, MCZ.

Myrmecocystus melliger subsp. *orbiceps:* an unspecified number of worker and female cotypes from Bull Creek, near Austin, Texas (Brues, Melander and Wheeler). Lectotype worker, by present selection (HL

1.85, HW 1.85, SL 2.25, WL 2.85, PW 1.25 mm), agreeing with above general description and Edwards Plateau specifics, in AMNH; lectoparatypes in AMNH, LACM, MCZ.

Distribution. Central Colorado south to Texas, west to desert mountain ranges of southeastern California; adjacent northern Mexico (Fig. 362).

Localities. *UNITED STATES*. *Colorado: Yuma Co.:* Wray, 3700′, 17–19 Aug. 1919 (AMNH); [1.5 mi S Beecher Isl., 3600′, 2 Sept. 1955 (R. E. Gregg), Gregg, 1963]. *Washington Co.:* [Akron, 4654′, 28 May 1949 (R. E. Gregg), Gregg, 1963]. *Denver Co.:* Denver, 28 July 1906 (W. M. Wheeler; MCZ); [same locality, no date (W. W. Robbins), Gregg, 1963]. *El Paso Co.:* Mt. Washington, nr. Colorado Springs, 19 July 1903 (W. M. Wheeler; cotypes of *M. melliger mendax;* AMNH, LACM, MCZ); Colorado Springs, 5900′, 23 Aug. 1967 (R. R. Snelling, No. 67–264; LACM). *Fremont Co.:* 5 mi NE Canyon City, 5700′, 24 Aug. 1967 (R. R. Snelling, No. 67–264; LACM); [Canyon City, 5333′, 4–5 July 1947 (R. E. Gregg); Royal Gorge, 6600′, 5 July 1947 (R. E. Gregg), Gregg, 1963]. *Pueblo Co.:* Pueblo, no date (T. Pergande Colln., No. 510; USNM); [Vineland, 4600′, 31 June 1947 (R. E. Gregg), Gregg, 1963]. *Otero Co.:* [Higbee, 4400′, 1–2 June 1947 (R. E. Gregg), Gregg, 1963]. *Huerfano Co.:* [6 mi SW Walsenburg, 6450′, 24 Sept. 1960. Gregg, 1963]. *Mesa Co.:* 4 mi S Fruita, 4700′, 13 June 1955 (R. E. Gregg; LACM, REG). *La Plata Co.:* Bondad, 6100′, 27 June 1919 (AMNH). *Baca Co.:* Regnier, 4500′, 6–9 June 1919 (AMNH). *Las Aminas Co.:* [5.5 mi N Trinidad, 6100′, 23 Sept. 1960. Gregg, 1963]. *Texas: Travis Co.:* West Bull Cr., near Austin, 17 Apr. 1901 (W. M. Wheeler; cotypes *M. melliger orbiceps;* AMNH, LACM, MCZ); 6 mi W Austin, 21 Apr. 1903 (W. M. Wheeler; CU). *Sutton Co.:* Sonora, 2100′, 26 Apr. 1964 (LACM). *Edwards Co.:* Barksdale, no date (W. M. Wheeler; GCW, MCZ, USNM). *Comal Co.:* New Braunfels, 26 July 1942 (W. S. Ross; CAS). *Bexar Co.:* Helotes, 1 July 1917 (CU, MCZ). *Hays Co.:* nr. Wimberley, 900′, 19 Apr. 1973 (R. R. Snelling, No. 73–40; LACM). *Williamson Co.:* Cedar Park, 18 June 1951 (G. C. & J. Wheeler, No. Tex–175; GCW). *New Mexico: Colfax Co.:* [5 mi S Raton Pass, 6400′; 16 mi E Raton, 6650′; 20 mi W Raton, 6950′; Cimarron Cyn., 6700′. Cole, 1954]. *San Miguel Co.:* [25 mi S Las Vegas, 5500′. Cole, 1954]. *Santa Fe Co.:* Santa Fe, 19 June 1909 (F. C. Pratt; MCZ, USNM); same locality, 7000′, 26 July 1968 (R. R. Snelling, No. 68–119; LACM); [10 mi S Santa Fe, 6500′. Cole, 1954]; 1 mi S Golden, 6 Aug. 1972 (C. A. Kay; CAK, LACM). *McKinley Co.:* [nr. Gallup (Kit Carson Cave Rd., 6950′); 25 mi E Gallup, 7200′. Cole, 1954]. *Quay Co.:* [9 mi W Glenrio, 3900′; 3 mi W Tucumcari, 4200′]. *Guadalupe Co.:* 0.6 mi N Dilia, 4800′, 21 Aug. 1967 (R. R. Snelling, No. 67–263; LACM); [Santa Rosa, 4650′. Cole, 1954]. *Torrance Co.:* [9 mi E Mountain Air, 6025′. Cole, 1954]. *Lincoln Co.:* [Malpais Lava Beds, nr. Carizozo. Cole, 1954]. *Socorro Co.:* [Water Cyn., 6550′, 16 mi W Socorro; 25 mi E (5950′), 25 mi N (6550′) Bernardo. Cole, 1954]. *Catron Co.:* Datil, 4 Aug. 1927 (W. S. Creighton; LACM); [20 mi E Alma, 6400′. Cole, 1954]. *Lea Co.:* [Hobbs, 3750′; N. Mex.-Tex. line, Hwy. 180-62. Cole, 1954]. *Otero Co.:* Alamogordo, 16 Apr. 1902 (MCZ); White Sands, 3 May 1960 (J. Durkin; USNM). *Doña Ana Co.:* vic. Aguirre Spg. Rec. Area, 12 & 21 May 1972 (C. A. Kay; CAK, LACM); [Las Cruces, 2750′. Cole, 1954]. *Luna Co.:* [6 mi NW Deming, 4550′. Cole, 1954]. *Grant Co.:* 26.5 mi S Silver City, 5900′, 7 Sept. 1972 (R. R. Snelling, No. 72–66; LACM); 23 mi SW Silver City, 6100′, 7 Sept. 1972 (R. R. Snelling, No. 72–68; LACM); [20 mi N (6400′), 70 mi N (7200′), 15 mi E (6900′) Silver City. Cole, 1954]. *County unknown:* "Rito de los Frijoles," no date (CKL. = T.D.A. Cockerell?; MCZ). *Arizona: Coconino Co.:* Oak Creek Cyn., nr. Sedona, 22 Aug. 1964 (G. C. & J. Wheeler, No. Ariz–48; GCW). *Yavapai Co.:* Ash Fork, 8 May 1905 (W. M. Wheeler; GCW, MCZ); 17 mi SE Camp Verde, 7 Aug. 1969 (R. R. Snelling; LACM); Rimrock, 9 Apr. 1968 (D. E. Surber, USNM). *Graham Co.:* Post Cyn., 5000–6000′, Pinaleño Mts., 16 July 1917 (W. M. Wheeler; MCZ). *Cochise Co.:* S. Fork, Cave Cr. Cyn., Chiricahua Mts., 24 May 1964 (L. M. Martin; LACM); 0.5 mi S Paradise, 5500′, 15 Aug. 1967 (R. R. Snelling, No. 67–228; LACM); Southwest Research Sta., 5400′, 4 Aug. 1970 (V. Roth; LACM); Portal, July 1974 (B. Hölldobler; MCZ); Chiricahua Mts., 25 Aug. 1959 (G. C. & J. Wheeler, No. Ariz–6; GCW); Texas Pass, Dragoon Mts., 20 July 1917 (W. M. Wheeler; MCZ); Dry Cyn., 5000′, Whetstone Mts., 21 Aug. 1951 (W. S. Creighton; LACM); Garden Cyn. (5400′), Carr Cyn. (5200–7100′), Miller Cyn. (5000–6100′), Coronado Peak (6600–6875′), Huachuca Mts., numerous dates and collectors (AMNH, GCW, LACM, MCZ, USNM); 8.1 mi SE Sunnyside, 5950′, 23 Aug., 13 Sept. 1971 (R. R. Snelling, Nos. 71–48, 71–55; LACM). *Pima Co.:* Oracle, 4500–5000′, various dates (W. M. Wheeler; GCW, MCZ); Apache Camp, 5500′, Santa Catalina Mts., 27 July 1917 (W. M. Wheeler; GCW, MCZ); Fenner Cyn., 3000′, Santa Catalina Mts., 19 Mar. 1919 (W. M. Wheeler; GCW, MCZ); Sabino Cyn., 3800′, Santa Catalina Mts., 8–20 July 1916 (MCZ); same locality, 17 July 1950 (W. S. Creighton; LACM); Baboquivari Cyn., 3500′, Baboquivari Mts., 26 July 1951 (W. S. Creighton; LACM); mouth of Madera Cyn., 4800′, Santa Rita Mts., 24 June 1951 (W. S. Creighton; LACM). *Santa Cruz Co.:* Madera Cyn., Santa Rita Mts., 1–6 Aug. 1965 (R. H. Crandall; LACM); same locality, 16 Apr. 1948 (R. E. Gregg; LACM, REG); Sweetwater, 5800–6000′, Santa Rita Mts., 28–29 June, 1951 (W. S. Creighton; LACM). *Nevada: Nye Co.:* A.E.C., N.T.S., Mercury, various dates and collectors (LACM). *Clark Co.:* 1 mi NW Granite Spgs., Dead Mt., "2–4–1953" (I. LaRivers; USNM); 3 mi E Nelson, 2200′, 11 Apr. 1964 (R. C. Bechtel; LACM). *California. San Bernardino Co.:* Carson's Well, 1900′, Turtle Mts., 31 Jan. 1967 (R. R. Snelling; LACM); 7 mi S, 34° E Kelso, 15 Apr. 1962 (UCB). *Riverside Co.:* 24 mi E Mecca, 13 Apr. 1965 (D. Veirs; UCB); Shaver's Well, Mecca Hills, 13 Apr. 1963 (R. R. Snelling; LACM); Hidden Spgs., Little San Bernardino Mts., no date or collector (T. W. Cook Colln.; LACM); Painted Cyn., 8 Mar. 1930 (USNM); Mecca Hills, 9 Mar. 1930 (USNM). *MEXICO*. *Chihuahua:* Nogales Ranch, 5200′, Sierra de en Medio, 3 Oct. 1951 (W. S. Creighton; LACM). *Sonora:* 4.8 mi S Cananea, 1 Aug. 1970 (V. Roth, LACM); Puerto Gonzalitos, 2500′, 9 Nov. 1952 (W. S. Creighton; LACM); Naco, 5100′, Sierra de San José, 17 Aug. 1951 (W. S. Creighton; LACM).

Ecology. Wheeler (1908) reported briefly on the type colony of *mendax*. Sexual forms were found emerging and taking flight at 4:10 P.M. following a rain shower. On the following day the nest was excavated. Since repletes were not found, but insect fragments were found in some chambers, Wheeler concluded the species to be carnivorous.

Colonies in Colorado were reported on by Gregg (1963), who found that crateriform tumuli may or may not be present. Nests may be situated beneath stones and there is apparently a preference for clay soils. He found the species at elevations ranging from 3600–

6600′, in the Upper Sonoran, mostly in Piñon-Cedar Woodland and Short Grass Prairie. Texas records include Piñon-Oak Savannah and Mesquite-Acacia Savannah. In other states it has been taken in Piñon-Juniper Woodland, Grama-Tobosa Shrubsteppe and Oak-Juniper Woodland.

The foraging behavior is much as that of *melliger,* already described and need not be elaborated here. Foraging is diurnal and the workers are active scavengers of dead arthropods and predators of living arthropods. Foragers of the colony observed near Wimberley, Texas, were seen to bring seven medium-sized (up to 25 mm) lepidopterous larvae in a period of 20 min. Other prey included one freshly killed muscoid fly, one dessicated muscoid and several fragments from an acridid, apparently recently dead. That workers also gather nectar and/or honeydew is attested by the presence of repletes in nests studied in Texas and Arizona.

The ant cricket *Myrmecophila nebrascensis* Lugger has been found in one nest observed 8.1 mi SE Sunnyside, Cochise Co., Arizona.

Wheeler observed a mating flight of this species at Mt. Washington, Colorado on 18 July 1903, already mentioned above. A flight was observed by Creighton in the Baboquivari Mts., Arizona, on 26 July 1951. His notes state simply . . . "Both ♀s & ♂s present. They take no notice of each other and take off singly. The usual excitement among the workers." There had been a thunder shower about noon of the day before. Activity of the reproductives is summarized in Table 1.

Discussion. Although *orbiceps* has page priority over *mendax,* I have chosen, as first reviser, to continue usage of *mendax.* The name *orbiceps* has been the object of a singularly calamitous history and to resurrect it would only create further confusion. The name has been in synonymy for twenty years and is, in my opinion, best left there.

Wheeler (1908) described *orbiceps* as a subspecies of *melliger* characterized by the presence of workers with orbiculate heads and the absence of repletes. He had numerous specimens available from Texas, New Mexico and Arizona; the type series was from Bull Creek, near Austin, Texas. His description and figures leave no room for doubt as to the identity of the insect being described. On a subsequent page of the same paper *mendax* was adequately described, also as a subspecies of *melliger.*

In the years following, the concepts of these forms remained fairly consistent although Creighton (1950) predicted that *orbiceps* would ultimately be shown to be a synonym of *melliger.* The conceptual *melliger,* as established by Wheeler and Creighton was not the same as Forel's ant; it was, in fact, misidentified samples of *orbiceps* in which there were no workers with orbiculate heads, but did include some material of *mendax.* Creighton and Crandall (1954), reporting a monumental nest excavation by Crandall, were able to show that the form with orbiculate heads did, indeed, produce repletes. They therefore placed *orbiceps* in synonymy with *melliger.*

Snelling (1970) reviewed the *melliger* group species. The concept of *melliger,* based on an examination of Forel's types, was clarified and Wheeler's *comatus* placed in the synonymy of that form and the status of *mendax,* as a valid species, was somewhat clarified. There is, however, no excuse for his treatment of *orbiceps,* for that name was placed in the synonymy of Forel's *placodops.* Type material of both was at hand for direct comparison, but no such comparison was made, simply because the concept as to the identity of *orbiceps* was exceptionally clear and it was obvious that *placodops* fits that concept perfectly.

It was with considerable chagrin, therefore, that I discovered that the types of *orbiceps* are not "*orbiceps*" at all. They no more match Wheeler's description and figures of *orbiceps* than does the long-haired variant of *mendax.* In fact, they are the long-haired variant of *mendax.* Wheeler apparently wrote up his description and then selected his best set of specimens as types and never realized that they were not conspecific. The subsequent identity of *orbiceps* has been based on the concept created by the description and figures, a concept which could not include the types. Because of the confused identity of *orbiceps* and because of the inappropriate nature of that name to the present species, I feel that continued use of *mendax* is fully justified.

This species is very closely related to both *melliger* and *placodops.* Erect body hairs are subject to much variation through the entire range of the species and have been a source for confusion in the past and for frustration to the present writer.

Samples from Colorado, northern New Mexico and Arizona, Nevada and California differ greatly from those of Texas and southern New Mexico and Arizona. In large workers of the northern, short-haired form, the longest hairs of the pronotum are 0.58–0.60 × the MOD and the longest discal hairs of the second tergum are about 0.65–0.68 × the MOD. From the Edwards Plateau of central Texas to the mountains of southern Arizona a distinctive, long-haired form predominates, but does not wholly replace "normal" *mendax.* In the large workers of this form, hairs are shortest in samples from the Edwards Plateau. The longest pronotal hairs are 0.70–0.75 × the MOD and the long discal hairs of the second tergum 0.75–0.80 × the MOD. Westward from the Edwards Plateau, hair length increases to an extreme condition present in samples from the mountains of southern Arizona. Here the pronotal hairs may be up to 1.30 × the MOD and the discal hairs of the second tergum up to 1.15 × the MOD.

Much the same situation applies in a north to south cline, for, distinctive as these extreme short-haired and long-haired forms are, they are perfectly intergradi-

ent to one another. There is no question, in my mind, of two species being represented, nor that the southern form can be set up as a subspecies: the cline is too fully developed. Furthermore, in the mountains of southern New Mexico and Arizona there are nests in which all, or most, of the larger workers are much more like the northern form. A single sample is available from Chihuahua (Nogales Ranch, Sierra de en Médio). In the large workers the long pronotal and discal hairs of the second tergum are 0.65 × the MOD. The single specimen from Cananea, Sonora, is a medium-sized worker but appears to be of the short-haired form, as seems true of the small workers from Puerto Gonzalitos.

The closely related species *placodops*, which ranges from western and southern Texas to southern Arizona, is a short-haired ant. It is broadly sympatric with *mendax*. Workers differ most conspicuously from those of *mendax* in the shorter hairs; in large workers, the long pronotal hairs are about 0.46–0.48 × the MOD, as are those of the second tergum. There appears to be little variation in this regard in *placodops*, western populations being very similar to those of Texas in hair length.

The great range of variation noted for *mendax* was very troublesome, especially since it closely approached the accentuated hair length of *melliger*. It became evident, finally, that those populations of *mendax* with long hair were those adjacent to, or sympatric with, the closely related *placodops*. I can only hypothesize that *mendax* is exhibiting character displacement against *placodops*.

As I interpret the situation, *mendax* and *placodops* may both be derived from a form very much like the present *melliger*. I also assume that *placodops* diverged at an earlier period and is now genetically more stable than *mendax*. The short-haired condition of *mendax* appears to be inhibited in those areas where it is adjacent to, if not actually sympatric with, *placodops*. Interestingly, the few specimens from northern Mexico, in areas where the range of *mendax* becomes sympatric with *melliger*, show an apparent reversal of the long-haired trend in *mendax*. In these, displacement against *melliger* produces short-haired *mendax*. Clearly, more field work must be done, particularly in northern Mexico. An effort should be made to delimit areas of *melliger-mendax* sympatry and to study the populations of these areas.

There has been some confusion in the past of the long-haired variant with *comatus*, a synonym of *melliger*. The New Mexico records cited by Cole (1954) and those from Colorado in Gregg (1963) as *comatus* are based on long-haired populations of *mendax*. Even more remarkable, perhaps, is the record of *mendax* from Hidden Springs Canyon, San Bernardino Co., Calif., recorded as *Formica subpolita camponoticeps* Wheeler by Cook (1953). This is merely another example of that author's complete lack of taxonomic ability.

Myrmecocystus (Endiodioctes) placodops Forel

Figures 52–60, 156, 168, 180, 188

Myrmecocystus melliger var. *placodops* Forel 1908. Bull. Soc. Vaud. Sci. Nat. (5) 44:70. ♀.

Myrmecocystus melliger, Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:348 *(in part)*; Wheeler 1912. Psyche 19:174–175 *(in part)*; Smith 1936. Jour. N. Y. Entomol. Soc. 44:169 *(misident)*; Creighton 1950. Bull. Mus. Comp. Zool. 104:442, 444–445 *(in part)*; Creighton and Crandall 1954. Biol. Rev., C.C.N.Y. 16:2–6 *(misident.)*.

Myrmecocystus melliger subsp. *orbiceps* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:349, Fig. 3 *(in part)*; Wheeler 1912. Psyche 19:173 *(in part)*; Smith 1936. Jour. N.Y. Entomol. Soc. 44:170 *(in part)*; Cole 1937. Entomol. News 48:139 *(in part)*; Creighton 1950. Bull. Mus. Comp. Zool. 104:442, 445 *(in part)*.

Myrmecocystus placodops, Snelling 1969. Contr. Sci., L.A. Co. Mus. Nat. Hist. 170:6, 7, 8 *(in part)*.

Diagnosis. Worker: HW 0.8–2.3 mm; head distinctly orbiculate in large workers; longest hairs of pronotum and disc of second tergum no more than 0.50 × MOD; long pronotal hairs abruptly tapering near tip; malar area with numerous erect hairs. *Female.* HW in excess of 2.00 mm; malar area with numerous fully erect hairs; hairs of occiput and mesoscutum less than 0.7 × MOD; discal hairs of second tergum less than 0.5 × MOD. *Male.* Apparently inseparable from those of *melliger* and *mendax*.

WORKER. *Measurements.* HL 1.10–2.37 (2.10); HW 0.80–2.30 (2.30); SL 1.40–2.15 (2.10); WL 1.7–3.1 (3.1); PW 0.7–1.4 (1.4).

Head: In small workers longer than broad to broader than long in largest worker, CI 81–109 (109); shorter than scape in small workers to longer than scape in large workers, SI 93–135 (100); sides straight and barely convergent toward mandibular insertions in smallest workers; in largest workers, margins slightly divergent down to about level of antennal sockets then abruptly convergent toward mandibular insertions through a slight, but distinct angle at the level of the antennal sockets. Occiput, in frontal view, gently and evenly convex from side to side in small workers, flat or slightly concave in largest workers and broadly rounded at sides. Eye small, 0.92–1.17 × first flagellomere; OMD 1.50–2.29 (2.22) × EL. Mandible with seven teeth.

Thorax: Slender to robust, PW 0.35–0.46 (0.44) × WL. Propodeum, in profile, a little longer than high, basal face flat or barely convex, broadly rounded into posterior face.

Petiole: In profile, thick-cuneate, slightly higher than long to distinctly higher than long, summit narrowly to broadly rounded; crest, in frontal view, flat or slightly convex, rarely weakly concave, never distinctly notched.

Vestiture: Cephalic pubescence very sparse, virtually absent from occipital sides, gena and malar area (except adjacent to mandibular base), most conspicuous

on frontal lobes, vertex and center of occiput. Pubescence more abundant on thorax, especially on side and propodeum, but only partially obscuring surface. First three terga closely pubescent, fourth tergum sparsely pubescent in large workers, often apubescent in small workers.

Malar area with 12+ erect, short hairs; longest occipital hairs 0.57 (small workers) to 0.70 (large workers) × MOD; a few short, erect hairs near inner eye margin; some hairs of vertex, occiput and malar area arising from coarse poriform punctures. Longest pronotal hairs no more than 0.50, usually 0.43–0.46 × MOD, hairs straight, often blunt or abruptly tapering at tip; mesonotal hairs usually about half as long as longest pronotal hairs; base and side of propodeum with numerous erect hairs which are shorter than longest pronotal hairs; side and crest of petiole with abundant erect hairs about equal to those of propodeum. Gaster with abundant erect hairs arising from coarse poriform punctures, those on disc of second tergum no more than 0.5 × MOD; hairs longer on apical segments and on sterna. Scape with numerous subdecumbent to erect, short hairs, except on inner face; all femora and tibiae with abundant short subdecumbent to erect hairs, longest on hind tibia about equal to minimum tibial thickness.

Integument: Head moderately shiny; lightly shagreened, more sharply so on clypeus, frontal lobes and malar area near base of mandible; shinier and less distinctly shagreened on occiput, frontal lobes densely micropunctate and with scattered coarse punctures, punctures somewhat obscured by dense shagreening; face between eye and frontal lobe without evident micropunctures at 125×, or with a few near eye margin; malar area with scattered weak, fine punctures and setigerous poriform punctures; vertex with abundant obscure micropunctures in ocellar area which extend onto occiput; occipital micropunctures usually limited to area immediately posterior to ocelli, rarely extended somewhat laterad; occiput with scattered setigerous poriform punctures. Thorax slightly shiny, densely shagreened, closely micropunctate, propodeum duller. First three terga moderately shiny, closely micropunctate and with sparse setigerous poriform punctures, minor workers less closely micropunctate on third tergum; fourth tergum shinier, with scattered micropunctures and coarse punctures.

Color: Head and thorax light to medium ferruginous, gaster blackish; thorax and legs often extensively infuscated, especially in small workers.

FEMALE. *Measurements.* HL 2.20; HW 2.33; SL 2.13; WL 5.1; PW 3.0.

Head: Slightly broader than long, CI 106; in frontal view, sides nearly straight, distinctly convergent below; a little longer than scape, SI 97. Occiput, in frontal view, slightly convex, broadly and evenly rounded onto gena. Eye small, 0.88 × first flagellomere; OMD 1.73 × EL; OOD 4.7 × OD; IOD 3.0 × OD. Mandible with seven teeth. Penultimate segment of maxillary palp slender, broadest at basal third, evenly tapering to apex.

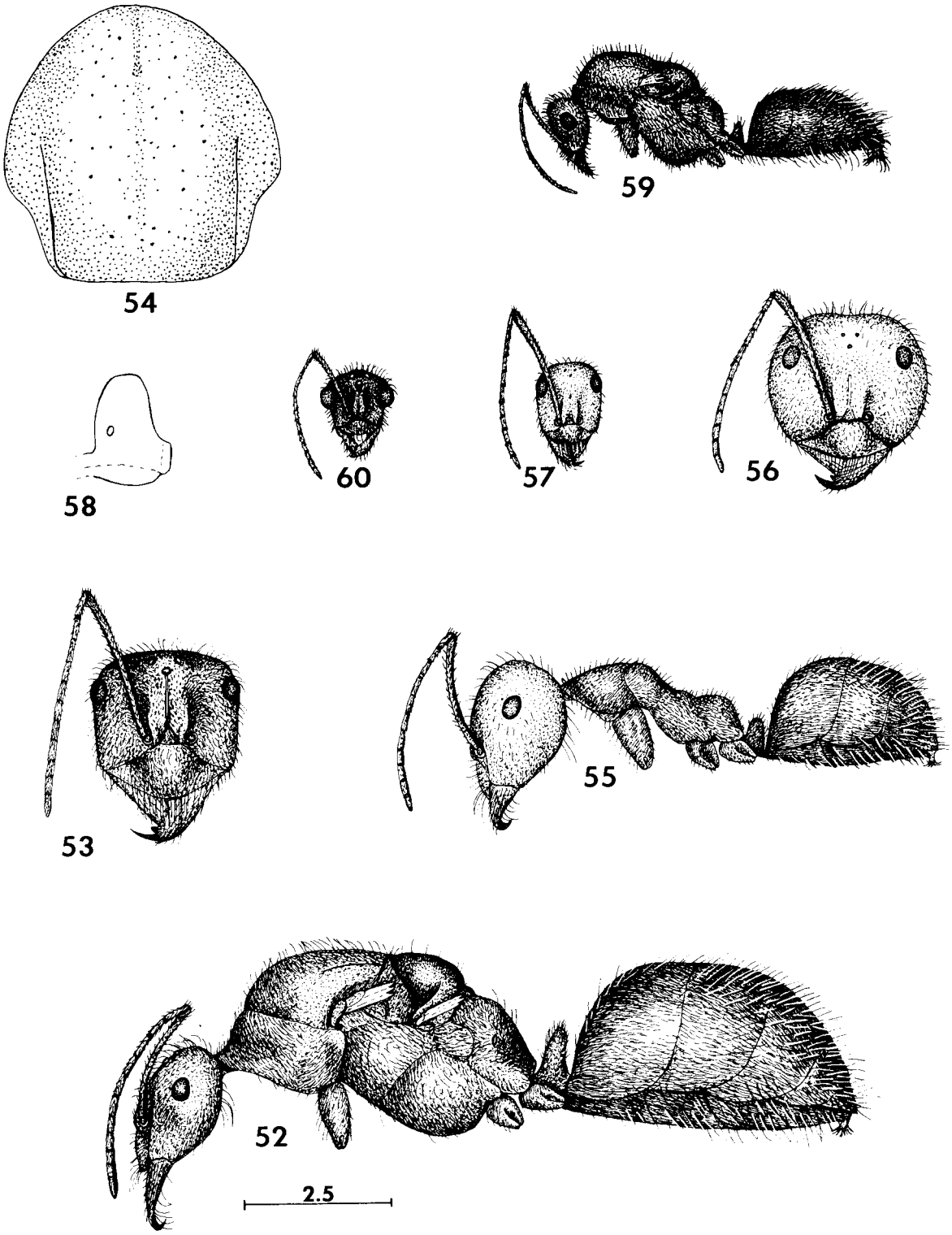
Thorax: Robust, PW 0.59 × WL. Scutum flattened behind; scutellum convex in profile, slightly flattened anteriorly. Basal face of propodeum strongly sloping and broadly rounded onto posterior face.

Petiole: In profile, moderately thick, cuneate, summit slightly convex; crest, in frontal view, broadly, angularly incised.

Vestiture: Cephalic pubescence general but sparse, densest on occiput and near base of mandible. Mesoscutum with pubescence very sparse, a little more abundant across anterior margin, conspicuous only on parapsis; general but sparse on scutellum. Pubescence longer, more abundant on pronotum, pleurae and propodeum, but partially obscuring surface only on latter. First four terga uniformly and densely pubescent.

Malar area with 15+ erect hairs, longest less than 0.5 × MOD; a few short hairs along inner eye margin, but area between eye and frontal lobe otherwise without erect hairs; longest occipital hairs about 0.6 × MOD. Mesoscutum with numerous erect hairs of nearly uniform length, longest about 0.5 × MOD. Scutellar hairs sparser than on scutum, longest about 0.8 × MOD. Longest anepisternal hairs about 0.8 × MOD, hairs sparse; katepisternum similar. Propodeum with hairs sparse on side, more abundant across base, longest about 0.6 × MOD. Petiole with numerous erect hairs on side and across crest. Gastric terga with numerous subdecumbent to suberect (a few fully erect, especially on first tergum) hairs, most of which, on first three terga, arise from poriform punctures; longest hairs on disc of second segment about 0.4 × MOD. Scape, all femoral and tibial surfaces with abundant short, suberect to erect hairs, longest on hind tibia about equal to minimum tibial thickness. Fore and hind wing without fringe hairs on apical or posterior margins.

Integument: Head slightly shiny, more densely shagreened than that of worker, clypeus dull; malar area dull, minutely roughened and with scattered fine punctures which become dense near mandibular base; face between eye and frontal lobe with numerous fine punctures which are largely obscured by dense shagreening; frontal lobes densely, finely punctate, some punctures ovoid; micropunctures of vertex, laterad of ocelli, separated by about a puncture diameter, denser between and behind ocelli; micropunctures sparser on occiput, especially laterad. Mesoscutum shiny, with micropunctures abundant only along anterior margin, disc with very scattered micropunctures and scattered coarse punctures, but with a median line of sparse micropunctures in otherwise impunctate median area; parapsis uniformly, densely micropunctate. Anepisternum closely micropunctate, interspaces slightly shiny and lightly shagreened; katepisternum similar but



FIGURES 52–60. *M. placodops*. 52, female, lateral view; 53, head of female, frontal view; 54, mesoscutum of female, distribution of punctures; 55, major worker, lateral view; 56, head of major worker, frontal view; 57, head of minor worker, frontal view; 58, petiole of major worker, lateral view; 59, male, lateral view; 60, head of male, frontal view.

more closely punctate. Propodeum slightly shiny, densely shagreened and closely micropunctate, with scattered coarse punctures on side and across base; lower half of posterior face smooth and shiny. First four gastric terga slightly shiny, uniformly, densely micropunctate, with scattered poriform punctures on first three, fourth with scattered coarse punctures; no impunctate median areas.

Color: Head ferruginous; thorax and appendages mostly brownish ferruginous; gaster medium brownish. Wings slightly brownish, veins and stigma light brown.

MALE. *Measurements.* HL 0.92–1.00; HW 0.90–0.97; SL 1.00–1.27; WL 2.2–2.3; PW 1.2–1.4.

Head: Slightly longer than broad, CI 97–98; distinctly shorter than scape, SI 109–127; in frontal view, sides straight, slightly convergent toward mandibular insertion. Occiput, in frontal view, evenly convex from side to side. Eye large, OMD 0.75–0.84 × EL; OOD 2.27–2.40 × OD; IOD 2.33–2.95 × OD. Apical margin of mandible without preapical tooth.

Thorax: Robust to very robust, PW 0.54–0.62 × WL. Propodeum, in profile, without evident basal face.

Petiole: In profile, thick, weakly cuneate, summit broadly rounded to sharply angular; in frontal view, crest with distinct angular incision.

Vestiture: Cephalic pubescence dilute, most conspicuous on frontal lobes. Pubescence general but thin on thorax, more abundant on pleura and propodeum. First three terga conspicuously, but thinly, pubescent; fourth tergum less pubescent, remaining terga with only scattered pubescence.

Malar area with about 10 erect hairs, longest about 0.6–0.7 × MOD. Longest occipital hairs about 0.6 × MOD. A few short, fine, erect hairs between eye and frontal lobe. Longest scutal hairs about 0.9 × MOD; scutellar hairs sparser, longest about 1.0 × MOD. Pleural hairs sparse, longest (on katepisternum) about 0.7 × MOD. Longest hairs across base of propodeum about 0.8 × MOD. Sides and crest of petiole with numerous short, erect hairs, longest about 0.3–0.4 × MOD. First three terga with broad median area free of erect hairs; erect hairs on side of second tergum about 0.3 × MOD; longest hairs on apical segment about equal to MOD. Scape, femora and tibiae with numerous short, fine, suberect to erect hairs, longest on hind tibia about equal to minimum thickness of tibia. Fore and hind wings without fringe hairs on apical or posterior margins.

Integument: Head moderately shiny, lightly shagreened, with sparse micropunctures and scattered coarse punctures. Mesoscutum slightly shiny, uniformly densely shagreened, with scattered micropunctures (obscured by shagreening) and coarse punctures; median area shinier and less sharply shagreened. Scutellum shiny, lightly shagreened, with sparse micropunctures and scattered coarse punctures. Mesopleura slightly shiny; anepisternum with sparse micropunctures and scattered coarse punctures which are obscured by dense shagreening; katepisternum shinier, less sharply shagreened. Propodeum about as shiny as katepisternum, sparsely micropunctate and with scattered, obscure, coarse punctures; discal area smooth and shiny. First three terga slightly shiny, distinctly tessellate, with abundant, but well separated, micropunctures and sparse coarse punctures (except in broad median area); remaining terga more sparsely micropunctate.

Color: Blackish brown, antennae and legs medium brown; mandible and labrum yellowish. Wings very faintly brownish, veins and stigma light yellowish brown.

Type Material. Described from a unique worker major from an unknown locality in Mexico; type in MNHG.

Distribution. Rio Grande Valley and adjacent lowlands of Texas and Mexico, west to Sonora and Arizona (Fig. 362).

Localities. UNITED STATES. Texas: Hall Co.: 6 mi SE Turkey, 18 June 1970 (C. W. O'Brien; LACM). *Hale Co.:* Hale, 19 Oct. 1968 (B. W. Robertson; LACM). *Tom Green Co.:* San Angelo (AMNH). *Concho Co.:* 15 mi N Eden, 29 May 1969 (LACM). *Culberson Co.:* 14 mi E Kent, 22 Aug. 1958 (A. C. Cole, No. Tx–74; LACM). *El Paso Co.:* El Paso, 28 July 1914 (J. C. Bradley; CU, USNM); same locality, 14 Aug. 1908 (R. C. Pratt; USNM). *Menard Co.:* Menard, 22 May 1946, 24 May 1939 (R. Melvin; USNM). *Pecos Co.:* 12 mi S Ft. Stockton, 9 Dec. 1901 (W. M. Wheeler; AMNH). *Burnet Co.:* Marble Falls, 3 May 1902 (W. M. Wheeler; AMNH). *Bexar Co.:* San Antonio, various dates and collectors (AMNH, GCW, LACM, MCZ, USNM). *Medina Co.:* Hondo (J. D. Mitchell; AMNH, MCZ, USNM). *Val Verde Co.:* Juno, 3 July 1917 (CU); Del Rio, 1–2 June 1902 (W. M. Wheeler; AMNH, GCW); 10 mi E Del Rio, 2 July 1917 (USNM); Langtry, 3 June 1902 (W. M. Wheeler; AMNH, LACM, USNM). *Brewster Co.:* 21 mi E. Marathon, 13 Apr. 1949 (UK). *Uvalde Co.:* Uvalde, 14 Apr. 1952 (C. D. Michener, *et al.*; UK); same locality, 19 May 1918 (J. C. Bradley; CU). *Karnes Co.:* Kenedy, 27 Oct. 1904 (G. P. Goll; LACM). *Maverick Co.:* 16 mi E Eagle Pass, 500′, 13 Apr. 1973 (R. R. Snelling, No. 73–5; LACM). *Victoria Co.:* Victoria, 8 July 1907 (J. D. Mitchell; LACM). *Refugio Co.:* Refugio, 29 Apr. 1909 (J. D. Mitchell, USNM). *Live Oak Co.:* Lake Corpus Christi State Park, 29 Nov. 1951 (W. S. Creighton; LACM). *La Salle Co.:* Cotulla, 8 Apr. 1908 (J. D. Mitchell; MCZ, USNM). *Dimmit Co.:* Catarina, 22 July 1955 (A. C. Cole, No. Tx–77; ACC). *Webb Co.:* Laredo, various dates and collectors (AMNH, LACM, USNM). *Zapata Co.:* San Ygnacio, 400′, 10 Oct. 1951 (W. S. Creighton; LACM); Falcon State Park, 2 Apr. 1968 (W. S. Creighton; LACM). *Starr Co.:* nr. Roma, May, 1965 (A. E. Lewis; LACM); 10 mi S Sullivan City, 25 Oct. 1951 (W. S. Creighton; LACM). *Willacy Co.:* Raymondville, 20 Oct. 1943 (W. D. Buchanan; USNM). *Cameron Co.:* Boca Chica, 25′, 14 Apr. 1973 (R. R. Snelling, No. 73–8; LACM). *Co. unknown:* Jones, 12 Oct. 1968 (A. B. Barbes; LACM). *New Mexico: Dona Ana Co.:* Hatch, 4100′, 10 June 1951 (W. S. Creighton; LACM). *Arizona: Cochise Co.:* Portal, 30 Apr. 1973 (R. Duffield, Nos. 153, 175; LACM). *Maricopa Co.:* Phoenix, 1100′, 24 Feb. 1933 (R. H. Crandall; USNM); Gila Bend Mts., 8 Aug. 1917 (W. M. Wheeler, GCW, MCZ). *Pinal Co.:* 30 mi W Casa Grande, 2 Dec. 1943 (E. S. Ross, CAS). *Pima Co.:* Tucson and vicinity, numerous dates and collectors (AMNH, LACM, MCZ, USNM); Sells, 2360′, 11 Aug. 1959 (R. A. Alexander; USNM); 25 mi S Ajo, 21 Mar. 1932 (USNM); Hqtrs., 1600′, Organ Pipe Cactus Natl. Mon., 15 Mar. 1952 (W. S. Creigh-

ton; LACM); Abra Wash, 1300′, Organ Pipe Cactus Natl. Mon., 22 Mar. 1952 (W. S. Creighton; LACM). *Yuma Co.:* 22 mi SSE Quartzsite, 5 May 1963 (R. R. Snelling; LACM); Palm Canyon, Kofa Mts., 4 May 1963 (R. R. Snelling; LACM). *MEXICO. Nuevo León:* Chinà, 600′, 12 Mar. 1953 (W. S. Creighton; LACM). *Tamaulipas.* 15 N. Ciudad Victoria, 6 June 1951 (Univ. Kans. Mex. Exped.; UK); Guemez, 7 June 1961 (L. B. Carney, No. 10; UK). *Chihuahua:* Camargo (LACM). *Sonora:* 35 mi W Sonoita, 26 Nov. 1959 (V. Roth; USNM); 2 mi S Sonoita, 1300′, 31 Oct. 1952 (W. S. Creighton; LACM); 4 mi S Santa Ana, 18 Aug. 1966 (R. J. Hamton; LACM, RJH); nr. Punta Chueca, 19 mi NW Bahía Kino, 3 Feb. 1972 (E. M. Fisher; LACM). *State unknown:* El Morál, Ciudad Porfirio Diaz, 7 June 1901 (S. F. Rangel; AMNH). *No specific data:* (type of *melliger* var. *placodops;* MNHG).

Ecology. This ant is most abundant in the Rio Grande Valley and plains of western Texas and has been taken in habitats ranging from Southern Cordgrass Prairie to Mesquite Savannah; the majority of records from this area are from Ceniza Shrub Grassland and Mesquite-Acacia Savannah. In the Panhandle region of Texas it occurs in Grama-Buffalo grass Grassland; in New Mexico records are from Creosote bush-Tarbush Grassland and in Arizona primarily in Creosote bush-Bur sage Grassland.

The first report on this species was made by Wheeler (1908). The nest was stated to be ". . . always in stony soil, has the form of an obscure crater, with an irregular or arcuate and sometimes very large entrance (2–3.5 cm. in diameter) leading down obliquely into the soil. The main gallery thus formed breaks up at a depth of 20–30 cm. into short passages and flat, irregular chambers. The colonies are rather small, comprising hardly more than 300–500 individuals . . ." He concluded that this is a ". . . highly predaceous and carnivorous ant . . ." which does not form repletes.

Parks (1929) observed *placodops* near San Antonio, Texas. A colony was exposed in a gravel pit near San Antonio. The nest was in excess of twelve feet deep; the first twelve feet were through a layer of coarse gravel and there were few galleries. At twelve feet it entered a layer of soft yellow sand; here chambers about 4″ diameter × ⅜″ high contained numerous repletes. He found that foragers obtain nectar from *Condalia obovata* Hook, *Colubrina texensis* Gray and *Zizyphus obtusifolia* Gray, all Rhamnaceae. Chambers containing grass seeds were stated to have been found; this requires confirmation, even though Parks further stated that workers were often seen carrying seeds. It was found that coyotes dig into the nests, presumably to get at the repletes.

A much more ambitious excavation is reported by Creighton and Crandall (1954). Working near Tucson, Arizona, Crandall excavated a nest to a depth of over sixteen feet and secured over 1500 repletes and many hundreds of workers, including numerous individuals with orbiculate heads. These two observations of excavated nests thoroughly dispel Wheeler's thesis that the form with orbiculate heads does not produce repletes and that the colonies are small and shallow.

This is a very active diurnal species. In the field it is a conspicuous ant as it runs across open areas. In bright sunlight it appears silvery or glittering white. Although it is actively predaceous on other small arthropods, the workers of *placodops* also visit flowers for nectar. In addition to the records cited by Parks (1929), I have seen foragers on *Baccharis* and *Helianthus* (Asteraceae).

The available data on the reproductives are given in Table 2.

TABLE 2

Activity of Reproductives of:

Locality	Date	Activity
M. placodops Forel		
TEX., Kenedy	27 Oct. 1904	♂♂, ♀♀ in nest
ARIZ., Tucson	2 Oct. 1953	♂♂ in nest
ARIZ., Tucson	14 Oct. 1953	♂♂ in nest
M. semirufus Emery		
CALIF., 2 mi S Pearblossom	12 Feb. 1967	♂♂ in nest
CALIF., Deep Cyn.	17 Mar. 1968	♂♂ in nest
CALIF., 4 mi W Lone Pine	18 Mar. 1968	♂♂ in nest
CALIF., Llano	11 Apr. 1952	♀♀ in nest
CALIF., Palmdale	20 Apr. 1965	♂♂ in nest
M. depilis Forel		
TEX., 37 mi SW Alpine	19 Aug. 1967	♂♂ in nest
N.MEX., Truth or Consequences	31 Mar. 1962	♂♂, ♀♀ in nest
N.MEX., Jornada Exp. Range	24 Apr. 1973	♂♂ in nest
N.MEX., Jornada Exp. Range	7 June 1972	♂♂, ♀♀ in nest
ARIZ., 5.3 mi NE Portal	9 Mar. 1962	♂♂, ♀♀ in nest
ARIZ., 2.5 mi NE Portal	4 Aug. 1959	♂♂, ♀♀ in nest
SLP., 6 mi W Cd. del Maiz	11 July 1973	♂♂ in nest

Discussion. The oldest name for this ant, *placodops*, is based on a single worker major from an unknown Mexican locality. Although Wheeler (1908) clearly intended his name *orbiceps* to apply to this form, that name, due to an unfortunate type series selection, must become a synonym of *mendax*.

Large workers with the characteristic orbiculate head are easily separated from those of the related species *melliger* and *mendax*. Workers of all sizes are further separated from those of *melliger* by the much shorter pilosity. Large workers differ from those of short-haired *mendax* populations by the shorter hairs on the pronotum and second tergum, which are less than 0.5 × MOD. In sympatric or adjacent populations of *mendax* these hairs are 0.75, or more, × MOD. This usually applies to media and minor workers as well.

The wholly allopatric populations of *mendax* are much more similar to *placodops* but seem never to produce large workers with orbiculate heads. The erect hairs on the dorsum of the pronotum and on the second tergum, although short, are still longer than in *placodops*. The punctures of the frontal lobes are usually more regularly distributed and are sharper in *mendax* than in *placodops*. The latter species is somewhat variable and no great reliance may be placed in this character. Minor workers of these allopatric populations are essentially indistinguishable. There are no reliable features by which the sexual forms may be separated, based on the presently available, limited material.

Myrmecocystus (Endiodioctes) semirufus Emery

Figures 61–69, 157, 169, 181, 189

Myrmecocystus melliger var. *semirufa* Emery 1893. Zool. Jahrb. Syst. 7:667. ♀.

Myrmecocystus melliger subsp. *semirufus*, Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:355 *(in part)*; Mallis 1941. Bull. So. Calif. Acad. Sci. 40:80 *(in part)*.

Myrmecocystus semirufa, Creighton 1950. Bull. Mus. Comp. Zool. 104:449–450 *(in part)*.

Myrmecocystus semirufus, Cook 1953. The ants of Calif.:345 *(in part)*; Snelling 1969. Contr. Sci., L.A. Co. Mus. 170:5–6, 8.

Myrmecocystus placodops, Wheeler and Wheeler 1973. The ants of Deep Canyon:125–126 *(misident.)*.

Diagnosis. Worker: Malar area with more than 10 erect hairs visible in frontal view; thorax abundantly hairy, erect hairs of promesonotum uniform in length, none more than 0.5 × MOD; head, thorax and appendages clear ferruginous. *Female:* Malar area, in frontal view with 10+ erect hairs; thorax exceptionally robust, PW 0.71 × WL; parapsis sparsely, coarsely punctate; median area of first two terga sparsely punctate in contrast to remainder of disc; penultimate segment of maxillary palp broader basally than apically. *Male:* Scutum and scutellum uniformly densely tessellate; first three terga uniformly densely pubescent and micropunctate; longest occipital hairs stiff, less than 0.50 × MOD.

WORKER: *Measurements.* HL 1.13–1.73 (1.20); HW 1.00–1.72 (1.12); SL 1.40–2.00 (1.53); WL 1.9–2.9 (2.1); PW 0.7–1.3 (0.85).

Head: Usually distinctly longer than broad, rarely slightly broader than long, CI 86–103 (93), distinctly shorter than scape, SI 110–131 (128); in frontal view, sides straight and only slightly convergent toward mandibular insertions to gently convex in large workers. Occiput, in frontal view, flat or very slightly convex, abruptly rounded onto sides. Eye small, 0.90–0.96 (0.90) × first flagellomere; OMD 1.60–2.10 (1.88) × EL. Mandible with seven teeth.

Thorax: Slender to moderately robust, PW 0.37–0.46 (0.40) × WL. Propodeum, in profile, evenly curved from base to apex, without well defined basal and posterior faces.

Petiole: Thick in profile, not at all cuneate, summit broadly and evenly rounded; crest, from front, flat or slightly concave, without median notch; from above about 1.5 wider than long.

Vestiture: Pubescence moderately dense on vertex and occiput, sparse elsewhere on head; general on thorax, moderately dense, nowhere obscuring surface; dense on first three terga; fourth tergum sparsely pubescent in small workers, moderately pubescent in larger workers.

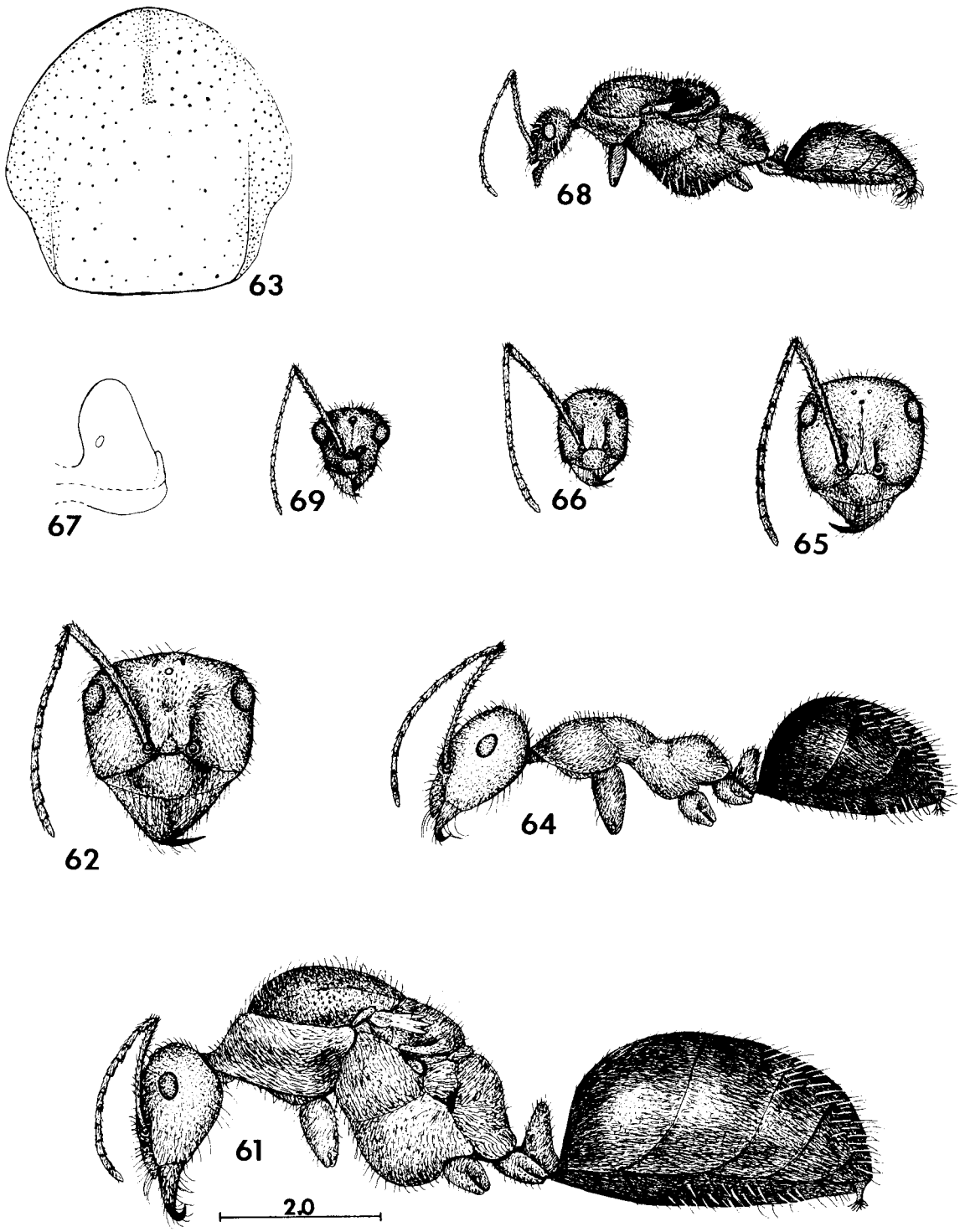
Malar area with more than 10 short, fully erect hairs; occiput with numerous short, straight, stiff, fully erect hairs, longest 0.59–0.64 × MOD; short, stiff erect hairs general elsewhere on head. Promesonotum with numerous uniformly short, stiff erect hairs, longest 0.5 or less × MOD; propodeum with numerous similar hairs on all except posteriorly sloping face. Petiole with numerous short, erect hairs across summit and along sides. First four terga with abundant short, fine hairs, mostly arising from poriform punctures, longest on disc of second about 0.1 mm. Scape, all femoral and tibial surfaces with abundant short, stiff, suberect to erect hairs.

Integument: Head moderately shiny, lightly shagreened; vertex and occiput closely micropunctate and with sparse coarser punctures; frontal lobes with coarse, close punctures; front of head with scattered coarse punctures, sparser on malar area. Thorax dull, densely shagreened and micropunctate. First three terga closely micropunctate and with scattered coarse punctures; fourth tergum similar to third in large workers, shinier, finely shagreened and with scattered coarse punctures in small workers.

Color: Head, thorax and appendages clear ferruginous, gaster medium to dark brownish; legs sometimes slightly brownish.

FEMALE. *Measurements.* HL 1.90; HW 2.00; SL 1.97; WL 4.1; PW 2.9.

Head: A little broader than long, CI 105, sides straight, slightly convergent below; slightly shorter than scape, SI 103. Occiput, in frontal view, gently



FIGURES 61–69. *M. semirufus*. 61, female, lateral view; 62, head of female, frontal view; 63, mesoscutum of female, distribution of punctures; 64, major worker, lateral view; 65, head of major worker, frontal view; 66, head of minor worker, frontal view; 67, petiole of major worker, lateral view; 68, male, lateral view; 69, head of male, frontal view.

convex, broadly rounded onto lateral head margins. Eye small, 1.08 × first flagellomere; OMD 1.50 × EL. OOD 4.7 × OD; IOD 3.8 × OD. Penultimate segment of maxillary palp broadest a little beyond base, gradually tapering to apex which is a little narrower than base. Mandible apparently octodentate (a small denticle present between basal and first subbasal teeth on the right mandible of the one specimen studied, absent on the left mandible).

Thorax: Unusually robust, PW 0.71 × WL. Mesoscutum flattened behind, but scutum and scutellum not aligned to same plane. Basal face of propodeum narrow and broadly rounded onto posterior face.

Petiole: Cuneate, summit narrow, flat; crest, in front view, shallowly, angularly incised.

Vestiture: Cephalic pubescence sparse, densest on vertex and occiput and near mandibular base. Pubescence sparse on scutum and scutellum, conspicuous but not dense elsewhere on thorax, long on propodeum and pleura, Mediobasal portions of dorsum of first tergum and mediobasal area of second tergum sparsely pubescent, otherwise first four terga moderately pubescent, pubescence not obscuring surface, thinner along broad middle area of each segment.

Erect hairs general on face, about 16 erect and suberect hairs present on malar area; longest occipital hairs less than 0.65 × MOD. Erect hairs numerous on scutum, longest about 0.50 × MOD; some scutellar hairs much longer, nearly equal MOD; long pleural hairs sparse, longest about 0.65 × MOD; propodeum with numerous shorter hairs on sides and across basal face. Petiole with numerous short, erect hairs on sides and across crest. Erect discal hairs less numerous on segments beyond first tergum than on that segment, these hairs arising from coarse punctures and longest about twice minimum thickness of hind tibia. Scapes, femora and tibiae with abundant suberect to erect hairs; inner face of fore femur with hairs shorter, finer and sparser than elsewhere on that segment. Fore and hind wings with fringe hairs on apical and posterior margins.

Integument: Frons, on either side of middle, shiny, subpolished and impunctate, head otherwise slightly shiny and distinctly shagreened; vertex and occiput closely micropunctate and with sparse coarse punctures; frontal lobes coarsely, closely punctate; side of face with abundant, variably spaced (0.5–3.0 × puncture diameter) coarse punctures; malar area with sparse, coarse elongate punctures which become finer and denser below; clypeus sparsely, coarsely punctate. Mesoscutum shiny, lightly shagreened, almost polished posteromedially, with scattered coarse punctures; parapsis with sparse coarse punctures, separated by 1–3 puncture diameters, micropunctures absent. Scutellum shiny, lightly shagreened; finely punctate, punctures in middle separated by 1–2 puncture diameters, sparser laterad; with scattered coarse punctures. Pronotum, metapleura and propodeum slightly shiny, densely shagreened and micropunctate. Mesopleura slightly shinier, anepisternum anteriorly densely shagreened and with scattered coarse punctures, posteriorly more lightly shagreened and similarly punctate; katepisternum duller, closely micropunctate and with sparse coarse punctures. First tergum, at summit of declivity, with irregularly scattered coarse and micropuntures dle are separated by more than a puncture diameter and with sparse coarse punctures; middle of disc shiny, with irregularly scattered coarse and micropunctures which become denser caudad and laterad. Broad median area of disc of second tergum shiny, with sparse coarse and micropunctures which become denser caudad and laterad. Third and fourth terga uniformly closely micropunctate and with scattered coarse punctures.

Color: Head and antennae clear ferruginous; thorax light brownish ferruginous, extensive brown areas on scutum, scutellum and propodeum; legs light brownish ferruginous; gaster medium brown. Wings faintly yellowish, subcostal vein brown, remaining veins and stigma pale yellowish.

MALE. *Measurements.* HL 0.90–1.00; HW 0.83–0.97; SL 1.20–1.23; WL 2.3–2.6; PW 1.4–1.6.

Head: A little longer than wide, CI 93–97, distinctly shorter than scape, SI 123–133; in frontal view sides straight, distinctly convergent toward mandibular bases. Occiput, in frontal view, evenly convex, abruptly rounded onto lateral margins. OMD 0.90–1.00 × EL; OOD 2.0–2.4 × OD; IOD 2.8–3.0 × OD. Mandible without preapical notch or subbasal denticles.

Thorax: Robust, PW 0.57–0.62 × WL. Propodeum, in profile, broadly curved from base to apex, without defined basal face and posterior face.

Petiole: In profile, thick, cuneate, summit broadly rounded; crest, in frontal view, slightly concave in middle; from above, about twice wider than long.

Vestiture: Cephalic pubescence extremely dilute, conspicuous only on occiput. Thoracic pubescence extremely dilute over most surfaces, sparse even on pronotum and propodeum where it is most conspicuous. First three terga with sparse pubescence, fourth with only a few hairs.

Cephalic hairs general, stiff, about 8 on malar area, longest about 0.5 × MOD; longest occipital hairs less than 0.5 × MOD. Thoracic hairs stiff, abundant, longest about 0.5 × MOD, a little shorter across base of propodeum. Hairs of crest of petiole slightly longer, slender and acuminate. Hairs of first three terga short, less than 0.5 × MOD, more slender than those of mesoscutum. Scape, femora and tibiae with numerous suberect to erect hairs. Fore wing without fringe hairs; hind wing with a few hairs on posterior margin in basal half.

Integument: Head slightly shiny, densely shagreened and with sparse coarse punctures, occiput and malar area closely micropunctate. Scutum slightly shiny, densely shagreened, sometimes with traces of shinier area on midline; scutellum similar; pronotum and propodeum barely shiny, densely shagreened and closely micropunctate; pleura similar but without

micropunctures; entire thorax with scattered coarse punctures. Gaster slightly shiny, closely shagreened and micropunctate.

Color: Blackish brown, mandibles, antennae and legs light brown. Wings whitish, subcostal vein brownish, remaining veins nearly transparent apicad, becoming pale ferruginous basad.

Terminalia: Figures 169, 181, 189.

Type Material. Originally described from workers from Calif. (San Jacinto) and Colo. (Denver and Pueblo); Wheeler (1908) restricted the type locality to San Jacinto, Calif. At least one specimen from San Jacinto is in the Museo Civico, Genoa, Italy, but not available for study. Another worker, marked as cotype, is in the AMNH and here selected as Lectotype. Other San Jacinto specimens from the same series, but not originally seen by Emery, are in the USNM.

Distribution. Tulare and Inyo Counties, California south to northern Baja California. Desert mountain ranges (Fig. 360).

Localities. UNITED STATES. California: Tulare Co.: Porterville, 12 Sept. 1958 (R. P. Allen; CDA); Alta Meadow, Aug. 1917 (Cornell Univ. Exped.; CU). *Inyo Co.:* 7.6 mi S Big Pine, 4100′, 17 June 1969 (R. R. Snelling, No. 69–225; LACM); Independence, 3925′, 7 June 1939 (R. M. Bohart; LACM); 4 mi W Lone Pine, 18 Mar. 1968 (G. C. & J. Wheeler, No. Calif. 373; GCW). *Kern Co.:* Hwy. 58, 10 mi E Tehachapi, 3 Apr. 1970 (J. L. Johnson, CDA); Red Rock Cyn., 2800′, 22 Aug. 1954 (R. R. Snelling; LACM); 1 mi E Pyramid Hill, 13 June 1970 (R. J. Hamton; RJH); Last Chance Cyn., El Paso Mts., 15 Apr. 1964 (R. R. Snelling; LACM); 10 mi SE Mojave, 23 Mar. 1967 (R. J. Hamton; LACM, RJH). *Los Angeles Co.:* Palmdale, 20 Apr 1965 (R. H. Crandall; LACM); Little Rock, 2900′, 12 Apr. 1952 (W. S. Creighton; LACM); 23 mi NE Pearblossom, 3500′, 12 Sept. 1965 (R. R. Snelling; LACM); 2 mi S Pearblossom, 3500′, various dates (C. Henne, R. R. Snelling; LACM); Llano, 3300′, 11 Apr. 1952 (W. S. Creighton; LACM). *San Bernardino Co.:* Victorville, 28 May 1938 (C. M. Dammers; LACM); 5 mi E Boron, 4 Apr. 1967 (A. Mintzer; LACM); Morongo Valley, 8 Apr. 1952 (G. I. Stage; LACM). *Riverside Co.:* Jumbo Rocks, Joshua Tree Natl. Mon., 20 Mar. 1967 (R. J. Hamton; LACM, RJH); San Jacinto, 27 Nov. (T. Pergande Colln., No. 322; original series of *semirufa,* incl. 1 cotype; AMNH, USNM); Boyd Desert Res. Center, 4 mi S Palm Desert, 10 Apr. 1963 (G. Tamski; CIS); Deep Canyon, 800′–3600′, various dates (G. C. & J. Wheeler; GCW, LACM). *San Diego Co.:* Split Mtn., 500′, Anza-Borrego Desert State Park, 22 Apr. 1952 (W. S. Creighton; LACM). *MEXICO. Baja California:* 6 mi W Las Arrastras de Arriola, 8 June 1967 (E. L. Sleeper & E. M. Fisher; LACM); 10 mi S Cataviña, 29 July 1938 (E. S. Ross & A. E. Michelbacher; CAS).

Ecology. Habitats for this ant include California Oakwoods, Piñon-Juniper Woodland, Great Basin Sagebrush Shrub, Creosote bush-Bur sage Shrub and Creosote bush Shrub. Elevation ranges from 400 feet to about 5000 ft. The majority of the records are from the Piñon-Juniper Woodland to Creosote bush-Shrub ecotone. This is approximately equivalent, in the western Mojave Desert, to the Joshua Tree Woodland of Munz (1974).

Wheeler and Wheeler (1973) reported on this species (as *placodops*) in Deep Canyon. Within the Desert Biome in Deep Canyon, they found colonies distributed as follows: Larrea-Palo Verde Community, 800′ (3); Cholla-Palo Verde Community, 900–1200′ (14); Agave-Ocotillo Community, 2500′ (1). One colony was located at 3600′ in the ecotone between the Desert and Chaparral Biomes. A crateriform tumulus was observed to be about 25 cm external diam., inner rim about 15 cm diameter, the entrance 20–25 mm diam.

Nests studied near Pearblossom were all situated in deep, but well-packed sand at the edge of a wash, as was the one located south of Big Pine. The one found in Last Chance Canyon was sited at the edge of a road, about 20 feet above the bed of Last Chance Creek. The nests were surmounted by low, broad crateriform tumuli composed of sand particles and fine soil.

As with other species of *Endiodioctes, semirufus* is a diurnal forager and is a scavenger. It is also an effective predator; at Pearblossom, returning foragers were bringing in many recently dead insects, mostly leafhoppers (Cicadellidae) and grass bugs (Miridae), but including a few termites, beetles, flies and small wasps and bees. The quantity of recently dead insects strongly suggests active predation.

During the rainy spring and autumn seasons foragers are also active on flowers. At Pearblossom I have seen them on *Malacothrix* (Asteraceae), *Phacelia* (Hydrophyllaceae), *Salvia* (Lamiaceae), *Oenothera* and *Camissonia* (Onagraceae), *Mentzelia* (Loasaceae) and *Cryptantha* (Boraginaceae) during March–May; in September and October the workers are found at the flowers of *Eriogonum* (Polygonaceae) and *Haplopappus* (Asteraceae). The specimens collected near Tehachapi were noted to be on *Isomeris arborea* Nutt. (Capparaceae).

Activity of sexual forms is noted in Table 2.

Discussion. This name has been the subject of considerable confusion, briefly reviewed by Snelling (1969). The original description was based on specimens from San Jacinto, Calif. and Denver and Pueblo, Colo. Wheeler (1908) correctly recognized that two species were represented in Emery's material and restricted the true *semirufus* to the California sample; the Colorado specimens were assigned to his *mendax.* Thus, the type locality was restricted to San Jacinto, Calif. and has priority over the designation of Denver, Colo. by Creighton (1950), repeated by Gregg (1963). Cook (1953) cited both as the type locality.

Unfortunately, Wheeler (1908) then incorrectly applied the name to a very different, wide ranging ant which only superficially resembles *semirufus.* The correct name for "*semirufus*" of Wheeler and subsequent authors is *kennedyi,* except for those misidentifications which apply to still other species. The true *semirufus* is an uncommon species known only from southern California and adjacent Baja California.

Although the females are very different, the workers of this species most closely resemble those of *placodops* and are separable only with difficulty. The records

from Deep Canyon by Wheeler and Wheeler (1973) as *placodops* are based on specimens which I misidentified as that species. In my paper (Snelling 1969) on the *melliger* group I attempted to separate the two by the broader head and more obscurely punctate frontal lobes of *placodops*. The result is far from satisfactory, for some workers of *semirufus* do have the head wider than long, though the percentage of such individuals is much lower in *semirufus* than in *placodops*. That character, at least, is not to be relied upon.

The sculpturation of the frontal lobes is another matter, and I am forced to rely upon it, even though it is not wholly satisfactory.

In most workers of *semirufus* the frontal lobes are shiny and the surface is beset with numerous sharply defined, round punctures, the largest of which are about one-third greater than the smallest. The interspaces vary from as little as one-fourth a puncture diameter to slightly more than a puncture diameter. Similar, but more widely spaced, punctures are usually present on the face between the frontal lobe and the eye; these punctures are less sharp than those of the frontal lobes and the interspaces are distinctly tessellate and less shiny. From these facial punctures emerge short (about 0.06 mm long) stiff, erect hairs. The malar area has scattered coarse punctures which are clearly several times greater in diameter than the hairs arising from them. This is, in fact, generally true: the cephalic hairs arise from punctures conspicuously greater in diameter than the hairs. Between the ocelli of *semirufus* the surface is closely micropunctate; these punctures extend up onto the occiput, continuing back nearly to the foramen. On the occipital summit they occupy the middle one-third or more of the dorsum.

From the above conditions *placodops* differs. The surface of the frontal lobes is dull, often very closely tessellate. When punctures are sharp, their presence is greatly obscured by dense tessellation. Often, however, the punctures are shallow and not well defined. The face, between the eye and the frontal lobe is dull, finely tessellate; as a rule, the only punctures present are the micropunctures from which the pubescence emerges. A few coarse punctures may be present near the inner eye margin and in an arc laterad from the top of the frontal lobe.

The erect hairs of the malar area often arise from poriform punctures. Some of the hairs may emerge from punctures which hardly exceed the diameter of the hairs. In large workers the erect cephalic hairs, except those of the clypeus and frontal lobes, may all arise from such poriform punctures. In small workers these punctures may be present on the occiput.

The area between the ocelli is often not micropunctate in *placodops*. When micropunctures are present, as in *semirufus*, they usually are limited to the ocellar area. Seldom do they extend back to the summit of the occiput and seldom, or never, approach the foramen. When they are present they usually are found only immediately behind the ocelli, not extending laterad as in *semirufus*.

The most common variations of *semirufus* include more tessellate frontal lobes, a sporadic nest variant, weakening of facial punctures (Morongo Valley and some Deep Canyon samples) and weakening of occipital micropunctures (Morongo Valley and sporadic nido-variants elsewhere). In general these cephalic characters, even though they must be studied with care, seem to be the only effective means of separating workers. In color the two are similar, but *semirufus* often lacks dark areas on the thorax. Some samples, especially those from Deep Canyon and Independence, are fully as dark as *placodops*.

The distribution of *semirufus* appears to lie wholly to the west of that of *placodops*. They may become sympatric in the mountain ranges of the central Mojave Desert.

Mimicus Group

Myrmecocystus (Endiodioctes) depilis Forel

Figures 73–82, 158, 170, 182, 190

Myrmecocystus melliger var. *depilis* Forel 1901. Ann. Soc. Entomol. Belg. 45:135. ♀; Cole 1934. Ann. Entomol. Soc. Amer. 27:402.

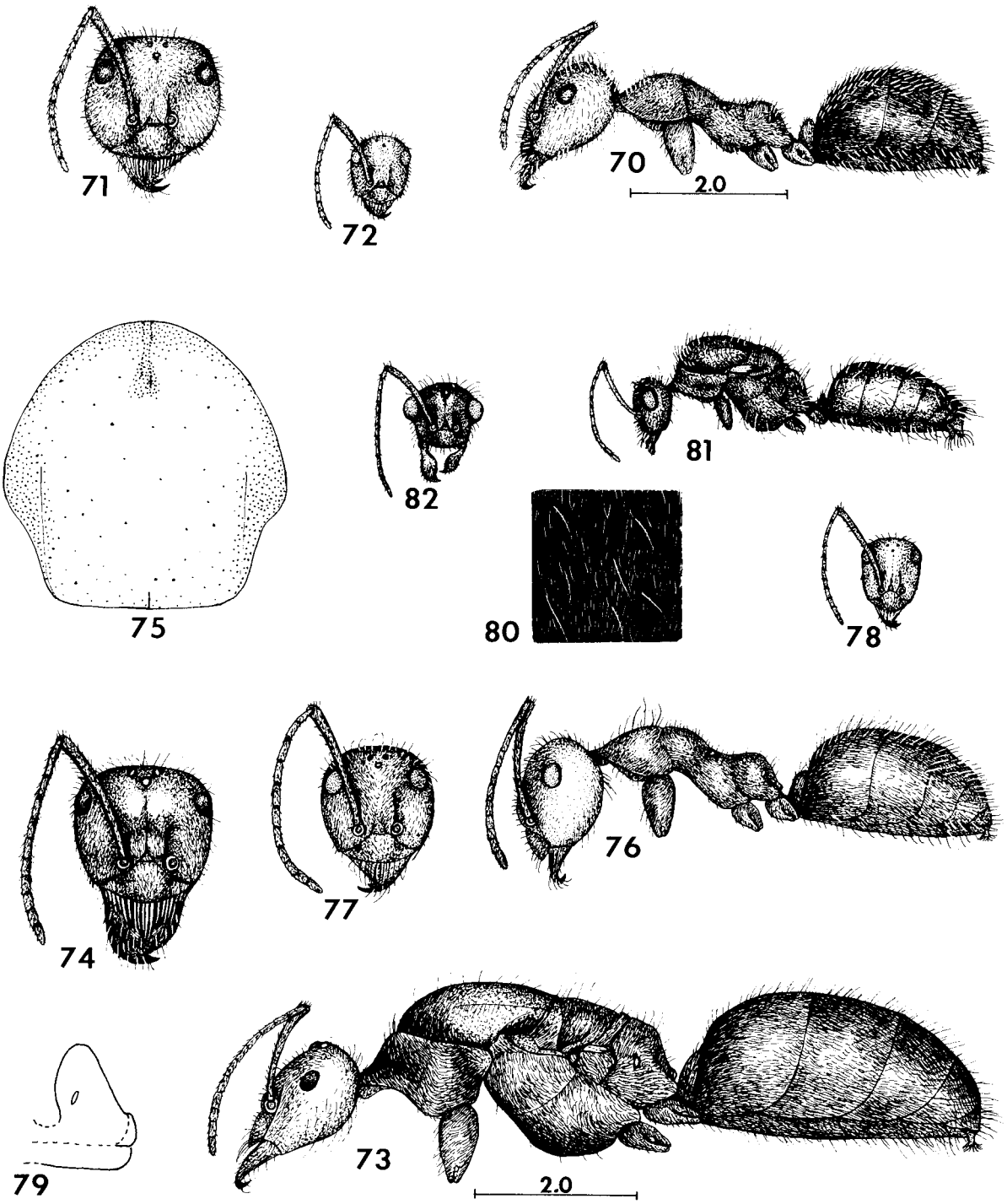
Myrmecocystus melliger subsp. *mimicus* var. *depilis*, Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:354. ♀ *(in part)*; Wheeler 1913. Psyche 19:173; Cook. 1953. The ants of California 342–343 *(in part)*.

Myrmecocystus mimicus, Creighton 1950. Bull. Mus. Comp. Zool. 104:446–448 *(in part)*; Cazier and Statham 1962. Jour. N.Y. Entomol. Soc. 70:125–149 *(in part)*; Cazier and Mortenson 1965. Jour. Kans. Entomol. Soc. 38:19–44 *(in part)*.

Diagnosis. Worker: Malar area with few or no erect hairs in frontal view; gaster blackish, head and thorax extensively infuscated; some pronotal hairs longer than EL in large workers; large workers with abundant, medias and minors with scattered, pubescence on disc of third tergum. *Female:* OMD 1.6 or more × EL; longest occipital hairs about equal MOD, longest scutal hairs about 0.5 × MOD; parapsis closely, uniformly punctate; malar area with fewer than eight erect hairs. *Male:* Posterior half of mesoscutum very superficially tessellate; gastric pubescence very sparse; longest occipital hairs about 0.75 × MOD; longest scutal hairs less than 0.75 × MOD; OMD 1.13–1.54 × EL.

WORKER. *Measurements.* HL 0.90–1.53; HW 0.77–1.50; SL 1.10–1.67; WL 1.3–2.3; PW 0.6–1.0.

Head: Distinctly to slightly longer than broad, CI 80–98 (89), shorter than scape, SI 105–128 (120); sides of head, in frontal view, straight in small workers, slightly convex in large workers, slightly convergent toward mandibular base. Occiput, in frontal view, gently and evenly convex in small, medially flattened in large workers. Eye small, 0.89–1.36 × first flagellomere; OMD 1.45–2.00 × EL. Mandible with seven teeth.



FIGURES 70–72. *M. intonsus*. 70, major worker, lateral view; 71, head of major worker, frontal view; 72, head of minor worker, frontal view. Figs. 73–82. *M. depilis*. 73, female, lateral view; 74, head of female, frontal view; 75, mesoscutum of female, distribution of punctures; 76, major worker, lateral view; 77, head of major worker, frontal view; 78, head of minor worker, frontal view; 79, petiole of major worker, lateral view; 80, major worker, vestiture of third tergum; 81, male, lateral view; 82, head of male, frontal view.

Thorax: Slender, PW 0.40–0.46 (0.43) × WL. Propodeum, in profile, with basal face flat or slightly convex, juncture with posterior face narrowly rounded.

Petiole: In profile, thickly cuneate, summit bluntly rounded; in frontal view, crest evenly rounded, rarely with shallow median notch.

Vestiture: Pubescence sparse on head, abundant on thorax and first three terga (sparse or absent on third tergum in media and minor worker).

Cephalic hairs numerous on frons and occiput, some on occiput exceptionally long, slender and flexuous, subequal to EL; malar area, in frontal view, with at most three widely spaced, erect, short hairs, often none. Promesonotum with numerous erect hairs, some long, slender, flexuous (in large workers equal to or exceeding EL, in small workers usually about equal to MOD); base and side of propodeum with abundant erect hairs, some of which may equal or exceed 0.5 × MOD. Side and crest of petiole with numerous erect hairs, some of which may equal longest of propodeum. Terga with numerous long, erect hairs, longest on disc of second segment more than 0.5 × MOD; longer on apical segments and on sterna. Scape with erect hairs short, sparse, hairs mostly separated by more than twice their length; more abundant on femora and tibiae, but still sparse (those of any row on tibiae mostly separated by about twice their length).

Integument: Head moderately shiny, lightly shagreened, with scattered fine punctures in malar area and on face below vertex; occiput behind ocelli densely, finely punctate; frontal lobes closely, more coarsely punctate. Thorax slightly shiny, lightly shagreened and closely micropunctate, more coarsely so on propodeum. First two terga slightly shiny, lightly shagreened and closely micropunctate; third tergum similar (majors and most mediae) or subpolished and very sparsely punctate (minors and some mediae).

Color: Head, thorax, petiole and appendages medium ferruginous, often almost entirely brownish, but with brownish infuscation at least on vertex, propodeum, petiole and legs; gaster medium brown to blackish brown.

FEMALE: *Measurements.* HL 1.77–1.97; HW 1.83–2.04; SL 1.63–1.73; WL 4.0–4.5; PW 2.2–2.6.

Head: Usually slightly broader than long, CI 100–107, longer than scape, SI 88–93. In frontal view, margins nearly straight, slightly convergent toward mandibular base. Occiput, in frontal view, flattened in middle, sides evenly rounded onto lateral head margins. Eye small, 1.0–1.27 times length of first flagellomere, OMD 1.62–1.93 × EL. IOD 2.9–3.7 × OD; OOD 4.3–5.7 × OD. Penultimate segment of maxillary palp narrow, spindle-shape, narrower at apex than at base. Mandible usually with eight, sometimes with seven, teeth.

Thorax: Robust, PW 0.52–0.59 × WL. Posterior half of mesoscutum and anterior two-thirds of scutellum flattened, scutellum convex behind. Propodeum, in profile, with base narrow, poorly defined, broadly rounded onto posterior face.

Petiole: In profile, compressed-cuneate, crest narrowly rounded; crest, from front, distinctly angularly notched; from above about twice wider than long.

Vestiture: Erect hairs general on head, least abundant on malar area, where fewer than six are present on each side; occipital hairs variable in length, longest about equal to MOD; longest hairs on clypeal disc equal to about 0.5 × MOD. Mesoscutal hairs sparse, short, longest about 0.5 × MOD; scutellar hairs more variable, some about equal to EL; longest pleural hairs about equal to MOD; propodeum with numerous erect hairs on side and across base, longest equal to about 0.5 MOD. Petiole with numerous short, erect hairs on side and crest. Terga with numerous erect hairs, progressively longer on succeeding segments, longest on disc of second segment about equal to MOD. Fore femur without long erect hairs on inner face, a few short, erect hairs near lower margin. Tibiae with numerous suberect hairs which are about as long as minimum thickness of hind tibia. Scape with numerous fine erect hairs on outer and lower faces. Fore and hind wings without fringe hairs.

Pubescence sparse on head, most conspicuous on malar area and occiput; moderately long and dense on most of thorax, inconspicuous on scutum (except on parapsis and along anterior margin), sparse on scutellum; dense on first four terga.

Integument: Head moderately shiny, surface microreticulate; frontal lobes densely punctate, punctures of several sizes; clypeus duller, with scattered coarse punctures; face more sparsely and coarsely punctate than frontal lobes; malar area similar, but punctures denser; occiput finely and densely punctate. Mesoscutum shiny, center of disc impunctate, otherwise disc sparsely punctate, punctures of two sizes, parapsis with uniformly dense fine and irregularly scattered coarse punctures. Scutellum finely punctate, punctures evenly spaced, separated by about a puncture diameter. Mesopleura slightly shiny, with fine punctures separated by one-fourth to one-half a puncture diameter, those of anepisternum a little finer and more uniformly spaced than of katepisternum; metapleura and propodeum dull, roughened, with close, fine punctures and scattered coarse punctures. First four terga densely, finely piligerously punctate, without areas of sparse punctation of discs.

Color: Head light ferruginous, thorax and gaster medium to dark brownish, mesoscutal disc sometimes lighter; antennae and legs light brownish. Wings whitish, subcostal vein dark brownish, remaining veins and stigma yellowish brown.

MALE. *Measurements.* HL 0.83–0.93; HW 0.83–0.97; SL 0.93–1.03; WL 1.83–2.34; PW 1.13–1.30.

Head: Slightly longer than broad to slightly broader than long, CI 96–104, shorter than scape, SI 107–119; in frontal view, sides straight, evenly convergent below;

occiput, in frontal view, evenly convex from side to side, without perceptible lateral angles. OMD 1.13–1.54 × EL; OOD 2.4–3.0 × OD; IOD 2.3–3.0 × OD. Mandible without preapical notch or basal denticles.

Thorax: Robust, PW 0.53–0.64 × WL. Propodeum with narrow basal face broadly rounded onto posterior face.

Petiole: Cuneate in profile, summit narrowly rounded; crest, in frontal view, weakly notched to broadly, shallowly concave.

Vestiture: Pubescence everywhere sparse, more conspicuous on pleurae and sides and base of propodeum.

Pilosity short on frons, longer on malar area and behind eye, longest on occiput, longest occipital hairs about equal to MOD. Mesonotum with numerous erect hairs, longest less than 0.75 × MOD; some scutellar hairs longer, subequal to EL; longest pleural hairs about equal to MOD; side of propodeum with long, flexuous hairs, basal face with shorter hairs. Petiole with short, erect hairs on sides and crest. Gaster with long, flexuous hairs, longer and more abundant caudad. Scape, femora and tibiae with abundant erect to suberect short, stiff, acuminate hairs. Wings without fringe hairs on apical or posterior margins.

Integument: Head moderately shiny, distinctly shagreened, more distinctly so on malar area and gena; with scattered, obscure, piligerous punctures. Discs of scutum and scutellum shiny, very superficially shagreened, parapsis duller, more sharply shagreened. Pronotum, pleurae and propodeal base and sides duller, distinctly shagreened; disc of propodeum shiny and smooth. Most of dorsum of first tergum and narrow discal areas of second and third terga, nearly smooth, shiny and very superficially shagreened; remainder of these and other segments duller, more distinctly shagreened; all segments with scattered piligerous punctures.

Color: Blackish brown; mandibles, antennae and legs medium brown. Wings whitish, veins and stigma pale brownish.

Terminalia: Figures 170, 182, 190.

Type Material. Two cotypes from Pacheco, Zacatecas, Mexico, no date, collected by W. M. Wheeler. One, without gaster, selected as Lectotype, is in the MNHG; the other is in the AMNH.

Distribution. Western Texas to southern Nevada, south to central Mexico (Fig. 363).

Localities: UNITED STATES. Texas: El Paso Co.: El Paso, 11 July 1917 (LACM); Sierra Blanca, 8 July 1917 (LACM). *Ward Co.:* Monahans, 4 Dec. 1901 (W. M. Wheeler; AMNH, LACM, MCZ). *Pecos Co.:* Ft. Stockton, 8 July 1917 (Cornell Univ. Exped.; CU); same locality, 9 Dec. 1901 (W. M. Wheeler, AMNH). *Brewster Co.:* Garden Spring, Marathon, 12, 14 July 1933 (W. S. Creighton; LACM); Chisos Mts., 4000′, no date, (W. B. Phillips; AMNH); 37 mi SW Alpine, 4000′, 19 Aug. 1967 (R. R. Snelling, No. 67–248; LACM); 5 mi E Alpine, 15 May 1965 (A. E. Lewis; LACM). *Val Verde Co.:* Del Rio, 2 June 1902 (W. M. Wheeler; AMNH, GCW); same locality, 3 July 1917 (Cornell Univ. Exped.; CU). *New Mexico: Sierra Co.:* Truth or Consequences, 4240′, 31 Mar. 1962 (LACM). *Otero Co.:* Alamogordo, 4320′, 1–2 July 1917 (W. M. Wheeler; MCZ); same locality, no date (G. von Krockow; AMNH, MCZ); White Sands, 3 May 1960 (J. Durkin; USNM). *Doña Ana Co.:* Aden, 12 July 1917 (Cornell Univ. Exped.; CU); same locality and date (W. M. Wheeler; MCZ); Jornada Experimental Range, 4000′, various dates and collectors (CAK, LACM); Mesilla Park, 12 July 1917 (W. M. Wheeler, J. Bequaert; MCZ). *Luna Co.:* Deming, 10 July (T. D. A. Cockerell, No. 1354; AMNH); 23 mi S Deming, 24 Aug. 1959 (G. C. & J. Wheeler, N. Mex. No. 2; GCW). *Grant Co.:* Lordsburg, 13 July 1917 (LACM); same locality, 1 May 1942 (A. L. Melander; LACM). *Hidalgo Co.:* 22 mi N Rodeo, 4500′, 13 Aug. 1967 (R. R. Snelling; LACM); Rodeo, 3900′, 13 Apr. 1910 (S. J. Hunter, No. 1885; MCZ). *Arizona. Cochise Co.:* Bowie, 14 July 1917 (W. M. Wheeler; MCZ); Benson, 3600′, 9, 20 Nov. 1910 (W. M. Wheeler; AMNH); Portal, 30 Mar. 1973 (R. Duffield; LACM); same locality, 5 Aug. 1955 (W. Gertsch & E. Ordway; AMNH); 2.5 mi NE Portal, 4–19 Aug. 1959 (M. Cazier & M. Statham; AMNH, LACM); 5.3 mi NE Portal, 9 Mar. 1962 (M. Cazier; AMNH, LACM); 6.1 mi NE Apache, 4550′, 14–15 Aug. 1967 (R. R. Snelling, No. 67–225; LACM); nr. Douglas, 11 Oct. 1964 (R. R. Snelling; LACM); 25 mi E Douglas, 4000′, 24 Sept. 1951 (W. S. Creighton; LACM). *Pima Co.:* Pantano, 6 July 1950 (W. S. Creighton; LACM); Tucson, numerous dates and collectors (AMNH, GCW, LACM, MCZ). *Maricopa Co.:* Phoenix, May 1905 (W. M. Wheeler; AMNH). *Nevada: Clark Co.:* Sandy, 2600′, 13 Mar. 1960 (G. C. & J. N. Wheeler, No. Nev. 625; GCW). *MEXICO. Coahuila:* 11 mi W Rosa, 4000′, 14 Mar. 1953 (W. S. Creighton; LACM); 47 mi W Rosa, 4200′, same date and collector (LACM); 20 mi N Saltillo, 4000′, 5 Feb. 1952 (W. S. Creighton; LACM). *Nuevo León:* Las Margaritas, km. 689, Hwy. 57, 11 Aug. 1965 (Cornell Univ. Mex. Field Party; CU). *San Luis Potosí:* El Huizache, 4500′, 25 Apr. 1953 (W. S. Creighton; LACM); Hwy. 80, 6 mi W Ciudad del Maiz, 5000′, 11 July 1973 (R. R. Snelling, No. 73–80; LACM). *Chihuahua:* 2 mi S Parral, 5500′, 2 May 1953 (W. S. Creighton; LACM); 12 mi S Samalayuca, 10 July 1964 (J. A. Chemsak & J. Powell; UCB). *Sonora:* 4 mi S Sasabe, 3300′, 13 Sept. 1951 (W. S. Creighton; LACM); Rancho Bamori, 1400′, 18 Apr. 1957 (W. S. Creighton; LACM); 24 mi W Los Vidrios, 900′, 1 Jan. 1963 (W. S. Creighton; LACM); 16 mi N Punta Peñasco, 300′, 1 Nov. 1952 (W. S. Creighton; LACM); Cholla Bay, Punta Peñasco, same date and collector (LACM); Cabo Tepoca, 4 Feb. 1972 (E. M. Fisher; LACM). *Durango:* 18 mi S Lerdo, 4300′, 15 Mar. 1953 (W. S. Creighton; LACM); 26 mi S Lerdo, 4700′, same date and collector (LACM). *Zacatecas:* "Pacheco," no date (W. M. Wheeler; cotypes of *M. melliger* var. *depilis* Forel; AMNH, MHNG). *Jalisco:* 5 mi N Encarnación, 6200′, 31 Mar. 1953 (W. S. Creighton; LACM).

Ecology. Known habitats for this species range from Creosote bush Desert to Trans-Pecos shrub savannah in the United States, with the bulk of the records in Grama-Tobosa Shrubsteppe. Since many records attributed to *mimicus* by Wheeler (1908, 1913) and Creighton (1950) are actually based on this species, it follows that many of their behavioral observations refer to *depilis*. The notes on "*mimicus*" by Cazier and Statham (1962) are also based on *depilis*. These investigators studied *depilis* in southeastern Arizona. Their study area was on an alluvial fan comprised primarily of silt, sand and soil up to a depth of 12 inches underlaid by caliche. The principal cover was tarbush, *Flourensia cernua* D.C., with an open stand of creosote bush, *Larrea tridentata* (D.C.) in the northern half of the plot.

In the study plot (about 50,184 sq. yds.) more than 60 nests were present. Distances between individual colonies ranged from 14 to 132 feet, the average being 49 feet. Of 42 colonies studied, 19 had asymmetrical entrance holes; the average east-west diameter was 1.30 in. and the average north-south diameter 0.92 in. The 23 with more symmetrical entrances averaged 0.93 and 0.84 in. respectively. Of those with measurable tumuli 10 of the asymmetrical nests had tumuli averaging 7.17 in. in diameter. The tumuli were found to be rounded craters consisting of small or medium sized pebbles and soil, surrounded by discarded bits of plants, insects and miscellaneous debris.

Maximum foraging activity during the observation period (2 Aug.–12 Sept. 1959) took place when there had been a rain on the preceding night and daytime temperatures were between 80° and 98° F. or on warm, overcast days threatening rain. Both individual wandering and directional column foraging were noted. Ants were not found visiting flowers for nectar during August and September, but were found to bring back large amounts of dead and living arthropods. By contrast, during October and November, they were seen to be ". . . feeding on or gathering the pollen and nectar from at least two plants, *Parthenium incanum* H.B.K. and *Euphorbia albomarginata* Englm. and may have been getting honey-dew from a species of Aphid . . . on the latter plant."

These authors show that the scarabaeid beetle *Cremastocheilus stathamae* Cazier is regularly associated with this *Myrmecocystus*; and *C. constricticollis* Cazier was found once. Bombyliid flies were seen to apparently oviposit at the nest entrances and an unidentified dipterous larva was present in material excavated from a nest. Case-bearing chrysomelid beetle larvae, possibly of the genus *Saxinus*, were found just inside the nest entrance on 11 Sept.

Cazier and Statham found repletes present in the colonies which they studied. The author has collected them from a nest excavated 6.1 mi NE of Apache, Arizona. Known activity of the reproductive forms is summarized in Table 2.

Discussion. This ant has been repeatedly confused with *mimicus*. Curiously, Wheeler (1908) listed this as a variety of *mimicus*, although *depilis* had a priority of seven years! The two ants are superficially similar, but media and major workers of *depilis* always possess long, slender flexuous hairs on the pronotum, some of which equal or exceed EL. Also, the third gastric tergum usually has conspicuous appressed pubescence, except in the smallest workers. The minor workers are more difficult to separate, but those of *depilis* possess hairs of very variable length on the pronotal dorsum, a few of which are exceptionally long, about three times as long as the shortest hairs. In *mimicus* minors the pronotal hairs are uniform in length.

Much more vexatious is the problem of distinguishing between this and *nequazcatl* for the two appear to be closely related. The head and thorax are consistently and uniformly light ferruginous in *nequazcatl* workers, light to dark brownish in *depilis*. Erect hairs are less abundant on the scape of *depilis* workers, those of any row for the most part separated by more than their own lengths; the hairs are more numerous and closer in *nequazcatl*. The longest pronotal hairs are as long as, or exceeding, the eye length in *depilis*, about as long as the minimum eye diameter in *nequazcatl*.

The sexual forms of the two species are very similar, but those of *depilis* have shorter occipital hairs in the female and the mesoscutal hairs of both sexes are shorter. In females of *depilis* the eye is smaller, EL 1.00–1.27 × IF (EL 1.40 × IF in *nequazcatl*). Males of *depilis* also have somewhat smaller eyes, OMD 1.13–1.54 × EL (OMD 0.78–1.00 × EL in *nequazcatl*). These differences, although slight, appear to be consistent. The ranges of the two species become quite close in coastal areas of Sonora, Mexico, and there is no evidence to suggest that the characters tend to break down in these areas.

Myrmecocystus (Endiodioctes) mimicus Wheeler

Figures 83–91, 159, 179, 183, 191

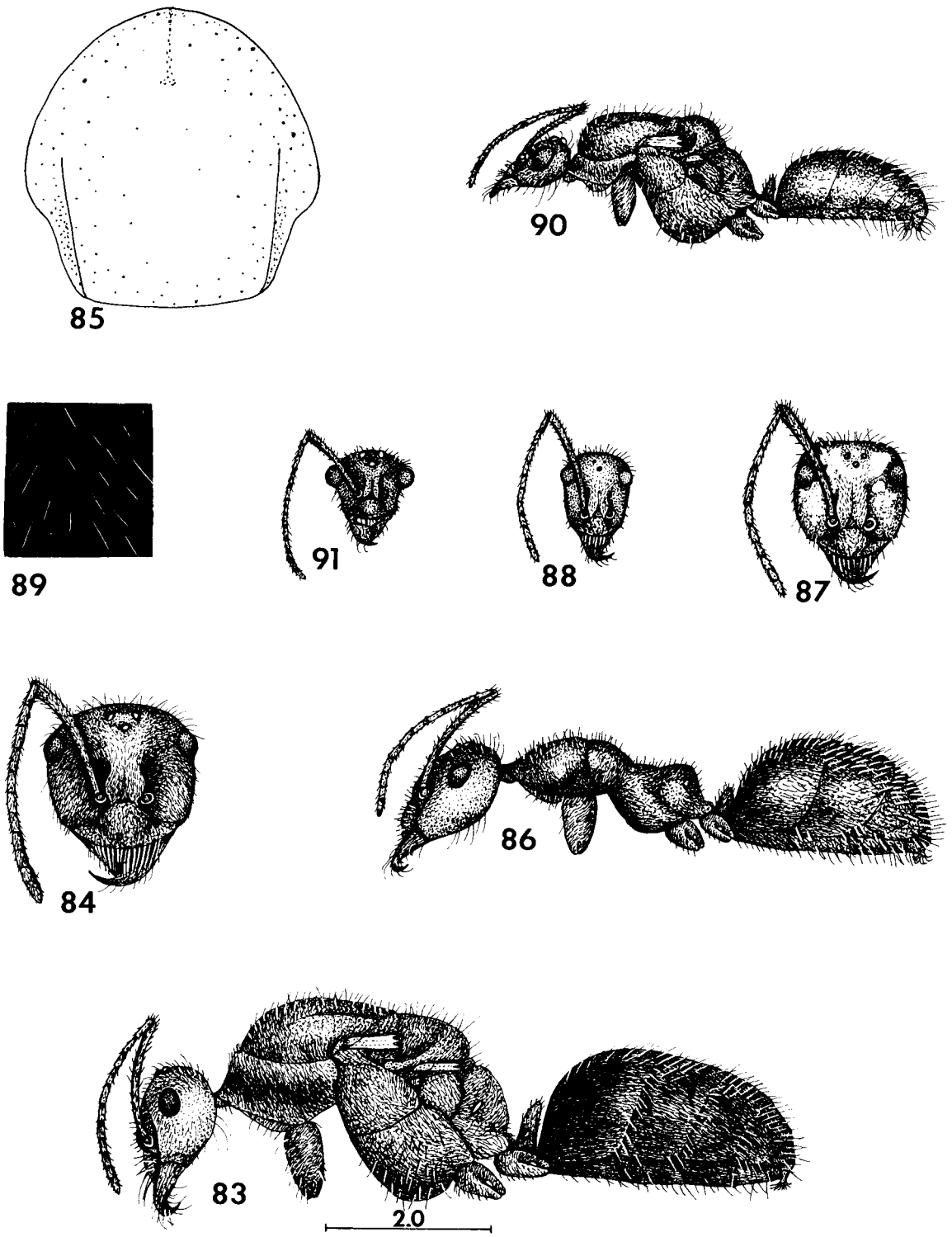
Myrmecocystus melliger subsp. *mimicus* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:353. ♀ ♀ ♂ *(in part);* Wheeler 1912. Psyche 19:174, 176 *(in part);* Wheeler 1917. *Ibid.* 24:180–132; Cole 1934. *Ibid.* 41:401–402; Smith 1936. Journ. N. Y. Entomol. Soc. 44:170; Mallis 1941, So. Calif. Acad. Sci., p. 20; Cook 1953. Ants of California, p. 344 *(in part).*

Myrmecocystus melliger mimicus var. *jesuita* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:354. ♀; Wheeler 1912. Psyche 19:174; Smith 1936. Jour. N. Y. Entomol. Soc. 44:170.

Myrmecocystus melliger subsp. *lomaensis* Wheeler 1912. Psyche 19:174, 175; Mallis 1940. Bull. So. Calif. Acad. Sci. 20; Cook 1953. The Ants of Calif., 343.

Myrmecocystus mimicus, Creighton 1950 Bull. Mus. Comp. Zool. 104:446–447. *(in part);* Cole 1954. Jour. Tenn. Acad. Sci. 29:285 *(in part);* Cole 1966. Sci. Bull., Brigham Young Univ. 7:22; Wheeler and Wheeler 1968. Ann. Entomol. Soc. Amer. 61:213 (larva); Wheeler and Wheeler 1973. Ants of Deep Canyon, pp. 124–125.

Diagnosis. Worker: Malar area with fewer than ten erect hairs, usually on lower half only; frons and vertex smooth, shiny, with little or no pubescence; third tergum with sparse pubescence only; pronotal hairs short, stiff, blunt. *Female.* Malar area with few or no standing hairs; first three terga uniformly, densely micropunctate; parapsis variably bipunctate; punctures of vertex sparse; alitrunk brownish ferruginous. *Male.* First three terga smooth, shiny, without conspicuous pubescence; mesoscutum polished and shiny, at least



FIGURES 83–91. *M. mimicus*. 83, female, lateral view; 84, head of female, frontal view; 85, mesoscutum of female, distribution of punctures; 86, major worker, lateral view; 87, head of major worker, frontal view; 88, head of minor worker, frontal view; 89, major worker, vestiture of third tergum; 90, male, lateral view; 91, head of male, frontal view.

in part; parapsis densely shagreened and micropunctate; pleural hairs at least 0.11 mm long; wings without fringe hairs.

WORKER. *Measurements.* HL 0.95–1.67 (1.20); HW 0.80–1.57 (1.20); SL 1.03–1.70 (1.30); WL 1.5–2.6 (1.8); PW 0.6–1.2 (0.8).

Head: Longer than broad to as broad as long, CI 82–100 (100), slightly shorter than to distinctly longer than scape, SI 97–118 (108); in frontal view, margins straight and slightly convergent toward mandibular base (smaller workers) to distinctly convex and abruptly narrowed below (largest workers); occiput, in frontal view, gently convex in smallest, to flattened in largest, workers, broadly rounded laterally. Eye small, 0.9–1.1 × first flagellomere; OMD 1.34–1.90 (1.83) × EL. Mandible with seven teeth.

Thorax: Moderately robust, PW 0.39–0.47 (0.46) × WL. Propodeum, in profile, higher than long, basal face short and moderately to broadly rounded into posterior face.

Petiole: Scale thick, weakly cuneate, summit broadly rounded, rarely distinctly wedge-shaped; crest, in frontal view, usually evenly rounded, but may be flattened or with a narrow, shallow median notch.

Vestiture: Pubescence sparse to scattered on head, but often noticeable on vertex and occiput; light to moderately abundant on alitrunk; abundant on first two terga, scattered or absent on third; rarely conspicuous on third, but if so, much less dense than on second.

Malar area, in frontal view, with 2–4 erect hairs near base of mandible, occasionally 2 or 3 more hairs between this group and lower eye margin; longest occipital hairs little, if any, more than 0.5 × MOD; pronotal hairs usually slightly shorter; shorter hairs conspicuous on rest of dorsum; sides and crest of petiolar scale with numerous short, erect hairs; discs of terga with abundant short, erect hairs, uniform in length on first three terga, longer beyond; sterna with hairs long, sparse. Scape, femora (including extensor surface) and tibiae with abundant short, erect hairs.

Integument: Head shiny, lightly to hardly shagreened; frontal lobe with fine punctures separated by a diameter or more; frons and vertex with scattered fine punctures; malar area more distinctly shagreened, with scattered fine punctures. Thorax moderately shiny, lightly shagreened and closely micropunctate. First two terga moderately shiny, lightly shagreened, closely micropunctate; third tergum shinier, more lightly shagreened, nearly impunctate, often polished.

Color: Head, alitrunk and appendages light to dark brownish ferruginous, rarely pale ferruginous; gaster blackish-brown.

FEMALE. *Measurements.* HL 1.80–2.00; HW 1.90–2.05; SL 1.60–1.90; WL 3.5–4.4; PW 2.3–2.7.

Head: Sides straight, slightly convergent toward mandibular insertions; head slightly longer than broad to slightly broader than long, CI 97–110; slightly to distinctly longer than scape, SI 84–98. Occiput, in frontal view, evenly arched, without, or with barely perceptible, lateral angle. Eye moderately large, 1.17–1.45 × first flagellomere; OMD 1.10–1.58 × EL; OOD 3.0–5.8 × OD; IOD 2.2–4.0 × OD. Penultimate segment of maxillary palp slightly wider at base than at apex, margins evenly convergent from base to apex. Mandible with seven teeth.

Thorax: Moderately to very robust, PW 0.58–0.69 × WL. Scutum and scutellum strongly flattened. Propodeum with well-defined horizontal basal zone.

Petiole: In profile, compressed-cuneate, apex narrowly rounded; crest, in frontal view, weakly to strongly angularly incised in middle.

Vestiture: Pubescence very diffuse on front of head, denser on occiput and malar area, distinctly longer on malar area than elsewhere on head. On thoracic dorsum, pubescence sparse, conspicuous only on parapsis and scutellum; longer and denser on sides and propodeum. Dense on first four terga, imparting distinct sheen.

Malar area with 1–4 suberect to erect hairs on lower half in frontal view, rarely 1 or 2 on upper half; longest occipital hairs 0.5 or less × MOD, rarely slightly longer. Longest mesoscutal hairs much less than 0.5 × MOD (eastern populations) or exceeding 0.5 × MOD (western populations); longest scutellar hairs subequal to MOD; pleural hairs less than 0.5 × MOD (eastern populations) or about equal to 0.5 × MOD (western populations). Propodeum with numerous erect hairs on base and side, longest in western populations. Crest and side of petiole with numerous short, erect hairs. First four terga with numerous fine erect hairs, on second segment up to 0.16 mm in eastern populations and up to 0.12 mm in western populations; longer on last segments and on sterna. Appendages with numerous decumbent to fully erect, short hairs, usually absent from posterior surface of scape; inner face of fore femur with short, suberect hairs abundant on distal half only. Wings without marginal fringes.

Integument: Clypeus slightly to moderately shiny, with sparse, coarse punctures; frontal lobes finely punctate in middle, conspicuously more coarsely and sparsely punctate toward margins; malar area with coarse, close, ovoid punctures; front of head coarsely, sparsely punctate, but with narrow to broad impunctate (or nearly so) band between eye and ocellar area; occipital punctures fine, dense. Disc of scutum shiny, with scattered coarse punctures, parapsis finely and densely punctate (punctures may be more separated adjacent to parapsidal line); scutellum uniformly closely and finely punctate. Anepisternum dull to moderately shiny, with close, coarse, ovoid punctures and scattered coarser, round punctures. Katepisternum usually duller, more finely and closely punctate. Propodeum dull, minutely roughened, closely and very finely punctate. Summit of

first tergum densely micropunctate; discs of second and third terga similar to first.

Color: Head and thorax dark reddish brown to medium brownish, gaster blackish; appendages lighter. Wings slightly whitish, veins and stigma yellowish to light brownish.

MALE. *Measurements.* HL 0.80–1.00; HW 0.77–0.97; SL 0.87–1.07; WL 1.7–2.2; PW 1.1–1.3.

Head: A little longer than broad to a little broader than long, CI 95–104, shorter than scape, SI 104–112; in frontal view, occiput evenly convex, without perceptible lateral angle; sides straight, evenly and distinctly convergent toward mandibular bases. OMD 0.70–0.84 × EL; OOD 2.0–3.2 × OD; IOD 1.7–2.8 × OD. Mandible without pre-apical notch, usually without pre-apical teeth, but rarely with one or two low denticles.

Thorax: Robust, PW 0.55–0.64 × WL. Propodeum, in profile, strongly sloping and without discrete basal face.

Petiole: In profile, cuneate, summit sharp; in frontal view, crest distinctly notched.

Vestiture: Pubescence everywhere sparse and inconspicuous, a little more abundant on pleurae and across base of propodeum.

Erect hairs sparse and short on head, those of occiput less than 0.5 × MOD. Scutal hairs even in length, longest less than 0.5 × MOD; scutellar hairs a little longer than those of scutum. Pleural hairs conspicuously longer, many exceeding 0.5 × MOD. Propodeum with short, erect hairs on side and across base. Petiole with short, erect hairs on crest and sides. Terga with hairs short and sparse on basal four segments, longer and more abundant on remaining; longer on sterna. Scape, femora and tibiae with numerous short, suberect to erect hairs. Forewing without fringe hairs; hind wing with fringe hairs on posterior margin.

Integument: Head moderately shiny, lightly shagreened, more densely so on malar area, with scattered fine, obscure punctures. Disc of mesoscutum shiny, lightly shagreened, with subpolished area on posterior portion on either side of midline; parapsis less shiny, more distinctly shagreened, punctures scattered, minute. Scutellum shiny to polished, with scattered fine punctures. Pleura moderately shiny, densely shagreened and with scattered fine, obscure punctures. Propodeum moderately shiny and densely shagreened, but may have subpolished median area. First three terga shiny and lightly shagreened to subpolished and barely shagreened and with scattered micropunctures.

Color: Blackish brown, appendage lighter. Wings whitish, veins and stigma yellowish to brownish yellow.

Terminalia: Figures 171, 183, 191.

Type Material. M. melliger subsp. *mimicus:* Lectotype worker, by present designation and agreeing with above general description and parenthetical data: Albuquerque, New Mexico, May 1905 (W. M. Wheeler) in AMNH. Lectoparatypes in AMNH, LACM, MCZ and USNM.

M. melliger mimicus var. *jesuita:* Lectotype worker, by present designation, agreeing with above general description (HL 1.50; HW 1.40; SL 1.55; WL 2.3; PW 1.0; CI 93; SI 102): Ft. Davis, Texas, 8 June 1902 (W. M. Wheeler) in AMNH. Lectoparatypes in AMNH, LACM, MCZ and USNM.

M. melliger subsp. *lomaensis:* Lectotype worker, by present designation, agreeing with above general description (HL 1.60; HW 1.55; SL 1.55; WL 2.4; PW 1.1; CI 97; SI 97): Point Loma, Calif. (P. Leonard) in AMNH. Lectoparatypes in AMNH, MCZ, USNM.

Distribution. Southwestern Kansas south to Big Bend region of Texas and north-central Mexico, west to Baja California and California (Fig. 364).

Localities. UNITED STATES. Kansas: Kearny Co.: no further locality, July 1962 (M. H. Bartel; USNM). *Morton Co.:* no further locality, 2800′, 5 Aug. 1911 (F. X. Williams; KU). *Oklahoma: Texas Co.:* no further locality, 14 June 1935 (C. T. Brues; MCZ). *Texas: Upton Co.:* Rankin, 10 Apr. 1949 (M. H. Michener; KU). *Jeff Davis Co.:* Ft. Davis, 8 June 1902 (W. M. Wheeler; cotypes of *M. melliger mimicus* var. *jesuita;* AMNH, LACM, MCZ, USNM); Hospital Cyn., Ft. Davis, same date and collector (GCW); Ft. Davis Natl. Mon., 4900′, 20 Aug. 1967 (R. R. Snelling, No. 67–257; LACM). *Culberson Co.:* Fay, 8 July 1917 (CU). *Brewster Co.:* Alpine, 4 June 1902 (W. M. Wheeler; AMNH, GCW); 5 mi E Alpine, 15 May 1965 (A. E. Lewis; LACM); 15.6 mi S Alpine, 4200′, 19 Aug. 1967 (R. R. Snelling, No. 67–251; LACM). *Presidio Co.:* Alamito, 19 Dec. 1901 (W. M. Wheeler; AMNH); W of Marfa, 16 June 1964 (C. D. Johnson; CIS). *El Paso Co.:* 9 mi E El Paso, 4000′, 28 July 1953 (KU). *New Mexico: Rio Arriba Co.:* Alcalde, 1 Aug. 1950 (W. S. Creighton, LACM); Embudo, Sept. (T. D. A. Cockerell; AMNH). *Bernalillo Co.:* Albuquerque, May 1905 (W. M. Wheeler, cotypes of *M. melliger* subsp. *mimicus;* AMNH, LACM, MCZ, USNM); same locality and collector, 28 May 1905 (GCW). *Santa Fe Co.:* 10 mi S Santa Fe, 6500′, 10 Sept. 1951 (A. C. Cole; LACM). *Guadalupe Co.:* Cuervo, 23 June 1940 (L. J. Lipovsky; KU); 0.6 mi S Cuervo, 4700′, 21 Aug. 1967 (R. R. Snelling, No. 67–261; LACM). *Otero Co.:* Alamogordo, no date (G. von Krockow; AMNH, USNM). *Doña Ana Co.:* Jornada Experimental Range, 4000′, various dates (C. A. Kay; CAK, LACM); same locality, 6 Sept. 1972 (R. R. Snelling, No. 72–64, 65; LACM); 28.8 mi W Las Cruces, 4200′, 18 Aug. 1967 (R. R. Snelling, No. 67–247; LACM). *Luna Co.:* 23 mi E Deming, 24 Aug. 1959 (G. C. & J. N. Wheeler, No. N. Mex. 2; GCW); 6 mi NW Deming, 4550′, 20 Aug. 1952 (A. C. Cole, No. H–462; LACM). *Grant Co.:* 7.5 mi W Hachita, 4600′, 17 Aug. 1967 (R. R. Snelling, No. 67–242; LACM). *Hidalgo Co.:* 1 mi W Rodeo, 3 Aug. 1961 (J. G. Rozen; AMNH); Peloncillo Mts., 29 July 1970 (V. Roth; LACM); "Las Truches," 1903 (L. Gerhardt; AMNH). *Arizona: Coconino Co.:* entrance Wupatki Natl. Mon., 5000′, 21 Aug. 1964 (G. C. & J. N. Wheeler, No. Ariz. 46; GCW); Oak Creek Cyn., near Sedona, 22 Aug. 1964 (G. C. & J. N. Wheeler, No. Ariz. 53; GCW). *Yavapai Co.:* Jerome, 9 May 1905 (W. M. Wheeler; AMNH). *Maricopa Co.:* Phoenix, May 1905 (W. M. Wheeler; AMNH); Tempe, May 1905 (W. M. Wheeler; AMNH); 13 mi S Aguila, 2300′, 1 Apr. 1967 (R. R.

Snelling; LACM); Oracle, 24 July 1917 (CU). *Pima Co.:* Tucson, and "desert east of", May 1905, 21–22 Nov. 1910 (W. M. Wheeler, AMNH), 7 mi E Robles Jct., 24 Feb. 1968 (G. C. & J. N. Wheeler, Nos. Ariz. 85, 87, 88; GCW); mouth, Madera Cyn., Santa Rita Mts., 4800′, 24 June 1951 (W. S. Creighton; LACM). *Cochise Co.:* Willcox, 4100′, 6 July 1950 (W. S. Creighton; LACM); Texas Pass [Canyon], 20 July 1917 (W. M. Wheeler; CU, GCW); same locality, 4800′, 11 Aug. 1967 (R. R. Snelling, No. 67–209; LACM); 4.5 mi N Paradise, 5100′, 15 Aug. 1967 (R. R. Snelling, No. 67–231; LACM); 2–5.3 mi NE Portal, various dates (M. Cazier; AMNH); Dry Cyn., 5000′, Whetstone Mts., 21 Aug. 1951 (W. S. Creighton; LACM). *Santa Cruz Co.:* Peña Blanca Spgs., 3800′, 13 June 1951 (W. S. Creighton; LACM); Ruby, 4600′, 25 June 1951 (W. S. Creighton; LACM). *California: Sacramento Co.:* Sacramento, 13, 27 Sept. 1944 (C. A. Hamsher; USNM). *San Joaquin Co.:* Lodi, 18 Aug. 1929 (H. H. Keifer; CDA); Lathrop, 9 Apr. 1968 (R. A. Taylor, *et al.*, CDA). *Stanislaus Co.:* Keyes, 9 Apr. 1970 (R. Vermeulen & T. R. Haig; CDA); Turlock, 25 June 1952, 4 Nov. 1951 (R. R. Snelling; LACM). *Merced Co.:* 12 mi S Merced, 7 Aug. 1967 (R. R. Snelling, No. 67-208; LACM). *Fresno Co.:* Mendota, 20 Mar. 1957 (R. R. Snelling; LACM); 13 mi W of mouth, Panoche Cyn., 5 Mar. 1957 (R. R. Snelling; LACM); Big Panoche Cr., 5 Feb. 1970 (P. A. Opler; UCB); 8 mi SE Huron, 21 Nov. 1955 (R. R. Snelling; LACM); 2 mi E Coalinga, 24 Sept. 1959 (R. R. Snelling; LACM). *San Benito Co.:* 33 mi SE Paicines, 9 June 1971 (R. R. Snelling, No. 71–3; LACM). *Tulare Co.:* Goshen, no date (J. C. Bradley; AMNH). *Kings Co.:* Hanford, 27 Apr. 1965 (D. Taylor; CDA); 7 mi S Armona, 200′, 5 Aug. 1967 (R. R. Snelling, No. 67–204; LACM); Corcoran, 16 Sept. 1955 (R. R. Snelling; LACM); 5.8 mi W Kettleman City, 950′, 25 Mar. 1967 (R. R. Snelling; LACM). *Kern Co.:* 12 mi W McKittrick, 2 May 1952 (S. F. Bailey; UCD); Fellows, 24 Feb. 1965 (F. C. Raney; UCD). *Santa Barbara Co.:* Ventucopa, 2 Mar. 1960 (R. P. Allen; CDA). *Los Angeles Co.:* 1.5 mi S Little Rock, 3500′, 21 Apr. 1969 (R. R. Snelling, No. 69–119; LACM); Pasadena, 29 Mar. 1918 (CU); Whittier, no date (H. J. Quayle; AMNH); Monterey Park, 28 Mar. 1945 (C. A. Hamsher; UCD). *San Bernardino Co.:* Cajon Cyn., 4000′, 7.7 mi NW Cajon, 13 Mar. 1972 (R. R. Snelling, No. 72–4; LACM); Morongo Valley, 11 Apr. 1952 (G. I. Stage; LACM); same locality, 7 Apr. and 13 Oct. 1963 (R. R. Snelling; LACM). *Riverside Co.:* Riverside, no date (H. J. Quayle; AMNH); Black Hill, 3000′, 9 Mar. 1970 (G. C. & J. Wheeler, No. Calif. 859; GCW); 8.6 mi E Temecula, 7 Mar. 1973 (R. M. Duffield, No. A–126; LACM); 9 mi E Temecula, 1200′, 20 Apr., 30 May 1969 (R. R. Snelling, Nos. 69–114, 120; LACM). *Orange Co.:* Silverado Cyn., 1650′, 20 Mar. 1971 (R. J. Hamton; LACM, RJH); El Toro, 31 Oct. 1931 (CDA). *San Diego Co.:* 1 mi N Warner Spgs., 28 Mar. 1963 (R. R. Snelling; LACM); same locality, 3 May 1969 (R. R. Snelling, No. 69–120; LACM); Jacumba, 3000′, 18 June 1952 (W. S. Creighton; LACM); El Cajon, 4 May 1962 (Rinder & Schwege; CDA); San Diego, 1–15 Aug. 1967 (N. Lewis; LACM); Pt. Loma, no date (P. Leonard; cotypes of *melliger* subsp. *lomaensis*, AMNH, AMNH, MCZ, USNM). *MEXICO. Chihuahua:* Samalayuca, 8 Aug. 1950 (R. F. Smith; UCB); 5 mi N Ojo Laguna, 4800′, 6 May 1953 (W. S. Creighton; LACM); Villa Ahumada, 3700′, 28 July 1953 (KU); El Pueblito, 4900′, 3 May 1953 (W. S. Creighton; LACM); 7 mi N Chihuahua, 4700′, 5 May 1953 (W. S. Creighton; LACM); Rio Parral, 3800′, 5 mi S Camargo, 6 May 1953 (W. S. Creighton; LACM); 3 and 6 mi S Gallego, 5100′, 6 May 1953 (W. S. Creighton; LACM). *Morelos:* 6 km E Cuernavaca, 2 Aug. 1963 (P. D. Hurd; UCB). *Sonora:* 20 mi E Altar, 18 Apr. 1957 (W. S. Creighton; LACM); Punta Peñasco, 1 Nov. 1952 (W. S. Creighton; LACM); same locality, 11 Nov. 1966 (R. J. Hamton; LACM, RJH); 4 mi S Sasabe, 3300′, 13 Sept. 1951 (W. S. Creighton; LACM); 6 mi S Sasabe, 3200′ (LACM); 11 mi S Sasabe, 3000′ (LACM); 12 mi S Benjamin Hill, 11 Sept. 1966 (R. J. Hamton; LACM, RJH). *Baja California:* Descanso, 20 May 1952 (W. S. Creighton; LACM); San Vicente, 8 July 1963 (R. L. Langston; UCB); 5 mi S Rosarito, 50′, 14 May 1952 (W. S. Creighton; LACM); 1 mi S Pozo Alemán, 1000′, 23 Feb. 1969 (R. R. Snelling, No. 69–22; LACM).

Ecology. This widely distributed species occurs in a variety of habitats, including the following: Piñon-Juniper Woodland, Oak-Juniper Woodland, Coastal Sagebrush Shrub, Great Basin Sagebrush Shrub, Saltbush-Greasewood Shrub, Creosote bush-Bur sage Grassland, Creosote bush-Tarbush Grassland, California Steppe, Grama-Galleta Steppe, Grama-Tobosa Shrubsteppe, Trans-Pecos Shrub Savannah, and Grama-Buffalo grass Grassland. In southern California the altitudinal range is from sea level to about 4,000 feet.

Mating flights most frequently take place in late afternoon following a soaking rain, but morning flights do occur. Seasonal occurrence of the sexual forms is tabulated in Table 3. According to Wheeler (1917) incipient colonies of this species are pleometrotic, an observation I have never been able to confirm. Although I have discovered numerous founding females, all were in individual burrows. Nor, in the many nests studied, have I ever discovered more than a single fertile female in any of these. Pleometrosis, if it does occur in this species, must be very uncommon.

The brief notes published by Wheeler (1908) are based on more than one species, as he had confused *depilis* and *romainei* with *mimicus*. The nests are commonly located in pebbly or clayey soil, with the latter apparently preferred. Although Wheeler described the tumuli as ". . . regular craters 10–15 cm. across at the base and 3–4 cm. high . . ." his Fig. 13 shows a simple hole in adobe soil with the excavated material thrown out in a low, irregular crescent. In my own experience the usual condition is well illustrated in that photograph. Regularly crateriform tumuli sometimes are constructed, but they are rare. Often, the entrance is concealed in a dense clump of grass (Fig. 354), with the excavated soil cast up about the clump in a manner reminiscent of the irregular superstructures of some *Lasius* and *Formica*. This is the only *Myrmecocystus* studied which commonly has the entrance concealed in a grass clump.

This is a diurnal species, foraging most actively during the middle part of the daylight hours. As with all species of *Endiodioctes*, *mimicus* is a general scavenger. It avidly visits flowers for nectar and has been observed in attendance on aphids. Repletes of this ant were recorded (as *lomaensis*) by Wheeler (1912) from Pt. Loma, California, and I have taken them from nests in various states.

Discussion. The type series of this ant, from Albuquerque, New Mexico, is mixed. It includes workers

here referred to *mimicus* and females and workers of *romainei*. I have seen none of the six males mentioned by Wheeler as part of the type series; the brief description of that caste would apply equally well to either species.

In selecting a Lectotype for this species I have been guided by expediency. The use of this name has been more or less uniformly applied since 1908. In 1950 Creighton placed var. *jesuita* and *melliger* subsp. *lomaensis* in synonymy with *mimicus*. I have chosen as Lectotype, therefore, a specimen which supports these interpretations. The alternative would have been to transfer the name to a wholly different species (*romainei* of this revision) and to resurrect *jesuita* for the species long known as *mimicus*. The former choice is least confusing.

The synonymy of *jesuita* was adequately discussed by Creighton. It is sufficient here merely to state that *jesuita* is the same as *mimicus* in the sense of the present study. When Wheeler (1912) described *lomaensis* he treated it as a subspecies of *melliger*. The characteristics by which it was to be separated from *mimicus*, also regarded as a subspecies of *melliger*, will not hold, as correctly noted by Creighton. However, it should be observed that there are differences between the California form and that of New Mexico and Texas. In both males and females of the eastern populations, the hairs of the mesopleura are uniformly quite short and well separated. The mesopleural hairs in the California populations are variable in length, many hairs up to 0.23 mm long, about twice the length seen in specimens from New Mexico and Texas.

Also noticeable in the sexual forms is relatively smaller eye size. Among the western females the malar area is 1.50–1.58 × the EL; in females from Arizona and New Mexico, the range is 1.10–1.43. A similar situation exists among the males studied: 0.78–0.84 in those from California, 0.70–0.75 in those from eastern parts of the range.

The population differences noted are not confined to the males and females, but they are more obvious in these castes. Western workers *(lomaensis)* do differ from their eastern counterparts. In these, the frontal lobes are more extensively and more abundantly punctate; the punctures extend well up onto the frons and they are mostly separated by two puncture diameters or less. In specimens from New Mexico and Texas the punctures do not extend onto the frons and the intervals between punctures are three to six times a puncture diameter. There is also a tendency among larger workers, in some California samples, to possess more abundant pubescence on the third tergum than is normal. Some samples from the area around Rodeo, New Mexico, are similar.

These differences are interesting, but difficult to interpret. They may represent another example of character displacement. In this case the species displacing against *mimicus* may be the closely related, and broadly sympatric, *depilis*. Over the broad area of sympatry, from southern Arizona to western Texas, both sexes of *depilis* are recognizable from those of *mimicus* by the much longer pleural hairs, up to 0.25 mm long in the females.

It is also possible that the western populations may represent a very closely related species, or, less likely, a subspecies. Before any conclusion can be reached, much additional material, with particular emphasis on the sexual forms, will have to be studied. Such material is not now available.

Kennedyi Group

Myrmecocystus (Endiodioctes) kathjuli new species

Figures 92–99, 160, 172, 185, 193

Diagnosis: Worker: Malar area with few erect hairs; pronotal hairs short, stiff; third tergum with abundant appressed pubescence; gaster black, but with mediobasal yellow blotches on first and second terga; CI usually (over 80%) less than 90; mandible octodentate. *Female:* penultimate segment of maxillary palp more than twice as wide in basal third as at apex; malar area with numerous very long, flexuous hairs; gaster ferruginous; thorax black with extensive ferruginous markings. *Male:* Ventral lobe of aedeagus convex in profile; mesoscutum uniformly tessellate, moderately shiny; petiolar node sharply cuneate, crest, from front, deeply incised; first three terga with abundant pubescence in middle; longest occipital hairs at least 0.75 × MOD; wings without fringe hairs; some mesoscutal hairs exceeding EL.

WORKER. *Measurements.* HL 0.95–1.23 (1.23); HW 0.77–1.17 (1.17); SL 1.17–1.53 (1.53); WL 1.5–2.2 (2.2); PW 0.60–0.90 (0.90).

Head: Distinctly longer than broad in all sizes, CI 82–95 (95) much less than SL, SI 115–132 (124); in frontal view, broadest below level of eyes, sides straight or very slightly convex, hardly narrowed toward mandibular insertions. Occiput, in frontal view, slightly convex, evenly rounded into sides through barely perceptible corners. Eye small, 0.98–1.00 (1.00) × first flagellomere; OMD 1.53–1.89 (1.89) × EL. Mandible with eight teeth.

Thorax: Slender, PW 0.36–0.44 (0.41) × WL. Mesonotum evenly sloping to metanotum. Propodeum higher than long; in profile, wholly convex from base to apex, without defined basal and posterior faces.

Petiole: In profile, broadly cuneate, with rounded crest; from behind, crest flat or gently convex, without median notch.

Vestiture: Cephalic pubescence reduced, sufficiently dense to impart a sheen only on occiput; pubescence moderately dense on thorax and first three terga.

Malar area with six or fewer fine erect hairs; longest occipital hairs little shorter than EL, much exceeding MOD. Pronotum with about 8–12 erect hairs, longest equal to about 0.5 × MOD; mesonotum with about twelve erect hairs, longest less than 0.5 × MOD; propodeum with about an equal number of similar hairs. Crest and sides of petiolar scale with a few fine erect hairs. First three terga with discal hairs sparse, shorter than apical thickness of hind tibia, hairs longer on margins, on succeeding segments and on sterna. Short, erect hairs numerous on anterior and lateral scape surfaces, all surfaces of femora (except inner face of fore femur) and exterior surface of tibiae.

Integument: Head polished and shiny, with scattered fine punctures, coarser and denser on frontal lobes; mandible finely striate and with scattered coarse punctures. Thoracic dorsum moderately shiny, lightly shagreened, sides and propodeum duller, more densely shagreened. Terga slightly shiny, densely shagreened and closely micropunctate.

Color: Head, thorax and appendages clear light ferruginous; gaster blackish brown, first two or three terga with large, yellowish, median blotches.

FEMALE. *Measurements.* HL 1.90–2.00; HW 1.90–2.10; SL 1.17–1.53; WL 1.5–2.2; PW 0.60–0.90.

Head: As broad as long or broader, CI 100–105, slightly longer than scape, SI 95. In frontal view, broadest at level of antennal socket, then convergent toward mandibular insertion. Occiput, in frontal view, gently convex, lateral corners broadly rounded. Eye small, about 1.2 × length of first flagellomere; OMD 1.55–1.75 × EL. OOD 3.0–3.7 × OD; IOD 2.5–2.7 × OD. Mandible with ten or eleven teeth. Penultimate segment of maxillary palp much narrowed apicad, more than twice broader in basal third as at apex.

Thorax: Robust, PW 0.57–0.62 × WL. Posterior half of scutum and anterior half of scutellum forming an even, flattened plane. Basal face of propodeum distinct, sloping toward posterior face which it meets in a weakly defined angle.

Petiole: Compressed in profile, apex very narrowly truncate; in frontal view, crest deeply, angularly incised.

Vestiture: Pubescence sparse over most of head, longer, denser on occiput and malar area, generally appressed, but some on occiput decumbent. Thoracic pubescence dense on pronotum, sides and propodeum, sparse on scutum (but denser on parapsis) and scutellum. First five terga with dense appressed pubescence.

Side of head, in frontal view, with numerous long, flexuous, fully erect, hairs; occipital hairs erect, slender, flexuous, many exceeding EL. Mesoscutum with sparse, fully erect hairs, some of which nearly equal EL; scutellum with some much longer hairs. Pleura with scattered long, erect hairs. Propodeum with numerous erect hairs on basal and lateral faces, longest exceeding EL. Petiole with numerous shorter erect hairs on sides and crest. Terga with sparse erect discal hairs, progressively longer on succeeding segments, those on first segment about equal to apical thickness of hind tibia. Scape with sparse erect hairs on all except posterior face, and abundant subdecumbent to erect, shorter and finer pubescence. Fore femur with numerous erect hairs on posterior and ventral surfaces, with abundant subdecumbent to erect pubescence on anterior and extensor surfaces; mid and hind femora with mixed decumbent to erect pubescence and pilosity; mid and hind tibiae with abundant mixed decumbent to erect pubescence and pilosity, but mostly appressed on flexor surfaces. Wings without fringe hairs.

Integument: Clypeus slightly shiny, integument roughened between coarse, scattered punctures. Front of head shinier, lightly shagreened, with abundant fine punctures, denser and closer on frontal lobes. Broad median area of scutum lightly shagreened and shiny, with scattered fine punctures; nearer parapsidal lines more coarsely punctate, punctures separated by about twice a puncture diameter; parapsis with punctures a little coarser, subcontiguous. Scutellum sparsely punctate in middle, lightly shagreened and shiny. Pleura duller, closely shagreened and with scattered coarse punctures. First tergum lightly shagreened and moderately shiny at summit, with scattered coarse punctures and more numerous but sparse micropunctures. Second and remaining terga duller, shagreened and densely micropunctate.

Color: Head, appendages and gaster ferruginous; occipital area, narrow apical margins of first four terga and sterna and most of fifth segments, brownish. Thorax blackish brown, with pronotum and scutellum mostly ferruginous and with ferruginous blotches posteromedially on scutum and on pleura and propodeum. Wings clear, subcostal vein dark brownish, remaining veins and stigma light brownish.

MALE. *Measurements.* HL 0.83–0.90 (0.90); HW 0.80–0.87 (0.87); SL 0.97–1.07 (1.00); EL 0.28–0.30 (0.30); WL 2.1–2.5 (2.2); PW 1.3–1.5 (1.4).

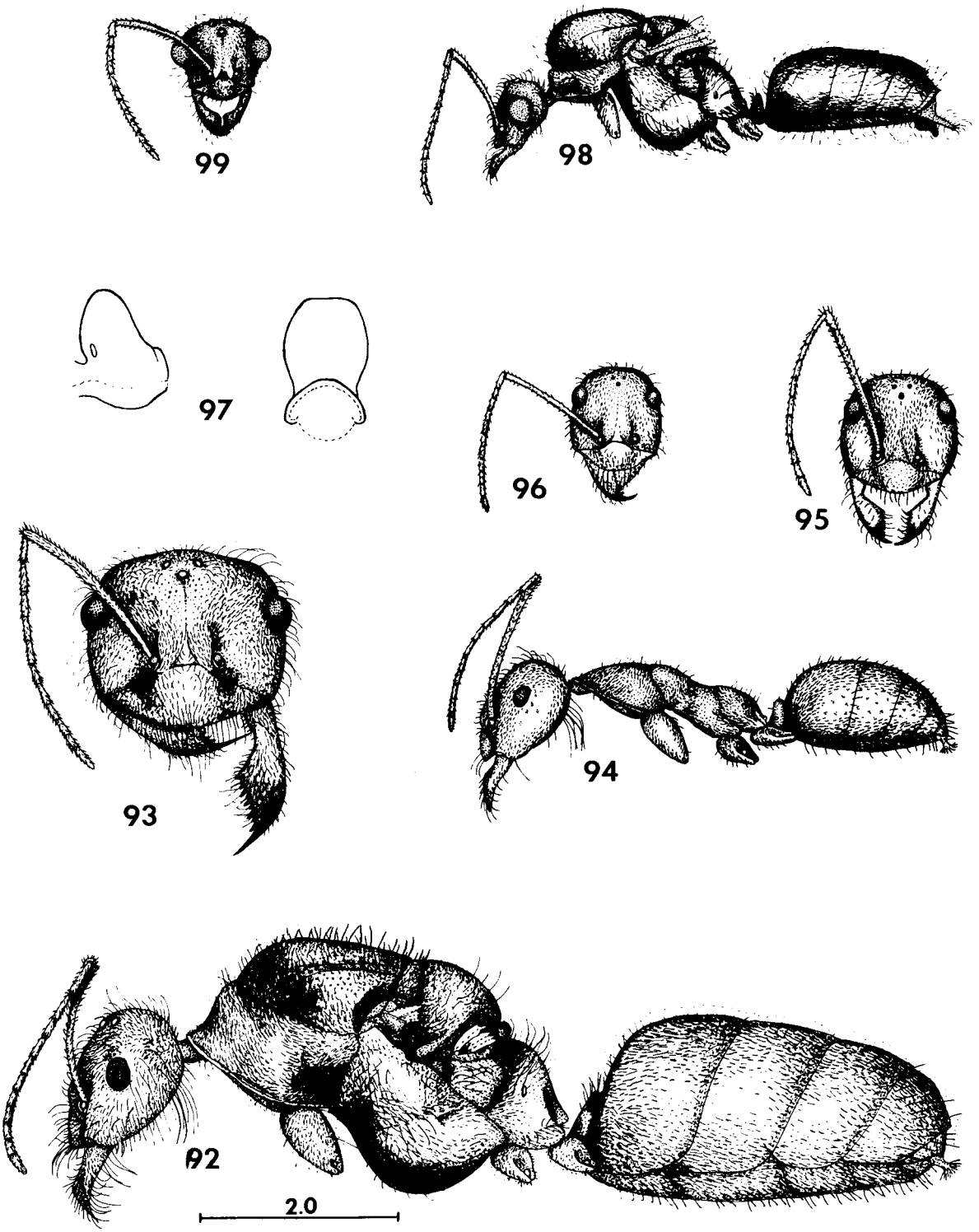
Head: A little longer than broad, CI 93–97 (95); distinctly shorter than scape, SI 111–124 (111); in frontal view, sides straight or slightly concave, slightly convergent toward mandibular insertions; occiput broadly convex and with poorly indicated lateral angles. OMD 0.78–0.89 (0.78) × EL; OOD 2.0–3.2 (3.0) × OD; IOD 2.2–3.2 (2.2) × OD. Mandible without preapical notch, cutting margin edentate or with minute denticle near basal angle (one specimen).

Thorax: Robust, PW 0.59–0.67 (0.64) × WL. Propodeum without basal face.

Petiole: Cuneate in profile, apex sharp; in frontal view, crest broadly, angularly incised.

Vestiture: Pubescence scattered on head and thorax, sufficiently dense on first three terga to form sheen.

Cephalic pilosity long, flexuous, about six hairs on each malar area; longest occipital hairs exceeding EL. Mesoscutal hairs numerous, some about equal to EL;



FIGURES 92–99. *M. kathjuli*. 92, female, lateral view; 93, head of female, frontal view; 94, major worker, lateral view; 95, head of major worker, frontal view; 96, head of minor worker, frontal view; 97, petiole of major worker, lateral (left) and posterior (right) views; 98, male, lateral view; 99, head of male, frontal view.

scutellum with much sparser, but longer, hairs; pleural hairs sparse, some longer than EL; propodeum with sparse hairs on sides and basal half, shorter than those of pleura. Petiole with short erect hairs on sides and crest. Gaster with sparse long, slender hairs. Front of scape with decumbent to erect hairs; remaining surfaces with decumbent to erect pubescence and scattered hairs. Femora with suberect to erect hairs on all surfaces; tibiae with numerous suberect to erect hairs externally, with scattered suberect to erect hairs and abundant decumbent to suberect pubescence on remaining surfaces. Wings without fringe hairs.

Integument: Head moderately shiny, lightly shagreened, with very sparse micropunctures and scattered coarse punctures. Malar area duller, more coarsely and closely shagreened and with a few very coarse, elongate, setigerous punctures. Occiput duller, with numerous, but still sparse, micropunctures. Mesoscutum moderately shiny, sharply shagreened and with scattered coarse punctures. Scutellum shinier, less sharply shagreened, with scattered coarse punctures. Mesopleura slightly shiny, densely and sharply shagreened, with sparse coarse punctures. Propodeum slightly shiny, uniformly shagreened, sparsely, coarsely punctate. Summit of first tergum moderately shiny, sparsely micropunctate; second and third terga duller, more distinctly shagreened and closely micropunctate.

Color: Blackish, antennae and legs medium brown. Wings clear, veins and stigma light brownish, subcostal vein darker.

Terminalia: Figures 172, 185, 193.

Type Material. Holotype worker, allotype male; one female, 94 worker and five male paratypes: Big Rock Wash, 2770′, near Palmdale Blvd., Los Angeles Co., CALIF., 31 Mar. 1972 (J. P. & K. E. Donahue) in LACM. Three worker paratypes in each of the following: AMNH, MCZ, USNM and private collections of GCW, REG.

Etymology. The specific name is compounded from the first four letters of the names of the collectors of the type series, Katherine and Julian Donahue, to whom this species is dedicated.

Distribution. Known at present only from the western Mojave Desert of California (Fig. 365).

Localities. UNITED STATES. California: Kern Co.: Red Rock Cyn., 1 May 1971 (R. J. Hampton; LACM, RJH); Short Cyn., 3500′, 3 Nov. 1967 (R. R. Snelling, No. 67–272; LACM); *Los Angeles Co.:* Lancaster, 2355′, 17 Aug. 1954 (R. R. Snelling; LACM).

Ecology. The few records of this ant are all from Creosote bush desert where Joshua trees *(Yucca brevifolia)* are present. Known elevational amplitude is a little over 1000 feet, extending from 2355–3500′. Nests are constructed in desert washes in deep sand and are surmounted by a low broad crateriform tumulus up to 17 cm in diameter. Foraging is diurnal, and the workers have been collected at floral nectaries. The sexual forms were present in the type series nest on 31 Mar. 1972 and a deälate female was taken on the ground at Red Rock Canyon on 1 May 1971.

Discussion. This species is most similar to such species as *nequazcatl, wheeleri* and *kennedyi.* The characteristics of the female are very similar to those of *wheeleri,* the only other species with a ferruginous gaster in this caste. The female of *wheeleri* is more extensively ferruginous on the thorax than that of *kathjuli,* but this is probably subject to too much variation to be useful. At present only the much longer cephalic and thoracic pilosity of *kathjuli* will separate the females of these species.

The shorter pronotal hairs will distinguish the worker of *kathjuli* from those of *nequazcatl* and *wheeleri;* the bicolored gaster will separate it from these and *kennedyi.* From *kennedyi,* which also has short pronotal hairs, further distinction lies in the consistently broader head of *kennedyi,* CI in excess of 90 in 88% of the specimens studied. No other species in this complex has eight-toothed mandibles.

Pale workers of *flaviceps* resemble this species but are recognized by the more abundant cephalic and thoracic pubescence, hence duller appearance, and broader head, in which CI exceeds 90 in more than 80% of the specimens studied. Also, the range of *flaviceps* in the Mojave Desert lies to the east of that of *kathjuli.*

Myrmecocystus (Endiodioctes) kennedyi Cole

Figures 100–108, 161, 173, 184, 192

Myrmecocystus melliger subsp. *semirufus,* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:355 *(part);* Wheeler 1912. Psyche 19:174 *(part);* Cole 1932. Ohio Jour. Sci. 31:536; Cole 1934. Ann. Entomol. Soc. Amer. 27:392, 402; Cole 1934. Entomol. News 45:100; Cole 1937. *Ibid.,* 48:138; Cole 1938. Amer. Midl. Nat. 20:371; Mallis 1941. So. Calif. Acad. Sci. 40: 20; Cole 1942. Amer. Midl. Nat. 28:386. *(all misidentifications)*

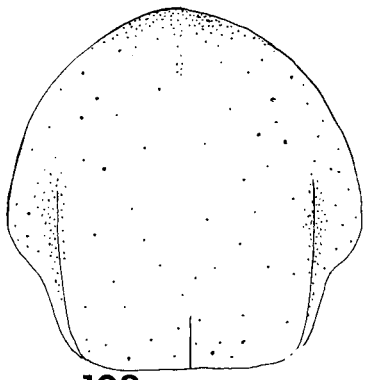
Myrmecocystus melliger subsp. *semirufus* var. *kennedyi* Cole 1936. Entomol. News 47:119. ♀♀♂.

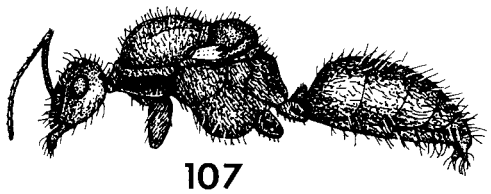
Myrmecocystus semirufa. Creighton 1950. Bull. Mus. Comp. Zool. 104:442, 449 *(in part, misidentification).*

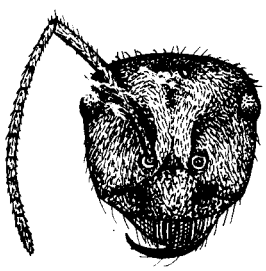
Myrmecocystus semirufus, Cook 1953. The Ants of California, Palo Alto, p. 345 *(in part, misidentification);* Gregg 1963. The Ants of Colorado, Boulder, pp. 643, 653–655 *(in part, misidentification);* La Rivers 1968. Occ. Papers, Biol. Soc. Nev. 17:9 *(misidentification);* Wheeler and Wheeler 1968. Ann. Entomol. Soc. Amer. 61:213 *(larva, misidentification).*

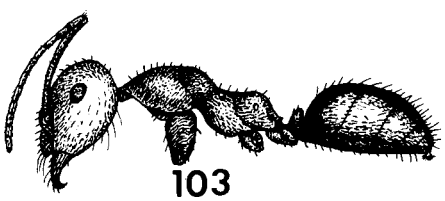
Myrmecocystus kennedyi, Snelling 1969. Contr. Sci., L.A. Co. Mus. 170:6; Wheeler and Wheeler 1973. Ants of Deep Canyon, 122, Fig. 45.

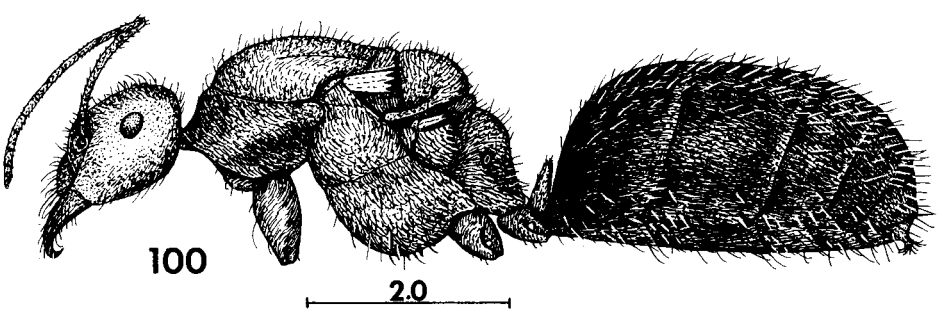
Diagnosis. Worker: Malar area with fewer than three erect hairs in frontal view; head polished, sparsely pubescent; promesonotal hairs short, even in length;











FIGURES 100–108. *M. kennedyi*. 100, female, lateral view; 101, head of female, frontal view; 102, mesoscutum of female, distribution of punctures; 103, major worker, lateral view; 104, head of major worker, frontal view; 105, head of minor worker, frontal view; 106, major worker, vestiture of third tergum; 107, male, lateral view; 108, head of male, frontal view.

third tergum thinly pubescent; CI in excess of 90 in more than 85% of population. *Female:* Mesoscutum with large impunctate median area; parapsis with punctures of two sizes; penultimate segment of maxillary palp slender, parallel sided; malar area with few or no erect hairs; occiput with abundant fine punctures. *Male:* Lower lobe of aedeagus convex in profile; mesoscutum with shiny areas along midline; parapsis mostly polished and shiny; anterior mesoscutal hairs long.

WORKER. *Measurements.* HL 0.87–1.27 (1.17); HW 0.77–1.23 (1.07); SL 1.03–1.47 (1.37); WL 0.9–2.0 (1.6); PW 0.5–0.9 (0.7).

Head: Longer than broad to a little broader than long, CI 80–103 (91) (exceeding 90 in 88% of specimens measured), shorter than scape, SI 109–130 (117); sides, in frontal view straight or gently convex, slightly convergent toward mandibular insertions. Occiput, in frontal view, flat or slightly convex, without perceptible lateral angles. Eye small, 0.9–1.1 × first flagellomere; OMD 1.42–2.25 (1.88) × EL. Mandible with seven teeth.

Thorax: Slender to moderately robust, rarely robust, PW 0.37–0.67 (0.43) × WL; mesonotum, in profile, evenly sloping to metanotum. Propodeum about as high as long, basal face broadly rounded into posterior face.

Petiole: Thick in profile, summit rounded; in frontal view, crest narrow, convex, without median incision.

Vestiture: Pubescence fully appressed, very short, fine and sparse on head, a little more abundant on occiput. Denser on thorax, especially on sides, and propodeum. Dense and fully appressed on first two terga, extremely scattered on third and following segments.

Malar area usually with three or four short, fine, erect hairs near base of mandible, rarely two to four elsewhere; occipital hairs sparse, short, longest hairs equal to about 0.5 × MOD. Erect hairs sparse on thoracic dorsum, longest pronotal hairs not more than 0.5 × MOD. Propodeum with conspicuous erect hairs on basal and lateral faces, all hairs shorter than longest pronotal hairs. Crest and sides of petiole with sparse, short, erect hairs. Erect discal hairs of first two terga numerous, short, about as long as minimum thickness of hind tibia; longer, sparser, on following segments and ventrally. Scape with numerous fine, erect hairs on all except posterior surface, with interspersed subdecumbent to suberect finer pubescence. Femora and tibiae with numerous fine erect hairs on all except inner surface of fore femur.

Integument: Head moderately shiny, very lightly shagreened and with scattered fine, obscure punctures; frontal lobes more coarsely, closely and sharply punctate; clypeus polished, with scattered coarser punctures. Mandibles finely striate and with sparse, fine punctures. Thorax slightly shiny, closely micropunctate and shagreened. First two terga slightly shiny and closely micropunctate; third tergum shiny, almost polished, with scattered micropunctures and finely shagreened.

Color: Head, thorax and appendages clear light ferruginous. Gaster blackish to brownish, rarely with yellowish median blotches on first two terga (see *Discussion*).

FEMALE. *Measurements.* HL 1.57–1.70; HW 1.64–1.87; SL 1.50–1.70; WL 3.4–3.9; PW 2.1–2.4.

Head: Sides straight, slightly convergent toward mandibular insertions; head broader than long, CI 105–109, slightly longer than, to as long as, scape, SI 95–100. Occiput, in frontal view, evenly and rather strongly convex from side to side, with no trace of lateral angles. Eye small, about 1.1 × first flagellomere; OMD 1.46–1.63 × EL. OOD 4.0–5.3 × OD; IOD 3.0–4.0 × OD. Penultimate segment of maxillary palp slender, parallel-sided. Mandible with seven teeth.

Thorax: Moderately to very robust, PW 0.57–0.71 × WL. Scutum and scutellum strongly flattened. Propodeum with strongly sloping basal face.

Petiole: In profile, compressed cuneate, apex acuminate; in frontal view, crest deeply angularly incised.

Vestiture: Pubescence diffuse on front of head and occiput, longer and denser on malar area, especially near base of mandible. Pubescence of thoracic dorsum sparse; longer and denser on sides and propodeum. Dense on gaster, producing noticeable sheen on first three terga, sparser on fourth segment.

Malar area with 1–6 erect hairs visible in frontal view; longest occipital hairs exceeding 0.5 × MOD. Longest mesoscutal hairs subequal to those of occiput; longest scutellar hairs exceeding MOD; longest pleural hairs shorter than those of scutellum. Propodeum with erect hairs about equal to those of mesoscutum present on basal and lateral faces. Petiole with sparse short, erect hairs on crest and sides. Terga with numerous short, fine, erect hairs discally, longer on succeeding segments and on sterna. Appendages with numerous fully decumbent to erect, short, fine hairs, except on posterior surface of scape and inner surface of fore femur, where subdecumbent to suberect pubescence is present. Wings without marginal fringes.

Integument: Clypeus shiny, with scattered coarse punctures; frontal lobes coarsely punctate, punctures separated by about a puncture diameter, interspaces smooth and shiny; except for sparsely punctate area before ocellar triangle, front of head coarsely and closely punctate, punctures separated by 2–3 puncture diameters; malar area with punctures coarse, close, mostly separated by a puncture diameter or less, tending to be linearly arranged, some elongate. Mesoscutum shiny, with scattered fine punctures, center of disc impunctate; parapsis finely punctate, punctures uniform in size, separated by up to twice a puncture diameter. Scutellum finely and sparsely punctate, especially along midline, shiny. Anepisternum moderately shiny, finely and sparsely punctate, interspaces finely shagreened; katepisternum duller, finely and closely punctate. Propodeum dull, finely and closely punctate,

interspaces roughened. Summit of first tergum with dense micropunctures; discs of second and third terga similar.

Color: Head and appendages light ferruginous, gaster blackish; thorax usually mostly light ferruginous, but scutum and pleura may be brownish. Wings light brownish yellow, veins and stigma ferruginous.

MALE. *Measurements.* HL 0.78–0.86; HW 0.73–0.85; SL 0.86–1.03; WL 1.8–2.1; PW 1.0–1.3.

Head: A little longer than broad to as broad as long, CI 94–100, shorter than scape, SI 108–120; in frontal view, sides straight, convergent toward mandibular bases; occiput, in frontal view, evenly arched, with barely perceptible lateral angle. OMD 0.82–1.00 × EL; OOD 2.8–4.0 × OD; IOD 2.5–3.5 × OD. Mandible without preapical notch or basal denticles.

Thorax: Robust, PW 0.56–0.68 × WL. Propodeum evenly sloping in profile, without basal face.

Petiole: Cuneate in profile, summit sharp; in frontal view; crest notched in middle or straight.

Vestiture: Pubescence everywhere sparse, except on pleura.

Pilosity short on front and vertex, a single hair in front of each lateral ocellus longer, exceeding 0.5 × MOD; hairs longer on side of head. Mesoscutal hairs numerous, stiff, longest less than MOD; some scutellar hairs a little longer; pleural hairs abundant, stiff, equal to those of scutum; propodeum with a few longer hairs on each side. Petiole with short erect hairs on sides and crest. Gaster with sparse long hairs. Scape, femora and tibiae with abundant, short, subdecumbent to erect hairs on all surfaces. Wings without fringe hairs on apical or posterior margins.

Integument: Malar area with close fine punctures, head otherwise polished, with scattered micropunctures; discs of scutum and scutellum polished and shiny, with scattered fine piligerous punctures. Pleura slightly shiny, integument roughened between fine punctures which are 2–4 puncture diameters apart. Propodeum moderately shiny and closely micropunctate on side, middle shinier, smooth and nearly impunctate. First three terga subpolished and shiny, with scattered micropunctures only.

Color: Blackish brown, mandibles, antennae and legs light brownish to yellowish. Wings faintly brownish, veins and stigma light yellowish.

Terminalia: Figures 173, 184, 192.

Type Material. Described from all castes from Indian Cove, nr. Hammett, Elmore Co., IDAHO (A.C. Cole). Holotype and paratypes of all castes in LACM. Additional paratypes in AMNH, MCZ, USNM.

Distribution. Southern Idaho and Oregon south to northern Baja California and Sonora; western Utah and Arizona (Fig. 365).

Localities. UNITED STATES. Idaho: Elmore Co.: Indian Cove, nr. Hammett, 12 Apr. 1932 (A.C. Cole, type series of *M. melliger semirufa* var. *kennedyi;* AMNH, LACM, MCZ, USNM); 1.6 mi W Hammett, 2625′, 19 June 1967 (R.R. Snelling, No. 67–169; LACM). *Gooding Co.:* Tuttle, 16 Aug., 27 Aug., 19 Sept. 1930 (USNM). *Oregon: Harney Co.:* Harney Lake Basin, 4200′, 44.2 mi SW Burns, 10 June 1967 (R.R. Snelling, No. 67–133; LACM). *Malheur Co.:* 39 mi W Jordan Valley, 4500′, 20 June 1967 (R.R. Snelling, No. 67–178; LACM). *Lake Co.:* Alkali Lake, 4500′, 9 June 1967 (R.R. Snelling, No. 67–124, 125; LACM). *Nevada: Humboldt Co.:* Massacre L., 14 June 1962 (R.R. Snelling; LACM); Soldier Mdws., 4400′, 2 July 1965 (R.C. Bechtel; NDA). *Pershing Co.:* 10 mi S Lovelock, 13 May 1951 (I. LaRivers, No. 1210; USNM). *Washoe Co.:* Mullen Gap, 1550′, 5 mi W Pyramid L., 18 May 1952 (I. LaRivers; USNM); Nevada Dominion Mine, 5 mi W Pyramid L., 8 May 1951 (I. LaRivers; USNM); Pinnacles, n. end Pyramid L., 28 Mar. 1952 (I. LaRivers; USNM); Pyramid L., no date ("E.J.N."; USNM); Lemmon Valley, 25 May 1968 (G.C. & J. Wheeler, No. Nev. 325; GCW); 2.8 mi W Wadsworth, 30 June 1963 (G.I. Stage; LACM); 6 mi N Nixon, 26 June 1965 (G.I. Stage; LACM). *Churchill Co.:* nr. Fallon, 25 Mar. 1956 (I. LaRivers; USNM); 3 mi E Fallon, 4000′, 29 Apr. 1965 (R.C. Bechtel; NDA). *Lyon Co.:* 2.5 mi N Smith, 7 Sept. 1965 (G.I. Stage; LACM). *Mineral Co.:* n. end Walker L., 11 Mar. 1964 (R.C. Bechtel; NDA). *Nye Co.:* 7 mi S Currant, 5000′, 2 Aug. 1969 (O. Shields & T. Emmel, No. 242b; LACM); Potts, 6700′, 27 Sept. 1966 (R.C. Bechtel & P.C. Martinelli; NDA). *Clark Co.:* Riverside, 1600′, 2 Apr. 1970 (G.C. & J. Wheeler, No. Nev. 698; GCW); Nelson, 3200′, 11 Apr. 1964 (R.C. Bechtel; NDA). *Utah: Washington Co.:* 5 mi S St. George, 2900′, 4 Aug. 1969 (R.R. Snelling, No. 69–236; LACM). *California: Lassen Co.:* 18 mi S Ravendale, 14 June 1962 (R.R. Snelling; LACM); 5.3 mi NE Litchfield, 4200′, 14 June 1969 (R.R. Snelling, No. 69–200; LACM). *Mono Co.:* 15 mi N Bishop, 4500′, 2 May 1971 (R.J. Hampton, *et al.;* LACM, RJH). *Inyo Co.:* Sand Spg., 3100′, Death Valley, 7 Mar. 1968 (G.C. & J. Wheeler, No. Calif. 328; GCW). *Kern Co.:* 6.5 mi S, 5 mi W Inyokern, 2 May 1970 (L. Lester; LACM). *Santa Barbara Co.:* Ventucopa, 2 Mar. 1960 (R.P. Allen; CDA, LACM). *Los Angeles Co.:* Llano, 9 Mar. 1957 (R.R. Snelling & M.D. Stage; LACM). *San Bernardino Co.:* Twentynine Palms, 2000′, 6 Nov. 1967 (R.R. Snelling; Nos. 67–288, 289; LACM); 10.7 mi N Earp, 375′, 2 Apr. 1967 (R.R. Snelling; LACM); Needles, no date (W.M. Wheeler; USNM); Dry Morongo Cyn., Morongo V., 7 Apr. 1963 (R.R. Snelling; LACM). *Riverside Co.:* Whitewater, 26 Oct. 1952 (R.F. Smith & E.G. Linsley; CIS); 5 mi NW Indio, 28 Oct. 1952 (R.F. Smith & E.G. Linsley; CIS); 5 mi W Indio, 16 Mar. 1963 (R.R. Snelling & R.H. Crandall; LACM); 5 mi E Thousand Palms, 100′, 16 Feb. 1963 (W.S. Creighton; LACM); Palm Springs, 23–25 Mar. 1919 (J.C. Bradley; CU, USNM); 3 mi E Mecca, 13 Apr. 1963 (R.R. Snelling; LACM); Palm Desert, 6 Dec. 1967 (G.C. & J. Wheeler, No. Calif. 276; GCW); 18 mi W Blythe, 21 June 1963 (F.D. Parker & L.A. Stange; UCD); Blythe, 4 July 1964 (Killgore; CDA); Indian Wells, 21 Sept. 1934 (H.H. Kiefer; CDA). *Imperial Co.:* Sandhills Hwy. Maint. Sta., 150′, 24 Oct. 1952 (W.S. Creighton; LACM); Glamis, 26 Nov. 1967 (M. Wasbauer; CDA); nr. Gray's Well, 22 June 1963 (R.L. Westcott; LACM). *Arizona: Maricopa Co.:* Phoenix, May 1905 (W.M. Wheeler; AMNH, MCZ). *Mohave Co.:* Yucca, May 1905 (W.M. Wheeler; USNM). *Yuma Co.:* Vintner, 150′, 26 Oct. 1952 (W.S. Creighton; LACM); Yuma, 26 Nov. 1910 (W.M. Wheeler; USNM). *MEXICO. Baja Calif.:* Arroyo Calamajué, 1400′, 11 Oct. 1975 (R.R. Snelling, No. 75–65; LACM). *Sonora:* Punta Peñasco, 11 Nov. 1966 (R.J. Hamton; LACM, RJH); 7 mi N Punta Peñasco, 200′, 1 Nov. 1952 (W.S. Creighton; LACM); Tepoca Bay, 25 Apr. 1921 (E.P. Van Duzee; CAS).

Ecology. Known habitats for *kennedyi* range from Sagebrush Steppe and Great Basin Sagebrush in the north to Creosote bush-Bur sage and Palo verde-Cactus shrub desert in the south. Cole (1934a) noted that this ant (as *melliger semirufus*) is found in ". . . all parts of the desert region irrespective of the soil type . . ." Since the present interpretation of *kennedyi* is more restrictive than previous interpretations, it follows that this no longer is strictly true. Thus, while *kennedyi* does exhibit a broad spectrum of nest sites, there is a decided preference for well-drained, coarse desert sands.

Cole (1934b) found that in southern Idaho nests were found in bare sandy areas between shrubs on small stable sand dunes. My own experiences parallel this observation: *kennedyi* tends to locate its nests in bare areas away from vegetation. Areas of dense grass, especially, seem to be avoided.

Nest tumuli of fully mature colonies may be as much as 20 cm in diameter, but rarely more than 6 cm high. These tumuli are usually in the form of very regular craters.

Wheeler (1908) reported finding workers tending pseudococcids (*Orthezia* sp.) near Needles, Calif. The pseudococcid *Phenacoccus gossypii* Townsend and Cockerell was found to be tended by *kennedyi,* near Gray's Well, Calif. (McKenzie, 1967). Shields (1973) found that larvae of the lycaenid, *Philotes rita pallescens,* were being tended by this ant near Currant, Nev. Specimens collected by the author south of Ravendale, Calif., were soliciting honeydew from an unidentified aphid feeding on *Lupinus*. In addition to soliciting honeydew from other insects, *kennedyi* very actively gathers nectar directly from floral and extra floral nectaries.

In addition to the above food sources, this species is also a general scavenger. The workers forage actively during the hot midday hours and secure large quantities of dead arthropods. Some are freshly killed and I have seen this species attack living insects. Those attacks which I have witnessed from inception are all similar to the following incident, observed near Mecca, Calif. on 13 Apr. 1963.

1311 hrs—Forager discovered live crab spider on ground under *Sphaeralcea,* grasped left fourth tarsus; spider attempted to dart away but ant pulled in opposite direction and impeded progress.

1314—Second forager discovered struggling pair; attempted to grasp left third tarsus, but moved to opposite side, took hold of right third tarsus. Both ants now pulling backward.

1315—Third ant joined, attached to left third tarsus; spider now being dragged toward nest about 1.5 m away.

1318—Two more ants: one more on left third tarsus; one, after considerable "indecision" finally settled on right fourth tibia.

1319—About 1.25 m from nest and another ant joined the attack, grasping first the right fore tarsus, but shaken off, managed firm hold on right second tarsus.

1320—All ants now working concertedly to stretch prey and at same time move toward nest.

1321—Two more ants—one on right second tarsus, one grasped side of abdomen in front of spinnerets.

1324—About 0.5 m from nest; six or seven more ants, but they continually change holds on spider, now effectively "spread-eagled".

1328—Spider carried down nest entrance by a mass of ants.

On another occasion a sphecid wasp, *Ammophila* sp., had "cached" a paralyzed lepidopteran larva while opening up her burrow. The caterpillar was discovered by a *kennedyi* worker which began to drag it away. The wasp, upon discovering the removal of her prey began a search, found it and began to drag it back toward the burrow. She was, however, driven off by the arrival of several more ants. Such "brigandage" may be fairly common.

Little is known about predation on honey ants by other animals. However, that horned lizards may occasionally prey on *Myrmecocystus* is indicated by an unpublished record before me. Mr. Lan Lester, Natural History Museum of Los Angeles County, found *Phrynosoma platyrhinos* feeding on *kennedyi* workers near Inyokern, Calif.

Known activity of the sexual forms is summarized in Table 3.

Discussion. This is the species erroneously referred to as *melliger semirufa* by Wheeler (1908) and subsequent authors. As shown by Snelling (1969), *melliger semirufa* is a very different species, belonging to the *melliger* complex. Cole's name, described as a variety of *melliger semirufa,* is available and must be used for this common species.

Creighton (1950) placed *melliger semirufa* var. *testacea,* sensu Wheeler (1908) and subsequent authors, in the synonymy of *semirufa (i.e., kennedyi).* Since the ant which Emery described as *testacea* is actually a senior synonym of *mojave* of the nominate subgenus, Snelling (1971) renamed *testacea* auctorum as *wheeleri.* Although related and superficially similar, there are numerous features by which *kennedyi* and *wheeleri* are separable, as discussed under the latter species.

The cephalic characters of this species show several interesting clinal variations. Gross head size averages larger in northern populations. While northern and southern populations both include the full range of variation, measurements from southern samples tend to be distributed in the lower half of the regression zone.

Overall eye size is of interest, too. Eye length increases by about 6% between the northern extremity of the range and the Mexican border. Below the border, there are too few samples to indicate a clear trend, but there appears to be a reversal. Thus, specimens from Idaho

TABLE 3

Activity of Reproductives of:

Locality	Date	Activity
M. mimicus Wheeler		
N.MEX., Jornada Exp. Range	26–27 Feb. 1972	♂♂, ♀♀ in nest
N.MEX., Jornada Exp. Range	26 July 1972	♂♂, ♀♀ mating flight
N.MEX., 0.6 mi S Cuervo	21 Aug. 1967	♀♀ in nest
ARIZ., 7 mi E Robles Jct.	24 Feb. 1968	♂♂, ♀♀ in nest
ARIZ., Texas Cyn.	11 Aug. 1967	♂♂ in nest
CALIF., 8.6 mi E Temecula	7 Mar. 1973	♂♂, ♀♀ in nest
CALIF., 5.8 mi W Kettleman City	25 Mar. 1967	♂♂, ♀♀ in nest
CALIF., 1 mi N Warner Spgs.	28 Mar. 1963	♀♀ in nest
CALIF., 9 mi E Temecula	3 May 1969	♂♂, ♀♀ in nest
CALIF., 1 mi N Warner Spgs.	3 May 1969	♀♀ in nest
B. CALIF., 5 mi S Rosarito	14 May 1952	♀♀ in nest
M. kennedyi Cole		
IDA., Indian Cove	12 Apr. 1932	♂♂, ♀♀ in nest
IDA., 1.6 mi W Hammett	19 June 1967	♀♀ in nest
ORE., Alkali Lake	9 June 1967	♂♂ in nest
NEV., near Fallon	25 Mar. 1956	♂♂, ♀♀ in nest
NEV., Riverside	2 Apr. 1970	♂♂, ♀♀ in nest
NEV., 3 mi E Fallon	29 Apr. 1965	♂♂ in nest
NEV., Nevada Dominion Mine	8 May 1951	♂♂, ♀♀ in nest
CALIF., 5 mi E Thousand Palms	16 Feb. 1963	mating flight after rain
CALIF., Twentynine Palms	6 Nov. 1967	♂♂, ♀♀ in nest

have an average EL of 0.244 mm, those from southern California average 0.267 mm and those from the Punta Peñasco area of Sonora average 0.247 mm. The similar, and closely related *nequazcatl* has an average EL of 0.267 mm. The apparently reversed cline of *kennedyi* may be an example of "character displacement". However, until sympatric populations of the two species, if such exist, can be studied this phenomenon, as described by Brown and Wilson (1956) is not definitely demonstrated.

Myrmecocystus (Endiodioctes) nequazcatl
new species

Figures 109–116, 162, 174, 186, 194

Diagnosis. Worker: Malar area with fewer than three erect hairs in frontal view; head polished, sparsely punctate, especially on vertex; promesonotal hairs long, some equal to EL; third tergum usually closely pubescent; CI less than 90 in more than 90% of specimens. *Female.* Mesoscutal disc polished, with scattered punctures; parapsis with punctures of two sizes, sparse except near parapsidal line; penultimate segment of maxillary palp slender, broadest near middle, more strongly tapering apicad; mesoscutal hairs long. *Male.* Terga polished and shiny, sparsely pubescent; mesoscutal hairs long; lobe of aedeagus convex below, finely dentate.

WORKER. *Measurements.* HL 0.98–1.34 (1.34); HW 0.83–1.23 (1.23); SL 1.20–1.50 (1.50); WL 1.6–2.3 (2.3); PW 0.6–1.0 (1.0).

Head: Longer than broad, CI 83–93 (93) (89 or less in over 90% of specimens), shorter than scape, SI 108–124 (112); sides in frontal view, straight or slightly convex, slightly convergent toward mandibular base. Occiput, in frontal view, flat or slightly convex, without perceptible lateral angles. Eye small, 1.0–1.1 × first flagellomere; OMD 1.50–2.00 (1.80) × EL. Mandible with seven teeth.

Thorax: Slender, PW 0.38–0.45 (0.44) × WL. Mesonotal profile even. In profile, basal face of propodeum flat, meeting posterior face in narrowly rounded angulation of about 130°.

Petiole: Node, in profile, with anterior and posterior face parallel below, anterior face sloping back in upper half to broadly rounded summit; in frontal view, crest flat or gently convex, without median notch.

Vestiture: Pubescence sparse on head, abundant on thorax and first two or three terga.

Cephalic hairs abundant on frons and occiput, slender, flexuous on latter, some occipital hairs about equal to EL; malar area with one or two hairs near mandibular base. Promesonotum with numerous long, slender, flexuous hairs, some about as long as MOD; base and side of propodeum with shorter flexuous hairs. Side and crest of petiole with flexuous hairs about equal to those of propodeum. Terga with numerous long hairs,

longest on disc of second segment more than 0.5 × MOD; longer on apical segments and on sterna. Scape, femora and tibiae with abundant, short, suberect to erect hairs.

Integument: Head moderately shiny, lightly shagreened, with scattered fine punctures in malar area and on face below vertex, vertex virtually impunctate; frontal lobes with abundant very fine punctures. Thorax slightly shiny, lightly shagreened and closely micropunctate. First two terga slightly shiny, lightly shagreened and densely micropunctate; third tergum either (a) shinier and more lightly shagreened, closely micropunctate or (b) subpolished, hardly shagreened and with scattered micropunctures.

Color: Head, thorax, petiole and appendages bright ferruginous; gaster blackish, often with base of first tergum lighter.

FEMALE. *Measurements.* HL 1.9; HW 1.9; SL 1.8; EL 0.4; OMD 0.7; WL 4.2; PW 2.9.

Head: As broad as long, CI 100, slightly longer than scape; SI 92.5. In frontal view, margins straight, convergent below. Occiput broadly, evenly convex. Eye small, about 1.4 × length of first flagellomere; OMD 1.6 × EL. IOD 3.1 × OD; OOD 4.3 × OD. Penultimate segment of maxillary palp regularly spindle-shaped, slightly narrower at apex than at base.

Thorax: Stout, PW 0.45 × WL. In profile, posterior half of mesoscutum gently convex, apical margin on same plane as anterior margin of flattened scutellum. Metanotal profile separated from that of scutellum.

Petiole: In profile compressed-cuneate; crest sharp; distinctly notched; from above about 2.5 times wider than long.

Vestiture: Erect hairs present on all parts of face, least abundant on malar area, with fewer than eight on each side between eye and mandible (excluding exceptionally long hairs from gular area which may be visible), and in area between eye and ocelli; occipital hairs variable in length, but with several which are longer than EL; hairs on frons and clypeus equally variable, but shorter, the longest about equal to MOD. Erect thoracic hairs moderately abundant, some on mesoscutum and many on pleura at least as long as EL; propodeal, petiolar and gastric hairs as described for *wheeleri*. Fore femur with sparse short, fine erect hairs on inner face. All tibiae with numerous suberect hairs which are about as long as minimum thickness of hind tibia. Scape with abundant short erect hair on outer and lower faces. Fore and hind wing without marginal fringe.

Pubescence much as described for *wheeleri*, dense on first four terga.

Integument: Head moderately shiny, surface microreticulate; frontal lobes with close, fine punctures of variable size, separated by a puncture diameter or less; clypeus duller, with scattered coarse, piligerous punctures; malar area more sparsely and coarsely punctate than frontal lobes. Mesoscutum shiny, impunctate in center, laterally with scattered coarse, piligerous punctures; parapsis with close fine punctures and scattered coarser punctures near parapsides and sparse coarse punctures elsewhere. Scutellum with narrow impunctate median line, otherwise uniformly punctate, punctures fine, round, separated by 1.5–2.0 puncture diameters; mesopleura slightly shiny, with fine punctures separated by one-fourth to one-half puncture diameter, those of anepisternum coarser than of katepisternum; metapleura and propodeum densely shagreened and roughened, with sparse microscopic and scattered coarser punctures. First four terga densely, finely piligerously punctate, without areas of sparse punctation on first or second segments.

Color. Head brownish ferruginous; thorax and gaster blackish brown; antennae and legs brown. Wings clear, slightly yellowish, subcostal vein dark brownish, remaining veins and stigma yellowish brown.

MALE. *Measurements.* HL 0.83–0.87 (0.87); HW 0.83–0.87 (0.83); SL 0.90–1.00 (0.97); WL 2.0–2.2 (2.1); PW 1.2–1.3 (1.3).

Head: Slightly longer than broad to slightly broader than long, CI 96–102 (96), shorter than scape, SI 106–120 (111); in frontal view, sides straight, evenly convergent toward mandibular bases; occiput, in frontal view, subangulate in middle to evenly convex from side to side, without perceptible lateral angles. OMD 0.78–1.00 (0.89) × EL; OOD 2.50–3.25 × OD; IOD 3.50–4.00 × OD. Mandible without preapical notch or basal denticles.

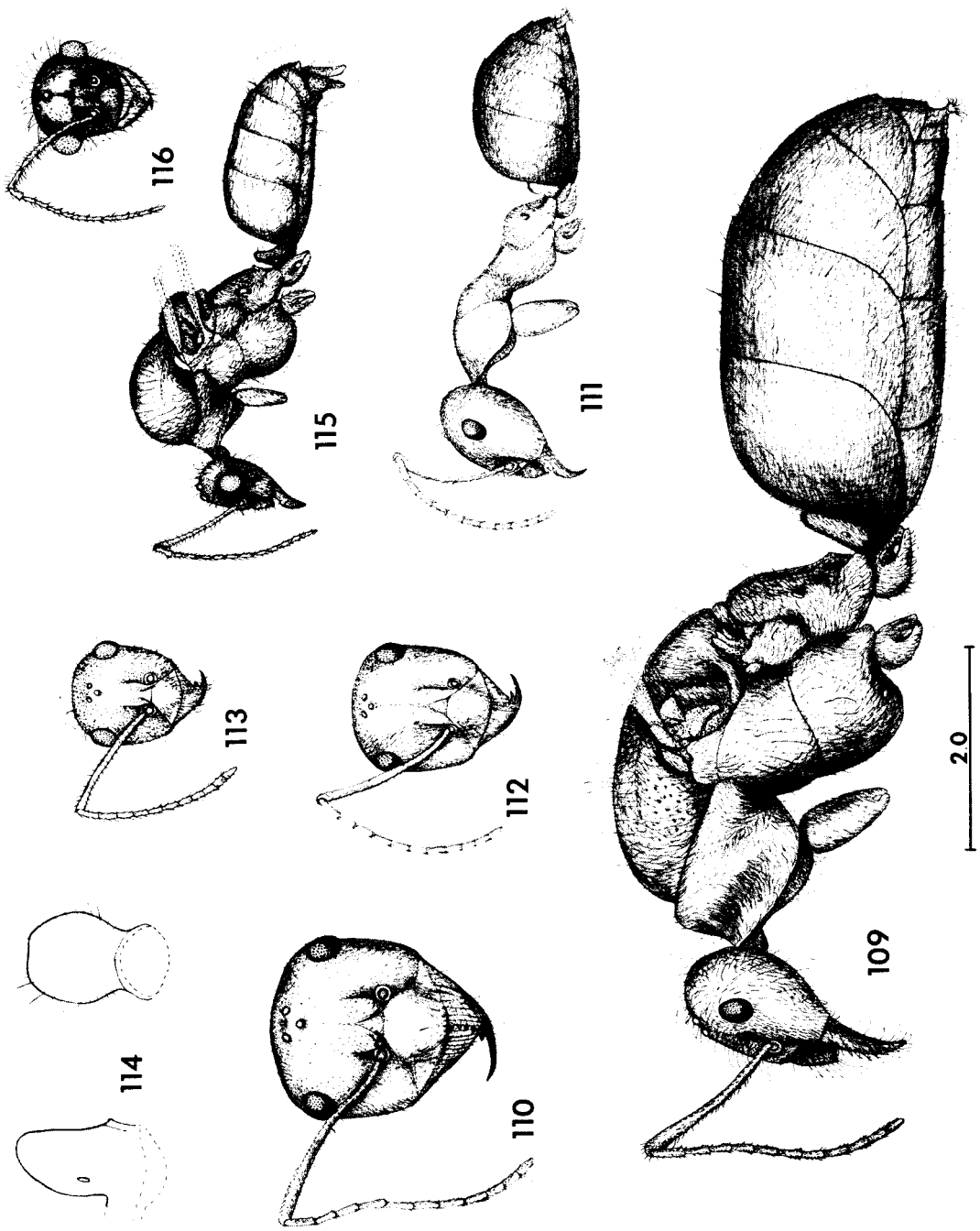
Thorax: Robust, PW 0.59–0.68 (0.62) × WL. Propodeum with weakly indicated basal face.

Petiole: In profile, cuneate, summit narrowly rounded; crest, in frontal view, weakly to distinctly notched.

Vestiture: Pubescence everywhere sparse, a little denser on pleura and propodeum.

Pilosity short on frons, longer on malar area and behind eye, longest on occiput, longer occipital hairs about equal to MOD. Mesonotum with numerous long, stiff hairs, longest about equal to MOD; some hairs on scutellum longer, about equal to EL; pleura with numerous long, flexuous hairs, some equal to, or slightly exceeding EL; side of propodeum with numerous long, flexuous hairs, basal face with a few shorter hairs. Petiole with short, erect hairs on sides and crest. Gaster with long, slender, flexuous hairs, longer and more abundant caudad and ventrally. Scape, femora and tibiae with abundant suberect to erect short, stiff, acuminate hairs. Wings without fringe hairs on apical or posterior margins.

Integument: Head moderately shiny, lightly shagreened, more closely so on malar area and behind eye; with scattered piligerous punctures. Discs of scutum and scutellum polished and shiny, parapsis moderately shiny and lightly shagreened. Pronotum,



FIGURES 109–116. *M. nequazcatal*. 109, female, lateral view; 110, head of female, frontal view; 111, major worker, lateral view; 112, head of major worker, frontal view; 113, head of minor worker, frontal view; 114, petiole of major worker, lateral view; 115, male, lateral view; 116, head of male, frontal view.

pleura and propodeum moderately shiny, distinctly shagreened. Terga polished and shiny, with scattered piligerous punctures; sterna very lightly shagreened, a little duller than terga.

Color. Blackish brown; mandibles, antennae and legs light brown. Wings clear, veins and stigma pale yellowish.

Terminalia: Figures 174, 186, 194.

Type Material. Holotype worker, allotype male; 1 female, 12 male, 25 worker paratypes: 1 mi W Desemboque de los Seris, Sonora, MEXICO, 5 Feb. 1972 (E. M. Fisher), in LACM. Additional paratypes: 17 workers, 5 mi S Puerto Libertad, Sonora, MEXICO, 6 Feb. 1972 (E. M. Fisher; LACM); 200 workers, Puerto Libertad, Sonora, MEXICO, 16–17 Apr. 1957 (W. S. Creighton, Nos. 233, 342; LACM). One male, five worker paratypes to AMNH, GCW, MCZ, and USNM.

Etymology. Nequazcatl, the Aztec (Nahuatl) name for the honey ants.

Distribution. Known only from the State of Sonora, Mexico, chiefly from the coast of the Gulf of California, but inland to Hermosillo (Fig. 363).

Additional Localities. MEXICO. Sonora: Hermosillo, 780′, 12 Mar. 1969 (R. R. Snelling, No. 69–92; LACM); 10 mi N Hermosillo, 800′, 15 June 1951 (W. S. Creighton; LACM); 10 mi S Hermosillo, 700′, 10 Nov. 1952 (W. S. Creighton; LACM); 6 mi S Peón, 0′, 11 Nov. 1952 (W. S. Creighton; LACM).

Ecology. Habitats for *nequazcatl* include Palo Verde-Cactus shrub and coastal sand dune desert. Workers were found foraging at mid-day at Hermosillo. Here, nests were in coarse-grain sandy clay and tumuli up to 25 cm in diameter were composed of coarse sand particles. At Puerto Libertad Creighton found nests situated in deep sand. His notes indicate that the ants construct ". . . a beautiful crater with steep sides and a diameter of about one foot when full-sized." His notes also indicate that he took a "colytid" (colydiid?) beetle from one nest. This beetle has not been located, but may have been a tenebrionid of the genus *Araeoschizus*.

Alates of both sexes were found on Feb. 5 near Desemboque de los Seris. It may be assumed that the mating flight occurs following spring rains. In all probability there are mating flights in the autumn, coinciding with the rains in October or November.

Discussion. This species most closely resembles such species as *kennedyi, kathjuli* and *wheeleri*. From all of these, the worker is separable by the exceptionally long, slender, flexuous pronotal hairs. Larger workers commonly possess abundant appressed pubescence on the third tergum, while smaller workers do not, but this is not consistent. The vertex, particularly between the eye and the ocelli is polished and impunctate in *nequazcatl*. In the other species of this group it is mostly lightly shagreened and with distinct punctures, especially in *kennedyi*.

In the female, the very sparsely punctate vertex will distinguish that caste from those of the other species. The parapsis is shiny and sparsely punctate, except near the parapsidal line, as in *kennedyi*. The closely micropunctate first tergum will further separate this caste from the female of *kathjuli;* the much longer mesoscutal hairs will distinguish it from *kennedyi* and the black gaster will separate it from *wheeleri*.

The polished, impunctate gastric terga will readily separate the male from those of *kathjuli* and *wheeleri*. From the latter it is further distinguished by the ventrally convex aedeagus which has minute teeth. The minute aedeagal teeth will also serve to distinguish *nequazcatl* from *kathjuli*. The much longer erect mesoscutal hairs will further separate *nequazcatl* from *kennedyi*.

Myrmecocystus (Endiodioctes) wheeleri Snelling

Figures 117–126, 163, 175, 195, 196

Myrmecocystus melliger semirufus var. *testaceus*, Wheeler 1908. Bull. Amer. Nat. Hist. 24:355–356 *(in part, misidentification);* Wheeler 1912. Psyche 19:174, 176 *(misidentification);* Cole 1934. Ann. Entomol. Soc. Amer. 27:402 *(misidentification);* Mallis 1940. Bull. So. Calif. Acad. Sci. 40:81 *(in part, misidentification).*

Myrmecocystus semirufa, Creighton 1950. Bull. Mus. Comp. Zool. 104:449 *(in part, misidentification).*

Myrmecocystus melliger semirufus testaceous (sic!), Cook 1953. Ants of California, 345–346 *(in part, misidentification).*

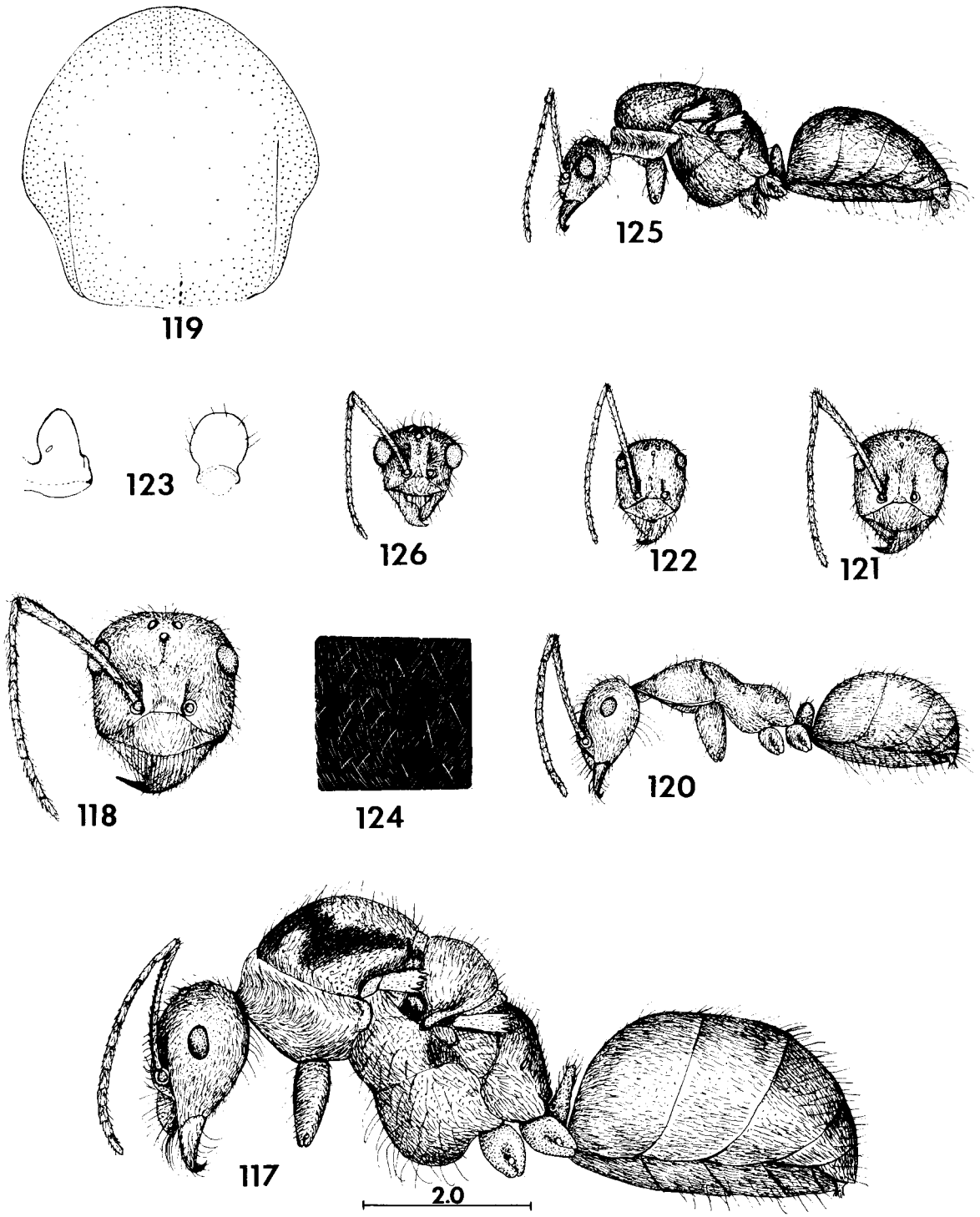
Myrmecocystus wheeleri Snelling 1971. Contr. Sci., L.A. Co. Mus. 214:11–15. ♀♀♂; Wheeler & Wheeler 1973. Ants of Deep Canyon, 127.

Diagnosis. Worker: Uniformly orange-ferruginous, rarely legs and gastric apex brownish; longest occipital hairs about equal to EL, longest pronotal hairs about 0.5 × MOD; third tergum densely pubescent; tibial hairs mostly decumbent. *Female:* penultimate segment of maxillary palp more than twice as wide in basal third as at apex; thorax and gaster extensively ferruginous. *Male:* ventral lobe of aedeagus concave in profile, coarsely serrate.

WORKER. *Measurements:* HL 0.93–1.26 (1.26); HW 0.83–1.10 (1.10); SL 1.16–1.60 (1.60); WL 1.6–2.0 (2.0); PW 0.60–0.83 (0.83).

Head: A little longer than broad, CI 81–96 (86), distinctly shorter than scape; SI 130–153 (145). In frontal view, head broadest at, or a little below, the eyes, sides straight or slightly, evenly convex, narrowed slightly toward mandibular insertions. Occiput in frontal view broadly rounded laterally, summit slightly convex or flattened. Eye small, barely longer than first flagellomere; OMD 1.5–2.1 (2.1) × EL. Mandible usually with seven teeth.

Thorax: Slender, PW 0.36–0.43 (0.41) × WL. Basal face of propodeum broadly rounded into posterior face.



FIGURES 117–126. *M. wheeleri*. 117, female, lateral view; 118, head of female, frontal view; 119, mesoscutum of female, distribution of punctures; 120, major worker, lateral view; 121, head of major worker, frontal view; 122, head of minor worker, frontal view; 123, petiole of major worker, lateral (left) and posterior (right) views; 124, major worker, vestiture of third tergum; 125, male lateral view; 126, head of male, frontal view.

Petiole: In profile, about as thick as high, narrowed toward evenly rounded apex; crest evenly convex in frontal view; in dorsal view, node 1.4–1.5 × wider than long.

Vestiture: Appressed pubescence sparse, short, on head, denser on occiput and vertex; distinctly longer and denser on thorax, coxae and femora, petiole and first three gastric terga. Pubescence very sparse or absent from fourth and fifth terga. Erect hairs sparse on head, confined mainly to clypeus, frontal area and occiput, those of occiput distinctly longer than EL, of frons and clypeus variable, but mostly shorter than EL; malar area with scattered erect hairs less than 0.5 × EL. Pronotum with 12–18 erect hairs of irregular length, longest about 0.5 × MOD, a variable number of much shorter hairs on neck; mesonotum with about a dozen erect hairs, less than 0.5 × EL; metanotum usually without erect hairs; propodeum with 12 or more erect hairs of variable length, the longest equal to at least 0.5 × EL. Petiolar scale with 6–10 fine, erect short hairs on crest. Discs of gastric segments with sparse erect hairs, about equal to 0.5 × EL, hairs of tergal margins only slightly shorter than EL. Scape with abundant fine, short suberect hairs on inner and lower faces. Inner face of fore femur without erect hairs except along lower margin, these about as long as those of outer face. Middle and hind tibiae with abundant fine, subdecumbent hairs on all surfaces, these a little shorter than minimum thickness of the tibiae.

Color: Orange-ferruginous, often with lower half of face more yellowish; fourth and fifth gastric segments often infuscate. Rarely most of thorax, gaster and legs infuscate in some minors.

FEMALE. *Measurements.* HL 1.8; HW 1.8; SL 1.8; WL 4.0; PW 2.5.

Head: As broad as long, CI 100; as long as scape; SI 100. In frontal view, head parallel-sided, as broad at mandibular insertions as at lower eye level. Occiput rounded laterally, without evident corners, slightly convex in middle. Eye small, 1.3 times length of first flagellomere; OMD 1.6 × EL; IOD 2.5 × OD; OOD 3.5 × OD. Penultimate segment of maxillary palp broadest at basal third, strongly narrowed toward apex.

Thorax: Robust, PW 0.62 × WL. In profile, posterior half of mesoscutum flat, apical margin below level of convex scutellum; scutellum and metanotum forming continuous convex surface.

Petiole: In profile compressed-cuneate, crest sharp; distinctly notched; from above, about three times wider than long.

Vestiture: Pubescence long, notably dense only on first three gastric terga, variably fully appressed to subappressed, especially on head.

Erect hairs present on all parts of face, least abundant on malar area immediately below eyes, and between eyes and ocelli; occipital hairs irregular in length, longest about as long as EL, hairs on frons and clypeus equally variable, but a little shorter. Hairs abundant on thoracic dorsum and sides, highly variable in length, some longer than EL (especially on sides); basal third of propodeum with abundant long hair, apical two-thirds with very short erect hairs, especially toward apex and around gland opening. Crest and sides of petiolar scale with numerous long erect hairs, gastric terga with abundant fully erect hairs on disc, separated by less than their own lengths, mostly about half as long as EL. Fore femur without conspicuous erect hair on inner face. Tibiae with abundant suberect hairs which are about as long as minimum thickness of hind tibia. Scape with abundant suberect, short hairs on outer and lower faces. Forewing without marginal fringe, hind wing fringed on posterior margin.

Integument: Head moderately shiny, lightly tessellate; frontal lobes with close, fine punctures of variable size, round to ovoid, separated by about a puncture diameter; malar area more sparsely, coarsely punctate. Center of mesoscutum impunctate, median area laterally with scattered fine punctures, becoming close and more distinct in lateral thirds and apically; anteriorly, median portion with sparse micropunctures; punctures denser and coarser on parapsis. Punctures of scutellum finer than of adjacent portion of scutum, sparse in middle, denser laterad; anepisternum minutely roughened between coarse, close punctures, katepisternum equally coarsely, more closely punctate; metapleura and propodeum similar to lower half of mesopleura. Discs of first two terga finely and densely micropunctate, but with punctures in middle irregularly spaced, some interspaces as much as two or three puncture diameters; third tergum uniformly, densely micropunctate.

Color: Orange-ferruginous, the following brownish: rectangular median mark on anterior half of mesoscutum, broad lateral stripes on posterior four-fifths of mesoscutum, irregular blotch on mesopleura above and irregular blotch on mesepisternum. Apical gastric segments lightly infuscated. Wings whitish hyaline, radial vein and stigma brownish, remainder of veins yellowish.

MALE. *Measurements.* HL 0.86–0.90; HW 0.83–0.90; SL 1.03–1.10; EL 0.30–0.33; WL 2.0–2.2; PW 1.16–1.23.

Head: Margins distinctly convergent toward mandibular insertions; head as broad as long or slightly longer (CI 96–100); distinctly shorter than scape; SI 119–128. OMD 0.80–0.90 × EL. Anterior ocellus ⅔ diameter of lateral ocelli; IOD 2.5–3.0 × OD; OOD 2.5–3.0 × OD. Mandible without basal teeth. Clypeus with short transverse depression below middle.

Petiole: In profile, higher than long, narrowed above, crest convex; in frontal view, evenly convex from side to side, except for vague to prominent median notch; in dorsal view about twice as wide as long.

Vestiture: Erect hairs abundant on body, those of scutellum as long as EL, length elsewhere generally

shorter but variable. Erect hairs of hind tibia about as long as thickness of scape. Pubescence sparse on head and thorax, abundant on propodeum and first four terga. Forewing without marginal fringe, hind wing with fringe on posterior margin only.

Integument. Head moderately shiny, lightly shagreened, with very sparse micropunctures and scattered coarse punctures. Malar area with a few very coarse, elongate punctures. Occiput duller, more closely micropunctate. Mesoscutum moderately shiny, sharply shagreened and with scattered coarse punctures. Scutellum shinier, less sharply shagreened, with scattered coarse punctures. Mesopleura slightly shiny, very densely shagreened, with scattered coarse punctures. Propodeum similar, but with shinier midline posteriorly. Summit of first tergum shiny and very sparsely punctate in middle; sides of summit of first tergum, entire second and third terga, moderately shiny, closely and uniformly micropunctate.

Color: Uniformly blackish, appendages light brownish.

Terminalia: Figures 175, 195, 196.

Type Material. Holotype worker, allotype male, 193 worker and two female paratypes, 6 mi SE of Pearblossom, 3500′, Los Angeles Co., Calif., 15 August 1965 (R. R. Snelling). Holotype, allotype and most paratypes in LACM; additional paratypes in AMNH, GCW, MCZ, MNHG, and USNM.

Distribution. Central California to Baja California (presumably), dry coastal valleys and desert margins (Fig. 365).

Localities. UNITED STATES. California: Merced Co.: 2.5 mi S Delhi, 4 June 1967 (R. R. Snelling, No. 67–100; LACM). *Fresno Co.:* Jacalitos Cyn., 6 mi S Coalinga, 25 Aug., 3 Sept. 1959 (R. R. Snelling; LACM). *San Luis Obispo Co.:* 5 mi NE Santa Margarita, 24 June 1963 (G. I. Stage; LACM). *Ventura Co.:* Camp Ozena, Upper Cuyama Cyn., 8–27 June 1963 (C. W. Kirkwood; LACM). *Kern Co.:* Bakersfield, 7 Oct. 1937 (A. Mallis; LACM, USNM). *Los Angeles Co.:* Bouquet Cyn., 23 Aug. 1954 (R. R. Snelling; LACM); Little Rock Dam, 3400′, 2 May 1970 (R. R. Snelling, No. 70–1; LACM); Bob's Gap, 3500′, 6 mi SE Pearblossom, various dates (R. R. Snelling; includes type series; LACM); Glendale, July 1941 (E. I. Schlinger; UCD); Eaton Cyn., San Gabriel Mts., 6 June 1963 (R. R. Snelling; LACM); Altadena, various dates and collectors (LACM, RHC, UCD, USNM); Irwindale, 500′, 4 Apr. 1963 (R. R. Snelling; LACM); Los Angeles, 9 June 1936 (A. Mallis; LACM); Claremont (Baker; AMNH). *San Bernardino Co.:* Cajon Cyn., 7.7 mi NW Cajon, 5 July 1964, 4 Aug. 1963 (R. R. Snelling; LACM); 4.3 mi N San Bernardino, 5 July 1964 (R. R. Snelling; LACM); 2 mi E Mentone, 200′, 13 Apr. 1963 (W. S. Creighton; LACM); Etiwanda, 28 Oct. 1967 (R. J. Hamton; RJH). *Riverside Co.:* 2 mi E San Jacinto, 1900′, 6 Mar. 1967 (R. R. Snelling; LACM); 4 mi W Anza, 15 June 1963 (R. R. Snelling; LACM); 2 mi W Dripping Spgs., 1300′, 4 June 1952 (W. S. Creighton; LACM); 9 mi E Temecula, 1200′, 20 Apr. 1969 (R. R. Snelling, No. 69–115; LACM); same locality, 3 May 1969 (R. R. Snelling, No. 69–121; LACM); Elsinore Mts., near summit Hwy. 74, 24 June 1964 (E. F. Riek & G. I. Stage; LACM); [Nightingale, 4000′ Wheeler and Wheeler, 1973:127]. *San Diego Co.:* 2 mi N Warner spgs., 8 July 1956 (R. M. Bohart; UCD); Pt. Loma, no date (P. Leonard; MCZ).

Ecology. This ant has been collected near sea level (Pt. Loma) to about 4000 feet in the San Jacinto Mts. It ranges from arid and semiarid regions of the San Joaquin Valley southward in dry coastal canyons and inland valleys and enters the western margins of the Mojave and Colorado Deserts. Habitats include California Steppe, Saltbush-Greasewood Shrub, California Oakwoods, Chaparral, Coastal Sagebrush Shrub, Juniper-Pinyon Woodland and Creosote bush-Bur sage Shrub.

Mallis (1940) described the crateriform tumulus to be about 5 in. diameter, with a single entrance about 0.5 in. diameter, but noted that two days later the same nest had two entrances about 1 in. apart. His observations were made near Bakersfield; the ants were seen to forage at mid day and to move rapidly over the sand.

The Wheelers (1973) found that one nest which they observed in Deep Canyon was in exposed sandy soil and surmounted by a ". . . shallow irregular earthworks 9 × 13 inches . . ." with ". . . several irregular entrances . . ." Exoskeletal fragments of arthropods, mostly ants, were in the refuse pile.

A worker was seen by Mallis (1940) bringing the abdomen of a honey bee to the nest. Arthropod remnants are abundant in the refuse piles of *wheeleri*, as already noted by the Wheelers. Head capsules of other ant species are often abundant, especially those of *Pogonomyrmex*, other *Myrmecocystus* and *Formica*. Since I've never seen *wheeleri* attacking other ants, these may be the result of scavenging, rather than predation. Live insects are regularly taken, especially immature cicadellids and small Lepidoptera larvae.

Foraging workers of this ant regularly visit flowers for nectar; they seem to be especially prone to visit species of *Eriogonum* (Polygonaceae) and prostrate *Euphorbia* (Euphorbiaceae). Although I have never found repletes in any of the nests I have studied, there is one replete in the material collected by P. Leonard at Pt. Loma.

Nest founding females have been found in Chaparral areas of southern California in early March after warm rains. The presence of alates in the nests in summer months (6 June and 15 Aug.) suggests that this species also takes advantage of summer and autumnal rains for mating flights. Known activity of the reproductives is summarized in Table 4.

Discussion. This ant has been erroneously identified by Wheeler (1908, 1912) as Emery's *testaceus*. The specimens from Phoenix, Arizona, thought by Wheeler to be transitional between this ant and *"semirufus" (i.e., kennedyi)* are actually *romainei*.

Although workers of *wheeleri* are usually wholly orange-ferruginous there are some samples in which

TABLE 4

Activity of Reproductives of:

Locality	Date	Activity
M. wheeleri Snelling		
CALIF., 2 mi E San Jacinto	6 Mar. 1967	♂♂ in nest
CALIF., 6 mi SE Pearblossom	16 Mar. 1972	♂♂ in nest
CALIF., Eaton Cyn.	6 June 1963	♂♂ in nest
CALIF., Camp Ozena	8–27 June 1963	deälate ♀ on ground
CALIF., 6 mi SE Pearblossom	15 Aug. 1965	♀♀ in nest
CALIF., 6 mi SE Pearblossom	22 Aug. 1965	♂♂ in nest
M. romainei Cole		
COLO., Trinidad	26 Aug. 1951	♀♀ in nest
COLO., 30 mi E Pueblo	26 Aug. 1951	♀♀ in nest
N.MEX., Albuquerque	May 1905	♀♀ in nest
N.MEX., Jornada Exp. Range	24 Apr. 1973	♂♂ in nest
N.MEX., Jornada Exp. Range	25 July 1973	♂♂, ♀♀ in nest
N.MEX., 2 mi San Juan	3 Sept. 1951	♀♀ in nest

legs and the apical gastric segments may be brownish, especially in minor workers. Such specimens are common in material collected at Little Rock Dam. Since the basal gastric segments may be yellowish in occasional specimens of *flaviceps* and *kennedyi*, and are normally so colored in *kathjuli*, other means of separation must be used. The presence of abundant pubescence on the third tergum will immediately separate *wheeleri* from *kennedyi*. The occipital and pronotal hairs are much shorter in *kennedyi* than in *wheeleri* and the tibial hairs are suberect to erect rather than decumbent.

The resemblance of *flaviceps* to *wheeleri* in pilosity is closer, since both possess abundant pubescence on the third tergum. In *flaviceps*, however, the tibial hairs are suberect to erect, the pronotal hairs do not exceed 0.5 × MOD and the occipital hairs are not equal to EL.

The most closely related species appears to be *kathjuli* and workers of the two species are very similar in most features. The pronotal hairs are a little longer in *wheeleri*, about 0.85–0.90 × MOD, than in *kathjuli*, about 0.60–0.65 × MOD. In the latter species, the sides of the first two terga are brownish and many of the hairs of the tibiae are suberect to erect.

The very broad segments of the maxillary palp and largely ferruginous gaster will immediately separate the female of *wheeleri* from all except *kathjuli*. The frontal lobes are uniformly punctate and the punctures separated by less than a puncture diameter in *wheeleri;* in *kathjuli* the punctures are very irregularly spaced, with many interspaces of 1–2 puncture diameters. The summit of the first tergum and the discs of the second and third, are uniformly closely micropunctate in *wheeleri* females. There are extensive impunctate areas on the first tergum, at least, in the *kathjuli* females seen.

Although male *Myrmecocystus* are a monotonously similar lot, offering few distinguishing characteristics, that of *wheeleri* is the proverbial exception. The ventral lobe of the aedeagus, instead of being strongly convex and finely serrate, as in all other species, is concave and coarsely serrate (Fig. 195). Otherwise, this sex is very similar to that of *kathjuli* but with shorter body hairs.

ROMAINEI GROUP

Myrmecocystus (Endiodioctes) koso new species

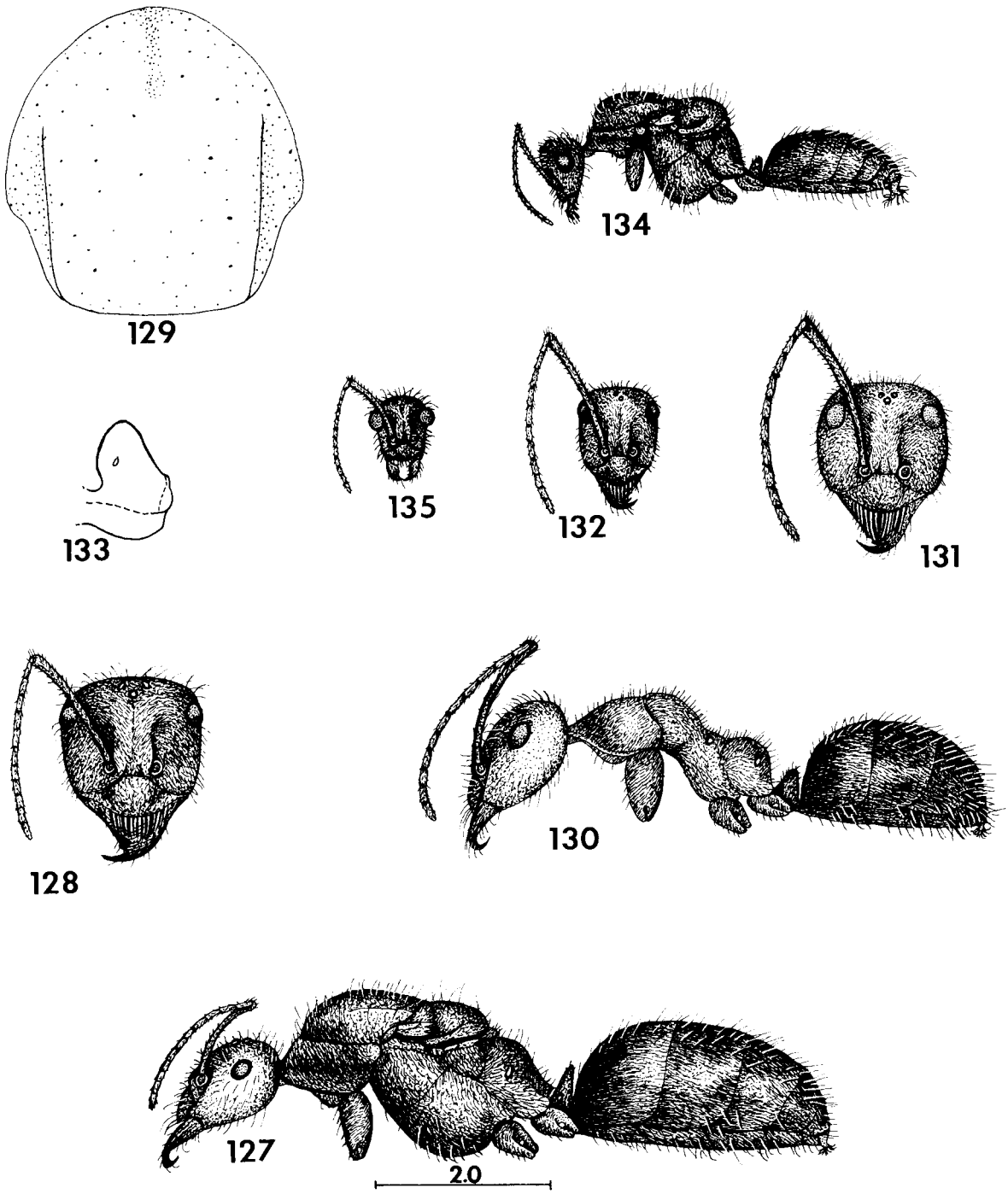
Figures 127–135, 164, 176, 199, 200

Myrmecocystus comatus, Cole 1966. B. Young Univ. Sci. Bull. 7:21 *(misidentification)*.

Diagnosis. Worker: Malar area with 10 or more erect hairs; HW less than 1.7 mm; pronotal hairs uneven in length, longest less than MOD, hairs mostly distinctly longer than on mesonotum; third tergum always, and fourth usually, densely pubescent; face with numerous irregularly spaced coarse, shallow punctures. *Female:* Parapsis with extensive impunctate areas and punctures of two sizes; penultimate segment of maxillary palp slender, nearly parallel-sided; malar area with numerous erect hairs; median area of first two terga largely impunctate; HW 1.8 mm or less. *Male:* ventral lobe of aedeagus convex in profile; mesoscutal disc shiny, very lightly tessellate to smooth, in contrast to parapsis; scutellum lightly tassellate and shiny; first three terga with median areas apubescent or nearly so; hing wing with fringe hairs along basal half of posterior margin; longest occipital and mesoscutal hairs more than 0.5 × MOD; HW less than 0.8 mm.

WORKER. *Measurements.* HL 0.83–1.63 (1.63); HW 0.73–1.67 (1.67); SL 0.97–1.93 (1.93); WL 1.3–2.7 (2.7); PW 0.5–1.2 (1.2).

Head: Longer than broad to slightly broader than long (largest workers). CI 87–102 (102), usually dis-



FIGURES 127–135. *M. koso*. 127, female, lateral view; 128, head of female, frontal view; 129, mesoscutum of female, distribution of punctures; 130, major worker, lateral view; 131, head of major worker, frontal view; 132, head of minor worker, frontal view; 133, petiole of major worker, lateral view; 134, male, lateral view; 135, head of male, frontal view.

tinctly shorter than scape, SI 105–136 (118); in frontal view sides straight (small workers) to moderately convex, slightly convergent toward base of mandible. Occiput in frontal view flat or slightly convex, broadly rounded laterally. Eye small, EL 1.05–1.10 (1.09) × first flagellomere; OMD 1.50–1.95 (1.92) × EL. Mandible with seven teeth.

Thorax: Slender to moderately robust, PW 0.35–0.48 (0.43) × WL. Basal face of propodeum broadly rounded into posterior face.

Petiole: In profile thick, cuneate, summit broad; crest, in front view, flat or slightly notched in middle; from above, about 1.5 × wider than thick.

Vestiture: Pubescence sparse on head; more abundant, producing a feeble sheen on occiput and around antennal sockets; dense on thorax. First three terga always closely pubescent, and usually fourth as well except in smallest workers.

Erect hairs general on head; malar area with at least ten erect hairs (except a few very small workers), usually 15+; longest occipital hairs usually about 0.8 × MOD. Pronotal hairs very uneven in length, longest hairs 0.6–0.7 × MOD, slender and acuminate; mesonotal hairs more even in length, usually thicker than those on pronotum, longest less than 0.5 × MOD; metanotal hairs uniformly quite short; propodeal hairs short basally, becoming progressively longer caudad, longest less than 0.5 × MOD. Petiole with numerous short, erect hairs on side and crest. Terga with abundant erect hairs, arising from poriform punctures on first three terga, progressively longer caudad; longest discal hairs of second tergum about 0.5 × MOD. Scape, femora (including inner face of fore femur) and tibiae with abundant short, suberect to erect hairs.

Integument. Head moderately shiny, distinctly shagreened; frontal lobes with variably spaced coarse punctures separated by up to 1.5 diameter; sides of face more finely, sparsely punctate, punctures shallow and poorly defined; vertex and occiput immediately behind ocelli closely micropunctate, micropunctures extending laterad only on extreme posterior part of occiput. Thorax slightly shiny, densely shagreened and micropunctate. First three terga slightly shiny, densely shagreened and micropunctate; fourth tergum shinier, less closely micropunctate.

Color: Head, thorax and appendages ferruginous; gaster medium to dark brown; occiput, propodeum and femora often lightly infuscated.

FEMALE: *Measurements.* HL 1.58–1.70; HW 1.63–1.80; SL 1.60–1.73; WL 3.5–4.0; PW 2.1–2.4.

Head: A little broader than long, CI 103–108; slightly shorter to slightly longer than scape, SI 98–102; sides of head, in frontal view, straight or barely convex, slightly convergent toward mandibular bases. Occiput, in frontal view, regularly convex from side to side. Eye small, 1.05–1.20 × first flagellomere; OMD 1.57–1.75 × EL; OOD 4.3–4.7 × OD; IOD 3.0–3.3 × OD. Penultimate segment of maxillary palp very slightly wider subbasally than at apex, sides straight, about seven times longer than wide. Mandible septemdentate, rarely with eight teeth.

Thorax: Robust to very robust, PW 0.55–0.69 × WL. Scutum flattened behind; scutellum slightly and regularly convex in profile. Basal face of propodeum broad, usually sloping in profile, and rounded onto posterior face.

Petiole: In profile, cuneate, strongly narrowed; crest, in frontal view, deeply angularly incised.

Vestiture: Pubescence sparse on all cephalic surfaces. Pubescence abundant on pronotum, thoracic pleura and propodeum. Broad median area of first two terga very sparsely pubescent; third similar but more conspicuously pubescent; fourth more pubescent than third, but still more thinly pubescent in middle than at side; these terga abundantly pubescent at sides.

Malar area with 12–18 long erect hairs visible in frontal view; facial hairs short, sparse between antennal socket and eye; longest occipital hairs subequal to MOD. Mesoscutum with numerous erect hairs, longest subequal to MOD; scutellar hairs longer, some exceeding MOD; pleural hairs numerous, mostly about 0.5–0.7 × MOD. Propodeum with numerous erect hairs at side and across base, similar to those of pleura. Petiole with long, slender hairs on sides and crest. Terga with numerous erect hairs, longest on disc of second segment about 0.78 × MOD, only slightly longer on apical segment. Scape, femora (including inner face of fore femur) and tibiae with abundant suberect to erect hairs. Fore wing without fringe hairs; hind wing with fringe hairs on basal half of posterior margin.

Integument: Head moderately shiny, clypeus and adjacent portion of side of face duller, closely shagreened; frontal lobes densely micropunctate, punctures round, interspaces 0.5–1.0 × puncture diameter, with scattered coarse punctures; face with sparse fine punctures, most abundant at sides and below, punctures less sharply defined than on frontal lobes; malar area with dense, fine, elongate punctures; vertex with close micropunctures in ocellar area extending onto occiput, extending laterad on posterior part of occiput. Mesoscutal disc shiny, with scattered coarse punctures; parapsis with scattered coarse punctures and dense micropunctures adjacent to parapside. Scutellum shiny, sparsely micropunctate and with scattered coarse punctures. Anepisternum slightly shiny, micropunctate, punctures mostly separated by about a puncture diameter, with scattered coarse punctures; katepisternum a little duller, more densely micropunctate and with scattered coarse punctures. Pronotum, metapleura and propodeum dull, densely micropunctate. Dorsum of first tergum and broad median areas of second and third terga moderately shiny, lightly shagreened, with sparse micropunctures and scattered coarse punctures;

fourth tergum similar but less shiny and more abundantly micropunctate; lateral, basal and apical areas of these segments densely micropunctate.

Color: Head and antennae ferruginous; legs brownish ferruginous to light brown; thorax and gaster medium brown, often with lighter areas on scutum and scutellum. Wings slightly whitish, subcostal vein medium brown, stigma and remaining veins pale yellow.

MALE. *Measurements.* HL 0.83–0.90 (0.90); HW 0.77–0.87 (0.87); SL 0.93–1.03 (1.03); WL 2.0–2.3 (2.2); PW 1.1–1.3 (1.).

Head: A little longer than broad, CI 92–97 (97), shorter than scape, SI 112–120 (115); in frontal view, sides straight, moderately convergent toward mandibular bases; occiput, in frontal view, evenly and strongly arched, without perceptible angles. OMD 0.72–0.88 (0.78) × EL; OOD 1.7–3.0 (2.3) × OD: IOD 2.0–3.5 (2.3) × OD. Mandible without preapical cleft or basal teeth.

Thorax: Moderately robust, PW 0.52–0.62 (0.52) × WL. Propodeum, in profile, with weakly defined basal face or evenly sloping.

Petiole: In profile, thick, hardly cuneate and with broadly rounded summit to cuneate with slightly angulate summit; crest, in frontal view, entire or with trace of medium notch.

Vestiture: Head nearly apubescent, a few hairs above eye, on frontal lobe and on lower malar area. Pubescence sparse on pronotum, denser on sides and propodeum; absent from scutum, scutellum and central area of propodeum. First three terga with sparse pubescence at sides, broad median area apubescent; fourth tergum without pubescence.

Malar area with 6–9 long, slender hairs; longest occipital hairs about equal to MOD. Mesoscutum with numerous erect hairs, longest about equal to MOD. Scutellum with sparse, longer hairs, longest about equal to EL. Pleura with shorter hairs, longest about 0.6 × MOD. Propodeum with similar hairs basally and laterally. Gastric segments with sparse long hairs, longest caudad and ventrally. Scape, femora and tibiae with abundant short, suberect to erect hairs. Forewing without fringe hairs; hind wing with fringe hairs on basal half of posterior margin.

Integument: Head shiny, malar area moderately shiny, lightly shagreened and sparsely micropunctate; occiput moderately shiny, lightly shagreened, sparsely micropunctate and with scattered coarse punctures. Mesoscutum shiny, very lightly shagreened to smooth, with scattered coarse punctures; parapsis duller, lightly shagreened, sparsely micropunctate, with scattered coarse punctures. Scutellum duller than disc of scutum, lightly shagreened, with scattered coarse punctures. Pleura slightly shiny, distinctly shagreened, sparsely micropunctate, with scattered coarse punctures. Side of propodeum similar to pleura, more distinctly micropunctate; base and disc shinier, lightly shagreened and sparsely micropunctate. Terga moderately shiny, lightly shagreened, with sparse micropunctures (more abundant laterad) and scattered coarse punctures.

Color. Medium to dark brownish; flagellum and tarsi yellowish; mandibles yellowish brown. Wings slightly whitish, subcostal vein brown, stigma and remaining veins pale yellowish.

Terminalia: Figures 176, 199, 200.

Type Material. Holotype and 266 paratype workers: Panamint City, 6600′, Panamint Range, Inyo Co., CALIF., 3 Nov. 1967 (R. R. Snelling, No. 67–274). Allotype male; 584 worker, 18 female, 36 male paratypes: Wildrose Cyn., 6000′, Panamint Range, Inyo Co., CALIF., 4 Nov. 1967 (R. R. Snelling, No. 67–275). Holotype, allotype and most paratypes in LACM; paratypes in AMNH, GCW, MCZ, USNM.

Etymology. Named for the Koso Amerindian tribe, a Piute-Shoshonean group who formerly inhabited the Panamint Range. The word *koso* in Shoshoni means "Land of Fire", appropriately descriptive of the regions where this species occurs.

Distribution. Mountain ranges of northern Mojave Desert in California and Nevada (Fig. 367).

Additional Localities. UNITED STATES. Nevada: Nye Co.: Nevada Test Site, near Mercury, various dates and collectors (AMNH, LACM, MCZ, USNM); Rock Valley, Nevada Test Site, 31 Mar. 1972, 8, 9 June 1972 (R. Chew; REC, LACM); Rhyolite, 18 Mar. 1931 (A. H. Sturtevant; USNM).

Ecology. The type locality is in an area of Piñon-Juniper Woodland; the allotype nest from an area of Shadscale Scrub. Cole (1966) recorded this ant, as *comatus,* from the Nevada Test Site. He found it to be ". . . well represented in the *Grayia-Lycium, Larrea-Franseria, Atriplex-Kochia* and mixed communities; scarce in the *Coleogyne* and *Salsola* communities; rare in Piñon-Juniper areas."

Nests are in open areas and are usually surmounted by a low, circular crater. A crater may be absent, but this may be due to wind and/or rain action. Cole observed that most colonies were very populous, which accords with my observations in the Panamint Range.

Nothing is known of the mating flights. Alates of both sexes were taken in the allotype colony in early November. These were mostly callows and many sexual pupae were present. The season was already approaching winter at that altitude and I do not believe a mating flight would occur so late in the season, but that the sexual forms would overwinter and fly in warm vernal weather.

Discussion. Workers of this ant look like diminutive *placodops.* The conspicuously smaller size of the major workers (HW > 1.7 mm) and the presence of numerous punctures on the face will easily separate *koso* from *placodops.*

This ant is much more difficult to separate from *romainei*, to which it appears to be closely related. In the workers of *koso* the punctures of the side of the face are sparser, coarser, and less well defined than in *romainei;* this part of the face is conspicuously shagreened. The pronotal hairs are longer and more slender than the mesonotal hairs in *koso*, about equally long and thick in *romainei*. In both species the third tergum is pubescent, but the fourth is bare in *romainei*, usually pubescent in *koso*, except in the smallest workers.

The female of *koso* is easily separated from that of *romainei* by the sparsely punctate basal terga. Males of both species are similar, but that of *romainei* has much shorter erect hairs on the occiput and mesoscutum.

Myrmecocystus (Endiodioctes) romainei Cole

Figures 136–145, 165, 177, 197, 198

Myrmecocystus melliger subsp. *mimicus* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:353–354. ♀♀ *(in part); Wheeler 1912. Psyche 19:176 (in part).*

Myrmecocystus melliger semirufus, Wheeler 1908, *Op. cit.* 355 *(in part).*

Myrmecocystus melliger semirufus var. *romainei* Cole 1936. Entomol. News 47:120. ♀.

Myrmecocystus semirufa, Creighton 1950. Bull. Mus. Comp. Zool. 104:449 *(in part);* Buren 1968. Jour. Georgia Entomol. Soc. 3:119 *(misidentification).*

Myrmecocystus melliger, Cole 1954. Jour. Tenn. Acad. Sci. 29:285 *(in part).*

Myrmecocystus semirufa Forel !, Cole 1954. Jour. Tenn. Acad. Sci. 29:285 *(misidentification).*

Myrmecocystus semirufus, Gregg 1963. Ants of Colorado, 653–655 *(in part).*

Diagnosis. Worker: In frontal view, malar area with 5–17 hairs extending beyond margin; HW not exceeding 1.55 mm; frons and vertex finely and closely punctate; longest occipital hairs less than 0.5 × MOD. *Female:* malar area with numerous erect hairs; parapsis finely and closely punctate; first three terga uniformly, densely micropunctate; frons abundantly punctate. *Male:* ventral lobe of aedeagus convex; mesoscutum and scutellum faintly tessellate, shiny; summit of petiolar scale distinctly incised; first two terga without obvious pubescence except at sides, discs smooth and polished; mesoscutal and occipital hairs less than half minimum eye diameter.

WORKER. *Measurements.* HL 0.90–1.53 (1.17); HW 0.75–1.47 (1.03); SL 1.00–1.67 (1.37); WL 1.3–2.4 (1.7); PW 0.6–1.0 (0.7).

Head: Distinctly longer than broad to as broad as long, CI 80–100 (89), as long as to a little longer than scape, SI 100–121 (117). In frontal view, side straight in small workers, distinctly convex and abruptly convergent below in largest; occiput, in frontal view, with margin evenly convex (smallest workers) to flattened (largest), without lateral angle. Eye small, 1.00–1.25 × first flagellomere; OMD 1.45–2.00 (1.67) × EL. Mandible septemdentate.

Thorax: Moderately robust, PW 0.40–0.47 (0.42) × WL. Basal face of propodeum broadly rounded onto posterior face, distinctly shorter than posterior face.

Petiole: Usually about as thick as high, but in largest individuals may be higher than thick; crest rounded or flattened in frontal view, notched in largest workers; in dorsal view, about 1.4 × wider than long, in largest workers over twice wider than long and with distinctly projecting spiracles.

Vestiture: Pubescence sparse on clypeus, malar area and gula, conspicuously more abundant on frons and occiput; dense on thorax; dense and conspicuous on first three terga, sparse on following segments.

Erect hairs abundant on head, with ten or more present on malar area; longest occipital hairs 0.5, or less, × MOD: pronotal hairs all shorter than EL, longest hairs on disc about one-third longer than shorter hairs and distinctly longer than those of hind tibia; mesonotum and propodeum with numerous fully erect hairs; petiolar scale with a few erect hairs; terga with abundant erect hairs, progressively a little longer on succeeding segments, those of first segment about as long as those of hind tibia. Appendages abundantly hairy; scape with erect hairs on all faces; femora and tibiae with erect hairs on all faces.

Integument: Clypeus polished, with scattered coarse punctures; frontal lobes, frons and occiput moderately shiny, lightly shagreened, frontal lobes finely and closely punctate, frons more coarsely and sparsely punctate and with abundant micropunctures; occiput more finely and sparsely punctate than frons; malar area moderately shiny and sparsely punctate, the punctures coarser and somewhat elongate near eyes, closely shagreened near mandibles and less shiny. Thorax slightly shiny and closely shagreened, without evident punctures. First three terga slightly shiny, densely shagreened, with scattered fine punctures and a few small poriform punctures.

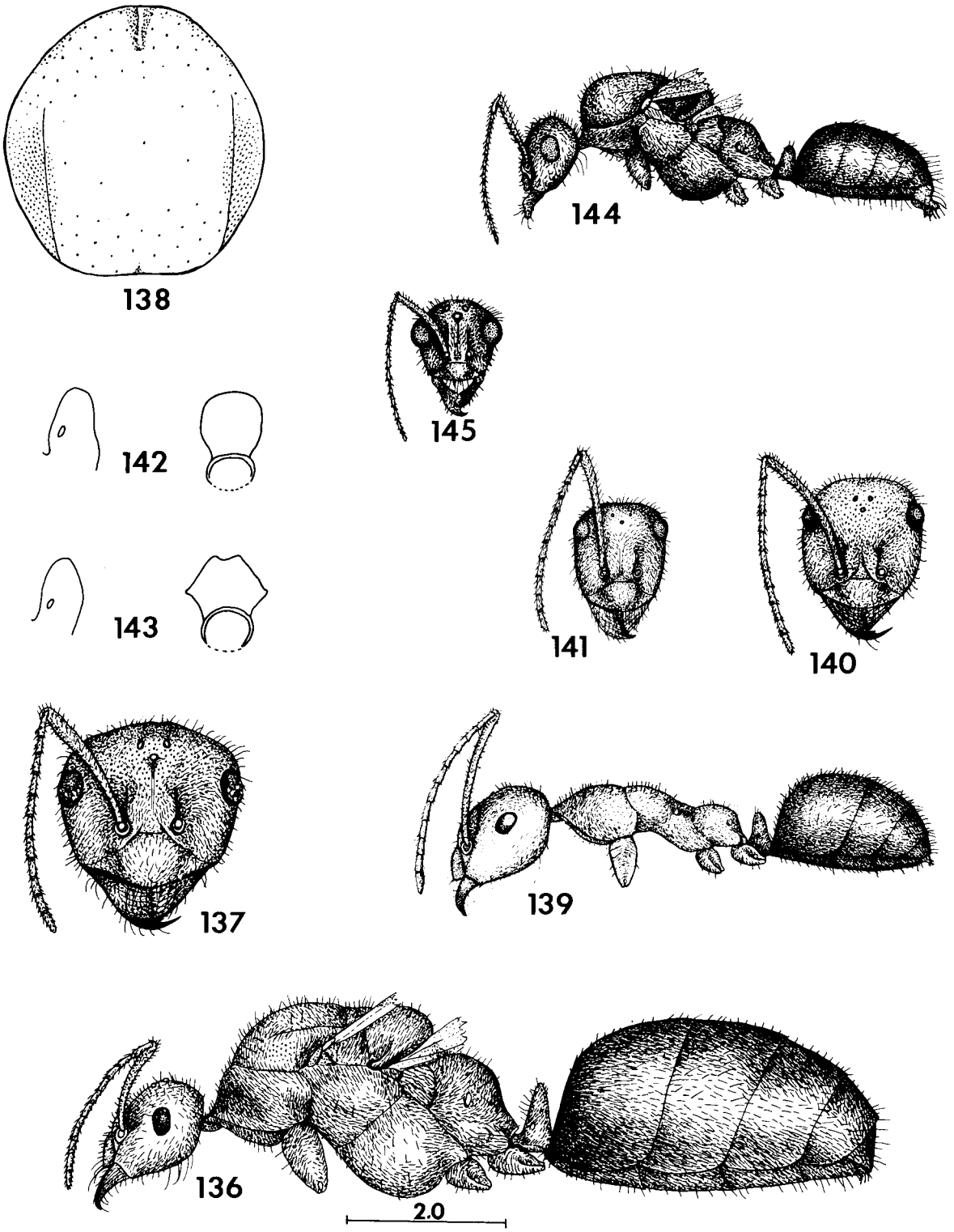
Color: Head, alitrunk and appendages ferruginous, gaster blackish brown (see DISCUSSION).

FEMALE. *Measurements.* HL 1.58–1.80; HW 1.67–1.88; SL 1.43–1.67; WL 3.8–4.3; PW 2.2–2.5.

Head: Sides straight, slightly convergent toward mandibular insertions; head as broad as, to broader than, long, CI 100–107; longer than scape, SI 88–94. Occiput, in frontal view, evenly convex from side to side, with broadly rounded lateral angles. Eye small, 1.09–1.20 × first flagellomere; OMD 1.54–1.75 × EL; OOD 3.3–5.5 × OD; IOD 2.0–3.3 × OD. Penultimate segment of maxillary palp slender, approximately parallel-sided. Mandible septemdentate.

Thorax: Moderately to very robust, PW 0.55–0.61 × WL. Scutum and scutellum moderately flattened. Basal face of propodeum ill-defined, broadly rounded into posterior face.

Petiole: Strongly compressed, crest angulate; in frontal view, crest deeply incised.



FIGURES 136–145. *M. romainei*. 136, female, lateral view; 137, head of female, frontal view; 138, mesoscutum of female, distribution of punctures; 139, major worker, lateral view; 140, head of major worker, frontal view; 141, head of minor worker, frontal view; 142, petiole of major worker, lateral (left) and posterior (right) views; 143, variant petiole of largest workers, lateral (left) and posterior (right) views; 144, male, lateral view; 145, head of male, frontal view.

Vestiture: Pubescence diffuse on front of head and vertex, denser on occiput and malar area. Sparse on dorsum of thorax, longer and moderately dense on sides and on propodeum. Dense on first four terga.

Malar area with 15–20 erect hairs visible beyond margin in frontal view; longest occipital hairs about 0.5 × MOD. Longest mesoscutal hairs about equal to longest occipital; longest scutellar hairs subequal to MOD. Pleural hairs equal to shortest scutal hairs, very sparse, separated by their own length or more. Propodeal hairs about equal to longest scutal hairs. Petiole with abundant short, erect hairs on sides and crest. Terga with abundant erect, short hairs (those on disc of second segment about 0.1 mm), but those of apical segment about twice as long as on preceding segments; sparse and short on discs of ventral segments. Erect hairs abundant on all except posterior face of scape; abundant on extensor surface of femora; sparse on inner or fore femur; abundant on tibiae. Wing margins without fringe hairs.

Integument: Clypeus moderately shiny, lightly shagreened and with sparse coarse punctures; frontal lobes finely and densely punctate; frons and vertex moderately shiny, abundantly punctate, punctures finer and denser above; occiput closely micropunctate. Malar area slightly shiny, with abundant coarse, elongate punctures. Mesoscutum shiny, middle of disc impunctate, with sparse, fine punctures toward parapside; parapsis finely, closely punctate. Scutellum uniformly finely and closely punctate, punctures separated by a diameter or more. Pleura and propodeum slightly shiny, densely and finely punctate. First four terga moderately shiny, densely micropunctate and with scattered coarse piligerous punctures.

Color: Head, alitrunk and appendages ferruginous, gaster blackish brown. Wings whitish, veins and stigma yellowish.

MALE. *Measurements.* HL 0.80–0.93 (0.85); HW 0.77–0.90 (0.82); SL 0.80–0.93 (0.90); WL 1.8–2.2 (2.2); PW 1.1–1.2 (1.1).

Head: A little longer than broad to as long as broad, CI 95–100 (96), as long as, to shorter than, scape, SI 100–108 (106); in frontal view, sides straight and distinctly convergent toward mandibular insertions; occiput, in frontal view, evenly rounded, with broadly rounded lateral angle. OMD 0.78–0.89 (0.89) × EL; OOD 2.3–2.8 (2.3) × OD; IOD 2.3–3.3 (2.3) × OD. Mandible with a single tooth on apical margin or simple.

Thorax: Moderately robust, PW 0.49–0.64 (0.52) × WL. Propodeum with strongly sloping and poorly defined basal face.

Petiole: Moderately cuneate in profile, summit subangulate; in frontal view, crest broadly, shallowly concave.

Vestiture: Pubescence generally sparse, but moderately dense on occiput, pleura and propodeum.

Cephalic hairs sparse, short, longest occipital hairs less than 0.5 × MOD; malar area with 10–15 erect hairs. Mesoscutal hairs sparse, longest equal to about 0.5 × MOD; scutellar hairs longer, longest little shorter than MOD: pleural hairs sparse, shorter than 0.5 × MOD. Propodeum with a few short hairs laterobasally and on pleura. Petiolar scale with sparse, short hairs on sides and crest. Terga with scattered short hairs, longer on apical segment; sterna with hairs longer, sparse. Short, erect hairs abundant on scape and legs. Forewing without fringe hairs; hind wing with short, sparse fringe hairs on basal half of posterior margin.

Integument. Malar area dull, with close, fine punctures; rest of head slightly to moderately shiny, closely shagreened and with scattered fine punctures; discs of scutum and scutellum moderately shiny to shiny, lightly shagreened, more faintly in middle and with scattered fine, piligerous punctures. Pleura moderately shiny, moderately shagreened and with abundant fine punctures. Disc of propodeum smooth, impunctate and shiny, side moderately shiny, with abundant fine punctures. First three terga shiny, subpolished, very faintly shagreened; remaining terga and sterna less shiny, more distinctly shagreened.

Color: Blackish brown, mandibles, antennae and legs light brownish. Wings whitish, veins and stigma yellowish.

Terminalia: Figures 177, 197, 198.

Type Material. "Described from a series of 54 workers taken by Miss Marjorie Romaine, at Cameron, ARIZONA." Data labels on the specimens read: "57 mi. N Cameron, Ariz.//5/15/32//M. Romaine." Holotype and most paratypes in LACM; additional paratypes in AMNH, MCZ, USNM.

Distribution. Western Kansas, Oklahoma and Texas, westward to Utah and central Arizona (Fig. 367).

Localities. UNITED STATES. Kansas:. Sheridan Co.: Selden, 2 Aug. 1941 (W. F. Buren; WFB). *Colorado: Pueblo Co.:* 30 mi E Pueblo, 26 Aug. 1951 (A. C. Cole; LACM). *Animas Co.:* Trinidad, 26 Aug. 1951 (A. C. Cole; LACM). *Oklahoma. Cimarron Co.:* 3 mi E. Kenton, 4 May 1951 (W. S. Creighton; LACM). *Texas: Hall Co.:* 2 mi S Turkey, 6 May 1970 (C. W. O'Brian; TTU); 6 mi SE Turkey, 21 May 1970 (C. W. O'Brien; TTU). *Lamb Co.:* NW of Olton, 3 Aug. 1968 (C. Schaefer; TTU). *Dickens Co.:* 4 mi N Dickens, 6 May 1970 (C. W. O'Brien; TTU). *Lubbock Co.:* Couch Ranch, 15 June 1968 (E. W. Huddleston; TTU). *Scurry Co.:* Fluvanna, 24 Aug. 1967 (E. W. Huddleston; TTU). *El Paso Co.:* [El Paso (Buren, 1963)]; 12.5 mi SE El Paso, 3600′, 23 Apr. 1973 (R. R. Snelling, Nos. 73–46, 47, 48; LACM); 18 mi E El Paso, 1 Sept. 1967 (E. W. Huddleston; TTU). *New Mexico: McKinley Co.:* 30 mi N Gallup, 29 July 1929 (W. S. Creighton; LACM). *Otero Co.:* White Sands, 24 Apr. 1944 (B. Rotger; USNM); White Sands Nat'l Mon., 15–17 Sept. 1951 (A. C. Cole; LACM); Tularosa Desert, no date (G. von Krockow; LACM). *Doña Ana Co.:* Mesilla Park, 12 July (J. Bequaert; MCZ); same locality, 12 July 1917 (W. M. Wheeler; MCZ); Jornada Experimental Range, 4000′, various dates (C. A. Kay, R. R. Snelling; CAK, LACM); 20 mi W Las Cruces, 18 May 1932 (A. C Cole; LACM, USNM);

Hatch, 4100′, 10 June 1951 (W. S. Creighton; LACM). *Grant Co.:* 2 mi N San Juan, 3 Sept. 1951 (A. C. Cole; LACM). *Bernalillo Co.:* Albuquerque, 4943′, 7 May 1905 (W. M. Wheeler; part of cotype series, *M. melliger mimicus,* MCZ). *Valencia Co.:* Las Lunas, 4850′, 5 Aug. 1972 (C. A. Kay; CAK, LACM). *County unknown:* Kennedy, 13 Apr. 1910 (W. D. Hunter; MCZ). *Utah: Uintah Co.:* Jensen, Dinosaur Natl. Mon., 26 June 1950 (E. V. Gregg; USNM). *Emery Co.:* Green River, 12 July 1932 (W. S. Creighton; LACM). *San Juan Co.:* Bluff, 8 July 1963 (G. F. Knowlton; UCD). *Millard Co.:* Lynndyl, 24 Aug. 1960 (G. F. Knowlton; UCD); Delta, 24 Aug. 1960 (G. F. Knowlton; UCD). *Garfield Co.:* Dixie State Park, 19 June 1964 (G. F. Knowlton; UCD). *Iron Co.:* Beryl, 25 Aug. 1960 (G. F. Knowlton; UCD). Washington Co.: Enterprise, 25 Aug. 1960 (G. F. Knowlton; UCD); Leeds, 3 June 1934 (A. H. Sturtevant; USNM). *Nevada: Eureka Co.:* 12 mi NNW Eureka, 5800′, 1 July 1971 (G. C. & J. Wheeler, No. Nev. 2246; GCW). *Arizona: Coconino Co.:* 57 mi N Cameron, 15 May 1932 (M. Romaine; type series *M. melliger semirufus* var. *romainei,* AMNH, LACM, MCZ, USNM); 30 mi N Flagstaff, 5000′, 1 Aug. 1950 (Cohn, Boone, Cazier; AMNH); Flagstaff, 9 Sept. 1951 (A. T. McClay; UCD). *Mohave Co.:* Yucca, May 1905 (W. M. Wheeler; AMNH); Willow Valley, 4 May 1972 (LACM). *Maricopa Co.:* Phoenix, May 1905 (W. M. Wheeler; AMNH); Tempe, May 1905 (W. M. Wheeler; MCZ). *Pinal Co.:* Florence, 20 July 1917 (W. M. Wheeler; MCZ). *Pima Co.:* Tucson, May 1905 (W. M. Wheeler; AMNH); Avora Valley, 15 Mar. 1968 (D. E. Surber; USNM); Continental, 19 Sept. 1936 (R. H. Crandall; USNM); Madera Cyn., Santa Rita Mts., 30 May 1963 (L. M. Martin; LACM). *Cochise Co.:* Benson, 21 July 1917 (W. M. Wheeler; MCZ). *MEXICO. Chihuahua:* Samalayuca, 6 Aug. 1950 (R. F. Smith; AMNH).

Ecology. Habitats in which this species has been collected included: Bluestem-Grama Prairie, Piñon-Juniper Woodland, Trans-Pecos Shrub Savanna and Creosote bush-Tarbush Grassland. The series from Selden, Kansas, was taken from a "road side nest." Colonies which I observed in Texas, southeast of El Paso, and at the Jornada Experimental Range, New Mexico, were all nesting in very deep, soft sand. Tumuli were low, somewhat irregular craters, with an external diameter up to 20 cm. Cole (1954) reported this ant, as *M. semirufa* "Forel" (!) from White Sands National Monument, the nests with ". . . neat, circular, sand craters . . . in open level sand areas with bunchgrasses and yucca between dunes." Although he reported that the gasters of living workers were a brilliant metallic blue color, I am unable to verify this phenomenon although I looked specifically for it in the material observed at the Jornada Experimental Range.

C. A. Kay and I attempted excavation of one colony at the Jornada Experimental Range, with largely unsatisfactory results. The nest was in deep, soft sand. While most honey ant species have a vertical, or nearly vertical, main shaft of considerable diameter descending to the nest, this species apparently does not. Rather, there are a few chambers near the surface. Descent to the nest proper is by way of a single, narrow tunnel which is very difficult to follow in the loose sand. At a depth in excess of four feet we abandoned the effort because, as the sand dried, the walls of the pit crumbled excessively. Since I found similar situations in sandy areas southeast of El Paso, this may be a normal response of this species in soil of this type. Known activity of the reproductives is summarized in Table 4.

Discussion. This species has been confused with others by previous authors. The confusion began as early as 1908, for Wheeler's cotype series of *mimicus* includes *romainei.* I have not been able to reassemble the entire type series, said to consist of ". . . numerous workers, six males and six females . . ." A pin of *mimicus* cotypes in the MCZ consisting of one female and two workers, and another pin of three worker cotypes in the LACM, are definitely *romainei;* other cotype pins, all workers, are *mimicus* as herein interpreted.

Cole described *romainei* as a variety of *semirufa* (i.e., *kennedyi*) from specimens collected 57 mi N of Cameron, Coconino Co., Ariz. The original description was not very detailed and was concerned primarily with differences between the new form and *kennedyi.* Creighton (1950) correctly recognized the similarities of this ant to *mimicus* and synonymized it with that name. Since the characteristics of *mimicus* were not at all clear at that time, the decision to do so is not surprising. It is my opinion, however, that this was incorrect and that *romainei* is an unusually distinctive species.

This medium-sized species is best recognized, in the worker and female, by the abundant erect hairs of the malar area and the uniformly short hairs on the occiput, promesonotum and gaster. The worker caste is further characterized by the rather closely micropunctate frons and vertex. The exceptionally short pleural hairs of the female are shared only with those of sympatric populations of *mimicus.* Since the malar area of the latter species is sparsely pilose, separation of the two is not difficult. When *mimicus* females possess more than two or three erect hairs on the malar area, these are still confined to the lower half of the area. In *romainei* they are evenly distributed along the entire area between the lower eye margin and the mandibular base. There are, furthermore, conspicuous erect hairs along the head margin behind the eye which project beyond the outer margin of the eye in full face view.

Workers of *romainei* from Utah and central Arizona are characterized by a weakening of the punctures of the vertex to the extent that it may be virtually impunctate at the sides. Such specimens closely resemble samples of *flaviceps* from the Mojave Desert and may not always be recognizable as *romainei.* Available material is too limited for adequate analysis, but these variant *romainei* possess some pronotal hairs which are more than 0.5 × MOD; in *flaviceps* the pronotal hairs are less than 0.5 × MOD.

The male, because it lacks conspicuous appressed pubescence on the first three terga, is readily separable from all species except *kennedy and mimicus.* The

mesoscutal hairs of *kennedyi* males are half, or more, as long as the MOD; the frons, the center of the mesoscutum and the parapsis are polished and shiny. Males of allopatric *mimicus* populations also have long pleural hairs, but those of sympatric populations are more difficult to separate. The pleural hairs appear to average longer in such *mimicus*, about 0.12 mm, while in *romainei* they are shorter, about 0.08 mm.

The color of the head and thorax of *romainei* workers varies from light to medium ferruginous in the samples from Oklahoma, Texas, New Mexico, Arizona and Utah. The samples from Selden, Kansas, and Las Lunas, New Mexico, are unusually dark. These approach the brownish ferruginous color of *mimicus* from the same area but may be recognized by the closely micropunctate frons, densely pubescent frons, occiput, promesonotum and third tergum and more pilose malar area.

The Selden series consists of 21 workers from a single nest. In this series, 16 (76%) have a CI or 90 or more. In a similar series from the type locality and a single nest, selected as randomly as possible, 14 (67%) possess CI of 89 or less. The sample from Kenton, Oklahoma, consists of a dozen individuals of which 10 (83%) have a CI in excess of 90. These samples are very limited, but it appears there may be a tendency toward relatively broader heads in northeastern samples.

Another variation involves large workers in samples from New Mexico and Texas. More specimens with HW at or above 1.23 mm have the petiolar scale broadened at the level of the spiracle, with the spiracle itself prominently projecting. When the petiole is viewed from above, the scale, excluding the spiracle, is about twice wider than long. This contrasts sharply with the usual shape, the scale 1.5 or less wider than long. This feature, apparently unique in *Myrmecocystus*, is not consistent; one worker, HW 1.23 mm, has a normal appearing petiole.

Smith (1935) recorded "melliger subsp. or var." from Oklahoma: Wichita Natl. Forest; Comanche Co.; Washita Co. I have been unable to locate any specimens from these localities but suspect they may prove to be *romainei*. They could, however, be *mimicus* and so these records must remain questionable for the present.

Flaviceps Group

Myrmecocystus (Endiodioctes) flaviceps Wheeler

Figures 146–154, 166, 178, 201, 202

Myrmecocystus melliger mimicus var. *depilis*, Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:354 *(in part)*; Cook 1953. Ants of California, pp. 342–343 *(in part)*.

Myrmecocystus yuma var. *flaviceps* Wheeler 1912. Psyche 19:177. ♀; Cook 1953. Ants of California, p. 353 *(in part)*.

Myrmecocystus flaviceps, Creighton 1950. Bull. Mus. Comp. Zool. 104:443; Wheeler and Wheeler 1974. Ants of Deep Canyon, p. 119, 121–122.

Myrmecocystus melliger subsp. *mimicus*, Cook 1953. Ants of California, p. 344 *(in part)*.

Diagnosis. Worker: Malar area with twelve or fewer erect hairs; pronotal hairs short, stiff; third tergum with abundant appressed pubescence; gaster uniformly brown, without mediobasal yellowish blotches on first and second terga; CI usually (over 80%) in excess of 90; mandible septemdentate. *Female:* penultimate segment of maxillary palp slender, approximately parallel-sided; punctures of parapsis variably spaced, of two sizes; discs of second and third terga very sparsely punctate and sparsely pubescent; fore femur with few or no erect hairs on inner and dorsal faces, the outer and ventral faces with abundant long hairs; malar area with numerous erect hairs. *Male:* ventral lobe of aedeagus convex in profile; posterior half of mesoscutum wholly or partly polished; first two terga with abundant appressed pubescence; occipital hairs always less than 0.75 × MOD; HW less than 0.8 mm.

WORKER. *Measurements.* HL 0.83–1.23 (0.95); HW 0.73–1.23 (0.87); SL 0.97–1.43 (1.07); WL 1.23–1.80 (1.27); PW 0.53–0.87 (0.57).

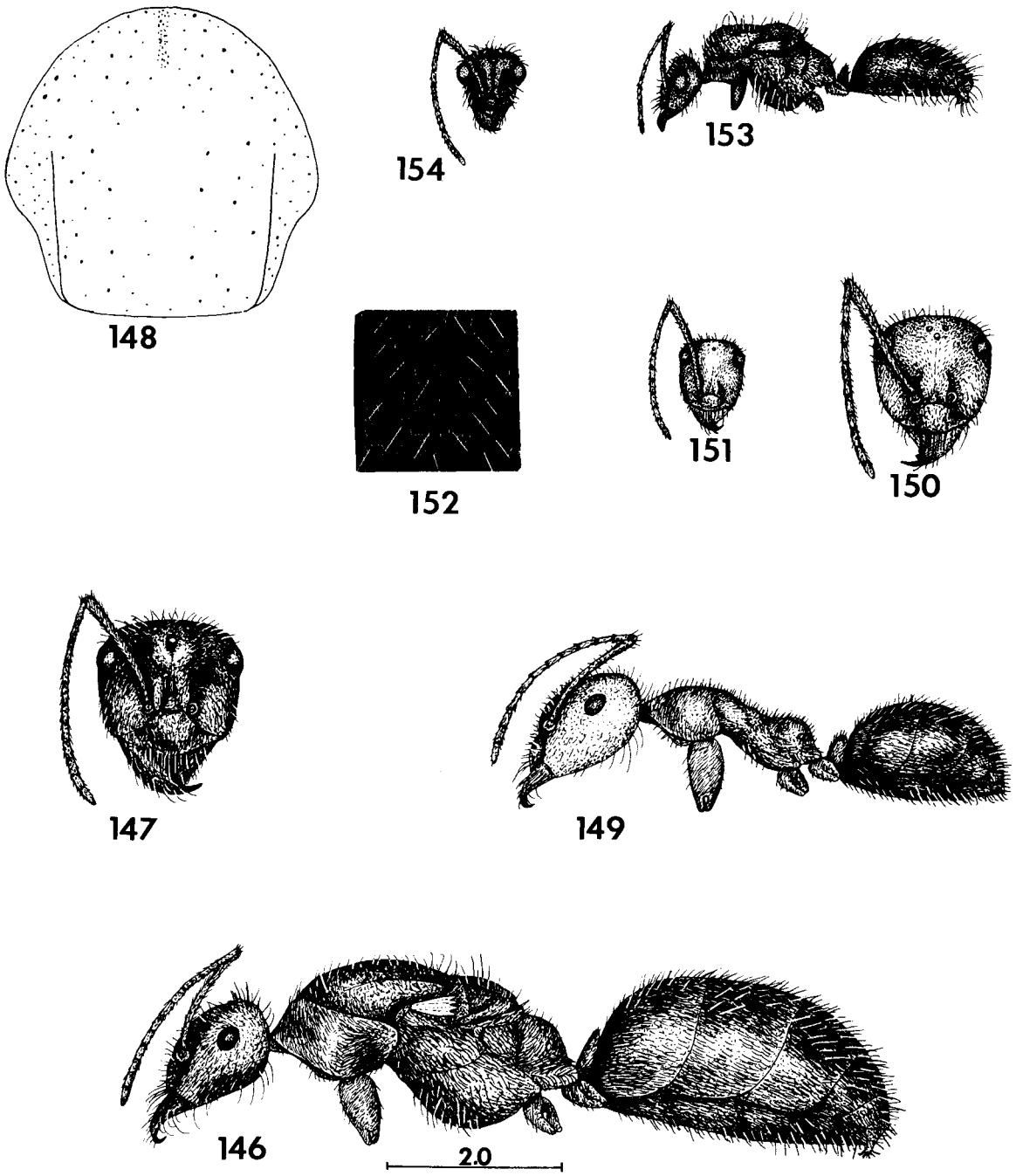
Head: Longer than broad in small workers to slightly broader than long in largest, CI 87–103 (91), over 90 in more than 80% of samples; HL less than SL, SI 108–129 (123); in frontal view broadest at or below lower eye margin, sides straight or barely convex, little or not at all convergent toward mandibular insertion. Occiput, in frontal view, evenly rounded from side to side, without lateral corners. Eye small, 0.75–0.83 (0.75) × first flagellomere; OMD 1.38–1.88 (1.63) × EL. Mandible usually with seven teeth, range: 6–8.

Thorax: Slender to moderately stout, PW 0.41–0.49 (0.45) × WL; mesonotum evenly sloping to metanotum. Propodeum higher than long; in profile, juncture of basal and posterior faces broadly rounded.

Petiole: In profile, bluntly cuneate, summit broadly rounded; crest, from behind, flat or slightly convex, without median notch.

Vestiture: Cephalic pubescence dilute, producing weak sheen on malar area and frons, more pronounced on occiput; pubescence moderately dense on thorax; denser on first three terga.

Malar area, in frontal view, with twelve or fewer fine, erect hairs; longest occipital hairs about 0.5 × MOD; pronotal disc with 10–14 short, erect hairs, longest 0.5, or less, × MOD; mesonotum with about 12 short, erect hairs dorsally, longest less than 0.5 × MOD; propodeum with about an equal number on basal face; crest and sides of petiole with a few very short, erect hairs. First three terga with sparse discal hairs which are shorter than apical width of hind tibia, hairs longer on apical margins, succeeding segments and on sterna. Short, erect to subdecumbent hairs numerous on anterior and lateral surfaces of scape, all femora (except inner face of fore femur) and extensor surface of tibiae.



FIGURES 146–154. *M. flaviceps*. 146, female, lateral view; 147, head of female, frontal view; 148, mesoscutum of female, distribution of punctures; 149, major worker, lateral view; 150, head of major worker, frontal view; 151, head of minor worker, frontal view; 152, major worker, vestiture of third tergum; 153, male, lateral view; 154, head of male, frontal view.

Integument: Head lightly shagreened and shiny, with close micropunctures on frons and frontal lobe; coarser and sparser on occiput. Thoracic dorsum moderately shiny, slightly and closely shagreened, sides and propodeum duller. First three terga slightly shiny, closely shagreened and micropunctate.

Color: Normal: Head, thorax and appendages yellowish-ferruginous, head a little darker on frons and occiput; gaster light to medium brownish. Baja California: Frons, occiput, thorax and gaster dark brownish; clypeus, mandible and malar area yellowish; legs medium brownish.

FEMALE. *Measurements.* HL 1.47–1.63; HW 1.57–1.73; SL 1.37–1.53; WL 3.4–3.8; PW 1.9–2.5.

Head: Slightly to distinctly broader than long, CI 102–111, longer than to as long as scape, SI 90–100; malar area, in frontal view, barely convex, not notably convergent toward mandibular insertion. Occiput, in frontal view, gently convex, lateral corners broadly rounded. Eye small, 1.00–1.45 × first flagellomere; OMD 1.46–1.73 × EL. OOD 4.00–4.34 × OD; IOD 2.66–3.33 × OD. Mandible with seven to nine, usually eight, teeth. Penultimate segment of maxillary palp approximately parallel-sided, not notably narrowed at base or apex.

Thorax: Robust, PW 0.53–0.69 × WL. Posterior half of mesoscutum, scutellum and metanotum flattened, in profile, forming a continuous slope to base of propodeum. Propodeum, in profile, usually evenly, gently convex, without defined basal and posterior faces; rarely with basal and posterior faces distinct.

Petiole: Sharply cuneate in profile, summit narrow; in frontal view, crest weakly to strongly angularly incised.

Vestiture: Cephalic pubescence moderately dense on occiput, lighter on frontal lobes and malar area, sparse elsewhere. Thoracic pubescence sparse on mesoscutum and scutellum, dense elsewhere. Gastric pubescence moderately dense basally and on sides of terga, but with broad median areas of first four segments very sparsely pubescent.

Side of head, in frontal view, with six or more long, slender flexuous hairs; occipital hairs erect, slender, longest less than MOD. Mesoscutum with sparse erect hairs, longest less than MOD; scutellum with sparse erect hairs, some of which are about equal to EL; pleura with scattered erect hairs similar to those of scutum. Propodeum with scattered erect hairs on all surfaces, longest less than MOD. Petiole with short erect hairs on sides and crest. Terga with sparse, short erect hairs, those of margins not conspicuously longer than those of discs; hairs of fifth tergum longer than those of first four segments. Scape with scattered short, suberect hairs on all except inner face and abundant shorter subdecumbent hairs. Fore femur with abundant long, erect hairs on ventral and outer faces, none on inner and dorsal faces; mid and hind femora and all tibiae with abundant short subdecumbent to erect hairs. Hind wing with fringe hairs along posterior margin.

Integument: Cephalic surfaces shiny; sides of clypeus irregularly, lightly shagreened and with scattered coarse punctures; malar area with abundant, fine, often elongate, punctures of variable size; frontal lobes with punctures irregularly spaced, often with impunctate areas, punctures of two sizes; frons with extensive impunctate areas on either side of midline, otherwise with sparse, fine punctures; occiput closely, finely micropunctate and with scattered coarser punctures. Scutum shiny, with scattered coarse punctures, sparser in middle; parapsis with punctures irregularly spaced and of two sizes. Median area of scutellum sparsely punctate, marginal areas more finely and closely punctate. Pleura slightly shiny, anepisternum a little more coarsely and less closely punctate than katepisternum. Propodeum dull, closely shagreened. Four basal terga moderately shiny on discs, lightly shagreened and with only sparse setigerous punctures.

Color: Head dark ferruginous with infuscated occipital and frontal areas; thorax dark brownish; gaster dark brown to blackish, with margins of segments yellowish; appendages medium brownish. Wings whitish, veins and stigma yellowish to brownish yellow.

MALE. *Measurements.* HL 0.68–0.80; HW 0.70–0.80; SL 0.77–0.93; PW 0.77–1.10; WL 1.50–1.90.

Head: Longer than broad to slightly broader than long, CI 96–102; distinctly shorter than scape, SI 108–123; in frontal view, malar margins straight, distinctly convergent toward mandibular insertions; occipital margin evenly convex, without defined lateral angles. OMD 0.67–1.00 × EL; OOD 2.50–3.50 × OD; IOD 3.00–3.50 × OD. Mandible without preapical notch, cutting margin edentate.

Thorax: Moderately robust to robust, PW 0.51–0.64 × WL. Propodeum without clearly defined basal face.

Petiole: Thick in profile, bluntly cuneate; crest, in frontal view, narrowly, shallowly, angularly incised.

Vestiture: Pubescence sparse on head and thorax, denser on propodeum; very scattered on first tergum, more conspicuous, but still sparse, on next three segments.

Cephalic pilosity fairly abundant, usually with about six hairs in malar area in frontal view; occipital hairs fine, longest less than half MOD. Mesoscutal hairs sparse, longest less than 0.5 × MOD; scutellar hairs sparse, longest a little less than MOD; pleural hairs sparse, none longer than 0.5 × MOD; propodeum with scattered hairs on side and across base, longest about 0.5 × MOD. Petiole with sparse short hairs on side and crest. Gaster with sparse, long, slender hairs, longest not exceeding MOD. Scape with abundant suberect to erect hairs, much sparser, or absent, from posterior face. Femora with suberect to erect hairs on all surfaces; tibiae with short, sparse, suberect hairs on extensor surface, finer, shorter, subdecumbent hairs

elsewhere. Posterior margin of hind wing with fringe hairs.

Integument: Head moderately shiny, lightly shagreened, nearly smooth on vertex; with scattered fine setigerous punctures. Discs of scutum and scutellum shiny, lightly shagreened, usually with polished median areas of irregular extent, and with scattered setigerous punctures; pleura slightly shiny, closely shagreened and with sparse setigerous punctures. Middle of propodeum smooth and shiny, segment otherwise closely shagreened and slightly shiny. Gastric segments moderately shiny, lightly shagreened, median areas of terga one to three often subpolished.

Color: Medium to dark brownish, gaster sometimes more yellowish (callows?); flagellum, mandibles and legs lighter. Wings whitish, veins and stigma yellowish to brownish yellow.

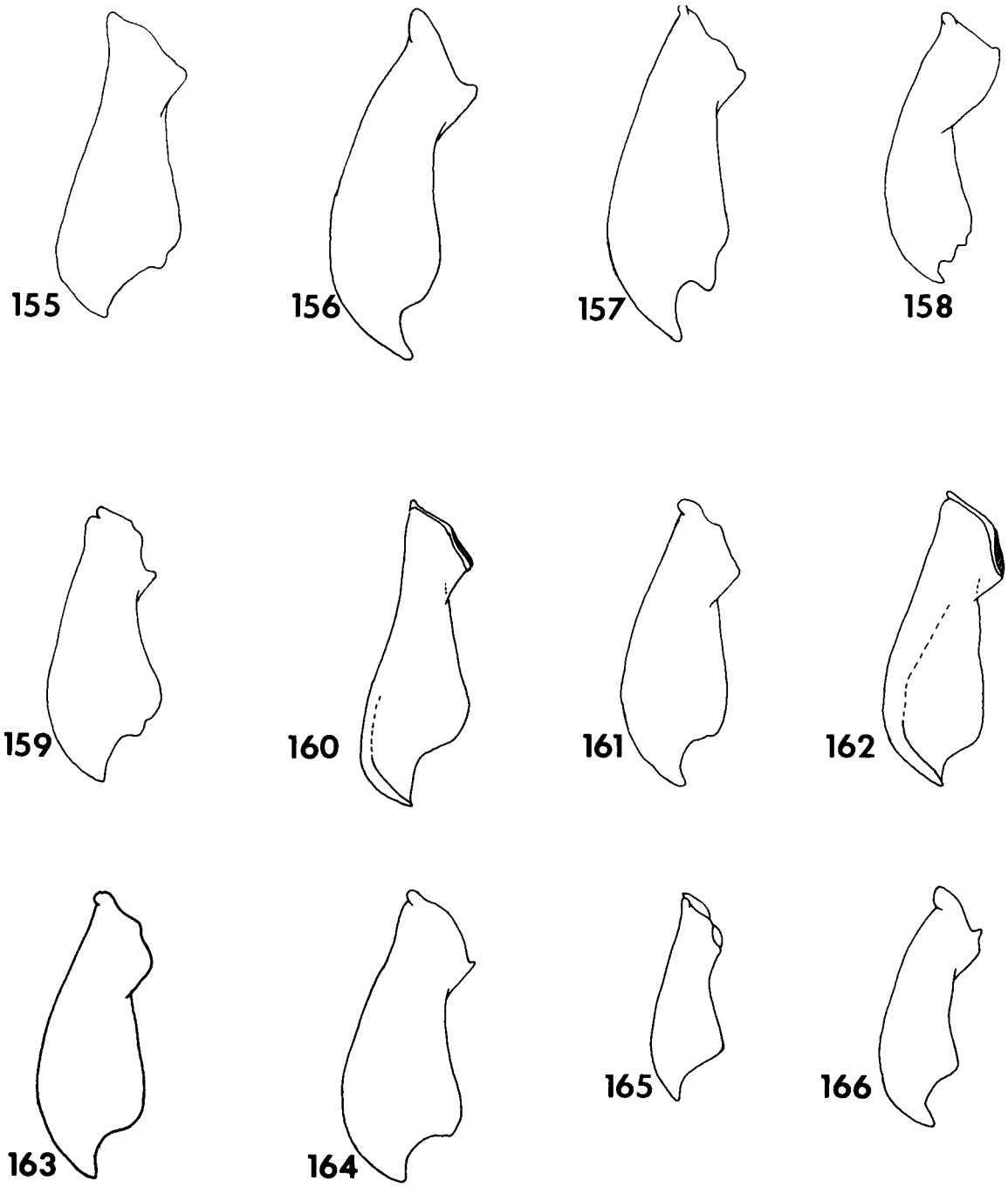
Terminalia: Figures 178, 201, 202.

Type Material. Wheeler 1913: "Described from numerous workers taken from several colonies at Yuma, Arizona . . ." Lectotype, by present designation, agreeing with the above worker description and parenthetical figures: Yuma, Ariz., 26 Nov. 1910, W. M. Wheeler, in AMNH. Lectoparatype workers with same data in AMNH, LACM, MCZ.

Distribution. Southwestern Utah and southern Nevada to northern Sonora and central Lower California (Fig. 366).

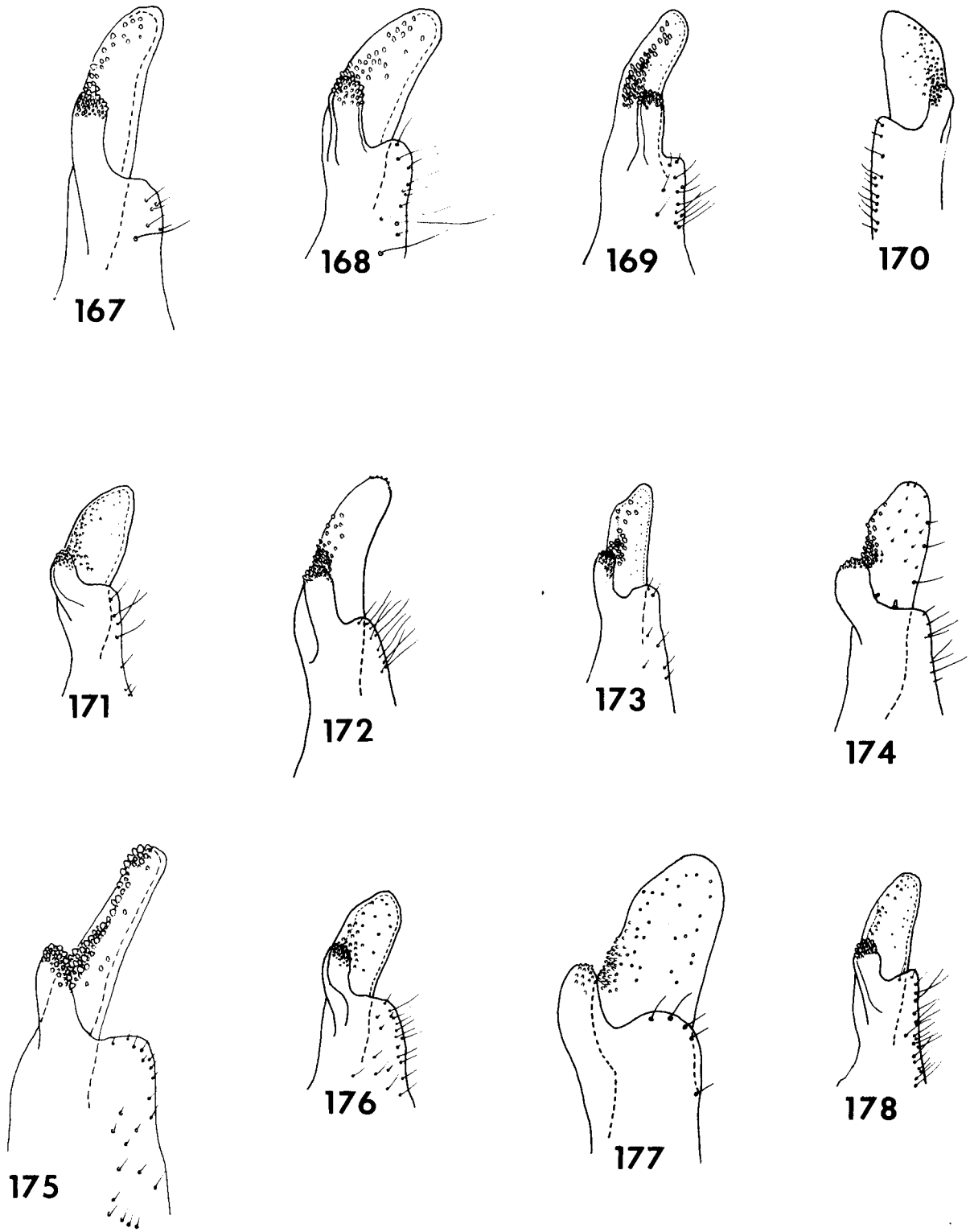
Localities. UNITED STATES. Utah. Millard Co.: 5 & 8 mi N Black Rock, 14 May 1970 (G. F. Knowlton & D. W. Davis; LACM, USU); 30 & 32 mi S Deseret, 14 May 1970 (G. F. Knowlton & D. W. Davis; LACM, USU). *Washington Co.:* Harrisburg, 13 May 1970 (G. F. Knowlton & D. W. Davis; LACM, USU). *Nevada: Esmeralda Co.:* Roosevelt Well, 4400′, 9 mi SW Gold Point, 7 Mar. 1968 (G. C. & J. Wheeler, No. Nev. 274; GCW); 11 mi E Lido, 5000′, 13 Apr. 1970 (G. C. & J. Wheeler, No. Nev. 767; GCW); Dyer, 5100′, 28 May 1970 (G. C. & J. Wheeler, No. Nev. 1027; GCW). *Nye Co.:* 7 mi N Tonopah, 7000′, 30 Oct. 1967 (G. C. & J. Wheeler, No. Nev. 269; GCW); 13 mi SW Beatty, 3800′, 15 Apr. 1970 (G. C. & J. Wheeler, No. Nev. 794; GCW); Beatty, 3400′, 17 Sept. 1952 (W. S. Creighton; LACM). *Clark Co.:* Red Rock Cyn., 3900′, 21 Mar. 1970 (G. C. & J. Wheeler, No. Nev. 652; GCW); 8 mi W Searchlight, 4100′, 13 Mar. 1970 (G. C. Wheeler, No. Nev. 610; GCW); 5 mi W Boulder City, 2000′, 18 Oct. 1952 (W. S. Creighton; LACM). *California: Inyo Co.:* 9-mile Cyn., 3400′, 7 mi S Little Lake, 17 June 1969 (R. R. Snelling, Nos. 69–230, 231; LACM); Grapevine R. Sta., 2100′, Death Valley Natl. Mon., 25 Jan. 1968 (G. C. & J. Wheeler, No. Calif. 300; GCW); Mesquite Spg., 1600′, D. V. N. M., 1 May 1952, (W. S. Creighton; LACM); Midway Well, 100′, D. V. N. M., 4 Mar. 1968 (G. C. & J. Wheeler, No. Calif. 313; GCW); same locality and collectors, 31 Oct. 1967 (No. Calif. 207; GCW); same locality, 12 Nov. 1968 (R. R. Snelling, No. 68–131; LACM); Tule Spg., −250′, D. V. N. M., 5 Mar. 1968 (G. C. & J. Wheeler, No. Calif. 323; GCW); Salt Well, −240′, D. V. N. M., 25 Jan. 1968 (G. C. & J. Wheeler, No. Calif. 299; GCW); Shorty's Well, −100′, D. V. N. M., 4 Nov. 1967 (R. R. Snelling, Nos. 67–278, 279; LACM); same locality and collector, 11 Nov. 1968 (No. 68–129; LACM); Ashford Mill, 0′, D. V. N. M., 28 Apr. 1952 (W. S. Creighton; LACM). *Kern Co.:* China Lake Naval Sta., 13–14 Nov. 1971 (D. E. Fortsch; LACM). *San Bernardino Co.:* Needles, 1–6 Apr. 1918 (J. C. Bradley; CU); 10 mi NE Mitchell Caverns, 4100′, 3 Apr. 1971 (R. J. Hamton; RJH); S end Marble Mts., 900′, 3 mi NE Cadiz, 30 Jan. 1967 (R. R. Snelling; LACM) Cottonwood Spg., 4400′, Granite Mts., 18 mi N Amboy, 6 Nov. 1967 (R. R. Snelling, No. 67–286; LACM); Pisgah Crater, 11 Feb., 11 Mar., 11 Nov. 1961, 17 Nov. 1962 (Norris & Heath; LACM); NW of Barstow, 2100′, May 1971 (W. R. Costa; LACM); Joshua Tree Natl. Mon., 7 mi SE Joshua Tree, 7 Oct. 1967 (R. J. Hamton; LACM, RJH); Lower Covington Flat, Joshua Tree Natl. Mon., 26 June 1966 (R. J. Hamton; RJH); Cajon Cyn., 4000′, 7.7 mi NW Cajon Jct., 13 Mar. 1972 (R. R. Snelling, No. 72–5; LACM). *Riverside Co.:* Coon Hollow, 525′, Mule Mts., 1 Feb. 1967 (R. R. Snelling; LACM); 3 mi NE Old Dale Jct., Joshua Tree Natl. Mon., 6 Apr. 1967 (R. J. Hamton; LACM, RJH); Fan Hill, Joshua Tree Natl. Mon., 26 Jan. 1967 (R. J. Hamton; RJH); Upper Covington Flat, 5325′, Joshua Tree Natl. Mon., 10 July 1966 (R. R. Snelling; LACM); Shaver's Well, 500′, 8 Mar. 1964 (R. R. Snelling; LACM); 3 mi W Shaver's Well, 1 Mar. 1964, 26 Mar. 1966 (R. R. Snelling; LACM); 12 mi ENE Mecca, 12 May 1968 (G. C. & J. Wheeler, No. Calif. 474; GCW); 7 mi E Mecca, 1 Nov. 1970 (R. J. Hamton; RJH); Pushawalla Palms, 6 Dec. 1967 (G. C. & J. Wheeler, No. Calif. 270; GCW); 7.1 mi N Indio, 1100′, 12 Oct. 1968 (R. R. Snelling, No. 68–125; LACM); 1.5 mi N Thousand Palms, 190′, 5 Feb. 1967 (R. R. Snelling; LACM); 3 mi E Thousand Palms, 100′, 16 Feb. 1963 (W. S. Creighton; LACM); same locality, 21 Feb. 1972 (R. R. Snelling, No. 72–1; LACM); Palm Desert, 1 Dec. 967 (G. C. & J. Wheeler, No. Calif. 221; GCW); Deep Cyn., numerous dates and collectors (LACM, GCW, CIS); Palm Springs, various dates (J. C. Bradley; CU, LACM). *Imperial Co.:* 10 mi W Winterhaven, 100′, 24 Oct. 1952 (W. S. Creighton; LACM). *San Diego Co.:* 5 mi N Descanso, 3000′, 12 July 1971 (J. H. Hunt, No. 409; LACM). *Arizona: Mohave Co.:* Yucca, May 1905 (W. M. Wheeler; AMNH). *Pinal Co.:* nr. Casa Grande, Dec. 1964 (W. A. Iselin; LACM); 8 mi N Casa Grande, 1300′, 29 Oct. 1952 (W. S. Creighton; LACM). *Pima Co.:* Abra Wash, 1300′, Organpipe Cactus Natl. Mon., 28 Mar. 1952 (W. S. Creighton; LACM); Quitobaquito, 900′, Organpipe Cactus Natl. Mon., 31 Mar. 1951 (W. S. Creighton; LACM). *Yuma Co.:* 45 mi S Quartzsite, 13 Apr. 1963 (G. I. Stage; LACM); 6 mi E Aztec, 200′, 28 Oct. 1952 (W. S. Creighton; LACM); Dateland, 150′, 27 Oct. 1952 (W. S. Creighton; LACM); Wellton, 150′, 27 Oct. 1952 (W. S. Creighton; LACM); Gila Mts., 700′, 21 Oct. 1952 (W. S. Creighton; LACM); Vintner, 150′, 26 Oct. 1952 (W. S. Creighton; LACM); Blaisdell, 200′, 26 Oct. 1952 (W. S. Creighton; LACM, Yuma, 26 Nov. 1910 (W. M. Wheeler, cotypes of *M. yuma flaviceps;* AMNH, LACM, MCZ). *MEXICO. Sonora:* 2 mi N Sonoyta, 31 Oct. 1952 (W. S. Creighton; LACM), 22 mi S Sonoyta, 800′, 1 Nov. 1952 (W. S. Creighton; LACM). *Baja Calif.:* 11 mi E Tecate, 3 May 1964 (R. R. Snelling; LACM); Bahía San Luis Gonzaga, 0′, 19 Feb. 1969 (R. R. Snelling, No. 69–4; LACM); Calamajué, 1100′, 19 Feb. 1969 (R. R. Snelling, No. 69–6; LACM); 5 mi W Calamajué, 850′, 20 Feb. 1969 (R. R. Snelling, No. 69–10; LACM); 35.3 mi S El Marmolito, 800′, 22, 23 Feb. 1969 (R. R. Snelling, Nos. 69–16, 17, 18); Calmalli, 1200′, 23 Feb. 1969 (R. R. Snelling, No. 69–19); 3 mi NW Camalu, 29 Mar. 1970 (E. M. Fisher; LACM); 2 mi S Rancho Mezquital, 10 Oct. 1972 (E. M. Fisher; LACM). *Baja Calif. Sur:* 8 mi SW El Arco, 23 Feb. 1969 (R. R. Snelling, No. 69–25; LACM); 26.9 mi S El Arco, 475′, 24 Feb. 1969 (R. R. Snelling, No. 69–30, 31; LACM); 3 mi W Las Parras, 1700′, 1 Mar. 1969 (R. R. Snelling, No. 69–57; LACM).

Ecology. Wheeler (1912) noted that craters of this ant were about 6–8 in. in diameter with entrances

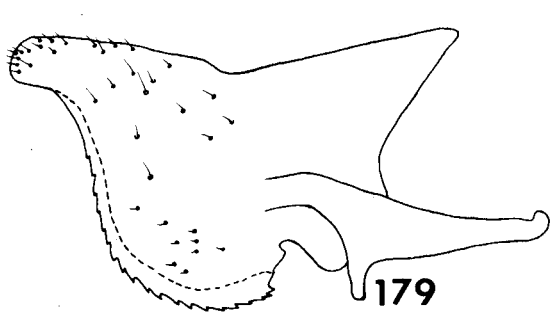


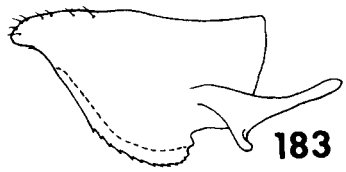
FIGURES 155–166. Male mandibles. 155, *M. mendax;* 156, *M. placodops;* 157, *M. semirufus;* 158, *M. depilis;* 159, *M. mimicus;* 160, *M. kathjuli;* 161, *M. kennedyi;* 162, *M. nequazcatl;* 163, *M. wheeleri;* 164, *M. koso;* 165, *M. romainei;* 166, *M. flaviceps.*

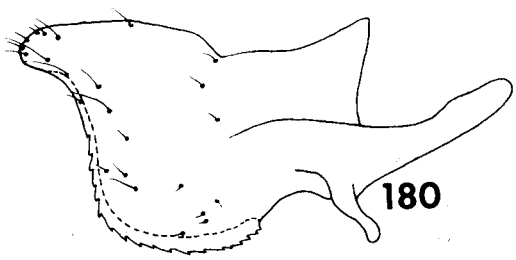
nearly 0.5 in. across. The nest crater figured by Wheeler (1908:367, Fig. 14) as that of *mimicus* from Needles, California, probably belongs to this species. Wheeler and Wheeler (1974), studying this ant at Deep Canyon, California, figured two nest craters. They reported 38 samples from the Desert Biome: Larrea-Palo Verde, 12; Cholla-Palo Verde, 25; Agave-Ocotillo, 1. The nests which they observed were larger than those noted by Wheeler, the craters 10–16 in. in diameter (but the one in figure 44 does not seem nearly so large) with

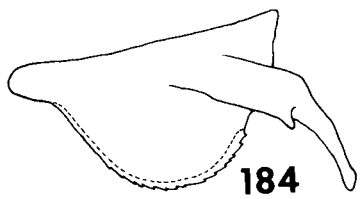


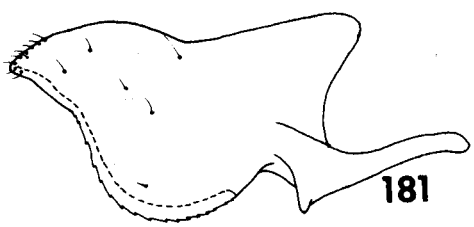
FIGURES 167–178. Male volsellae (inner view). 167, *M. mendax;* 168, *M. placodops;* 169, *M. semirufus;* 170, *M. depilis;* 171, *M. mimicus;* 172, *M. kathjuli;* 173, *M. kennedyi;* 174, *M. nequazcatl;* 175, *M. wheeleri;* 176, *M. koso;* 177, M. *romainei;* 178, *M. flaviceps.*

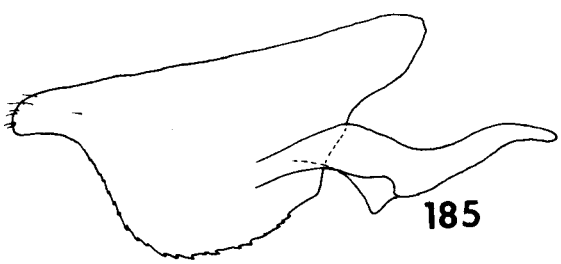


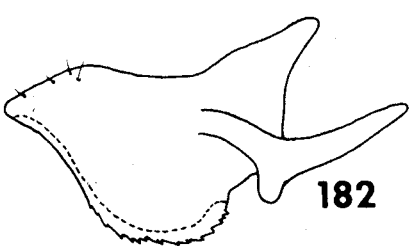


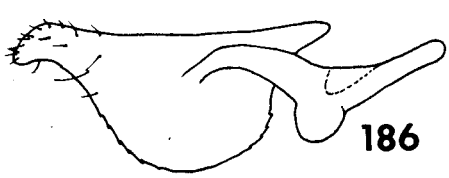




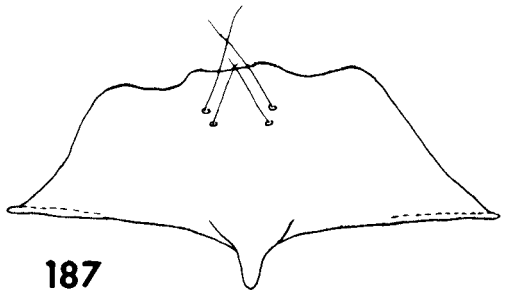


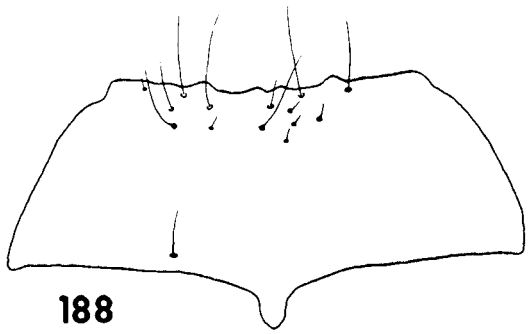


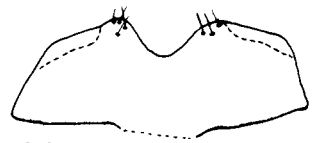


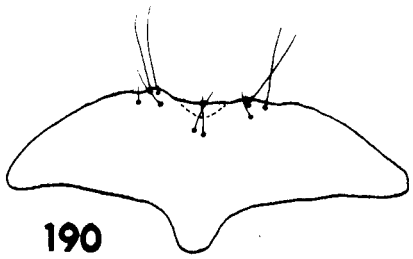


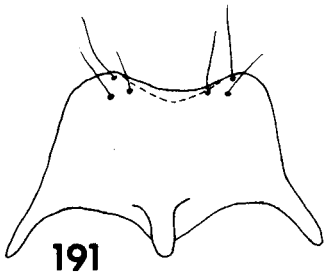
FIGURES 179–186. Male aedeagi, lateral view. 179, *M. mendax;* 180, *M. placodops;* 181, *M. semirufus;* 182, *M. depilis;* 183, *M. mimicus;* 184, *M. kennedyi;* 185, *M. kathjuli;* 186, *M. nequazcatl.*

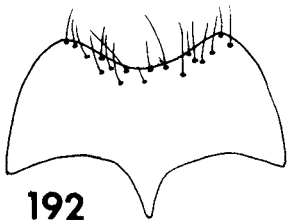


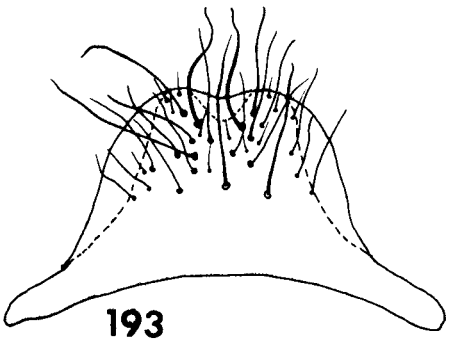


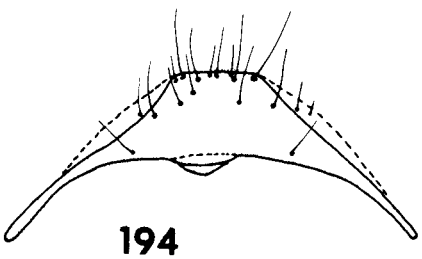




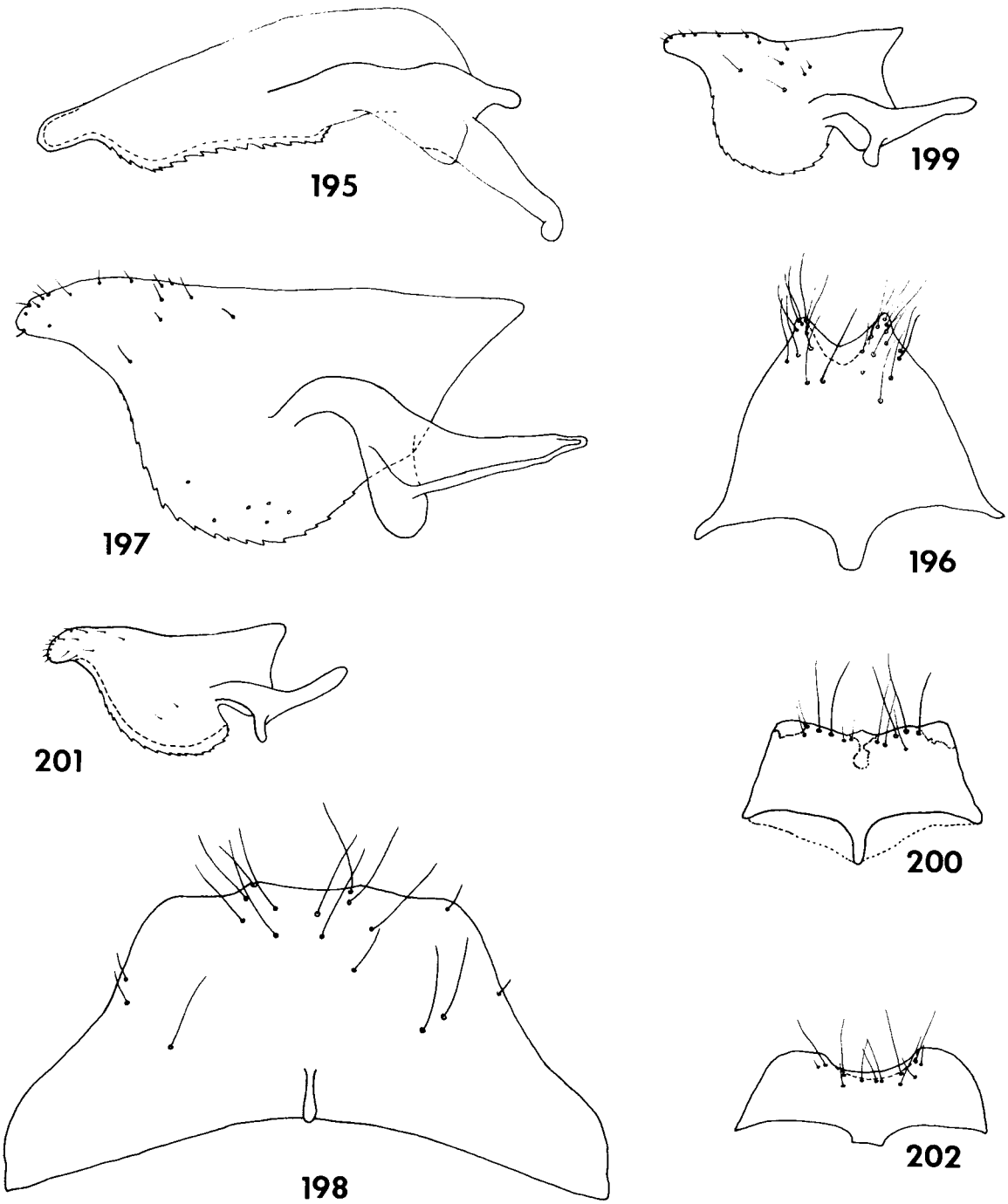








FIGURES 187–194. Male seventh sterna. 187, *M. mendax;* 188; *M. placodops;* 189, *M. semirufus;* 190, *M. depilis;* 191, *M. mimicus;* 192, *M. kennedyi;* 193, *M. kathjuli;* 194, *M. nequazcatl.*



FIGURES 195–202. Male aedeagi and seventh sterna, respectively. 195, 196, *M. wheeleri;* 197, 198. *M. romainei;* 199, 200, *M. koso;* 201, 202, *M. flaviceps.*

entrances 1.5–3.0 in. across. Alate females were found in the nests on 1 December.

Participation in a biocenose on *Opuntia echinocarpa* was observed by Wheeler and Wheeler. Other insects noted to be present were: ". . . mealybugs, aphids, other ants *(Solenopsis xyloni),* and braconids [*Lysiphlebus testaceus* (Cresson)] . . ." They further noted workers of this ant at extrafloral nectaries of *Euphorbia micromera.*

Habitats for this species include Juniper Steppe Woodland, Great Basin Sagebrush, Saltbush-Greasewood, Creosote bush, Creosote bush-Bur sage, and Palo

Verde-Cactus shrub communities. The ant is a diurnal forager, primarily as a scavenger-predator. Considerable quantities of nectar are taken from floral and extrafloral nectaries as well as indirectly through solicitation of mealybugs and aphids. Repletes were found in colonies near Shorty's Well, Death Valley.

Seasonal occurrence of reproductives is noted in Table 5. Creighton found the species flying after a light rain on 16 Feb. 1963 near Thousand Palms, California.

Discussion. Wheeler originally described this as a variety of *yuma,* but noted that it would perhaps ultimately rank as an independent species. The abundance of differences, which here place the two in different subgenera, more than justifies that assumption.

When Creighton (1950) elevated *flaviceps* to full species he apparently did so because it and *yuma* were known to be sympatric. There is no evidence that he knew either from other than their type series and in the case of *flaviceps* the types are in very poor condition. Creighton separated the two on the basis of head shape and color.

The type series consists wholly of minor and media workers, some of them callow, and is exceptionally poorly mounted. I have been able to examine about two dozen of these specimens and between them have accumulated the characters permitting the present interpretation. As now understood, this is a western form allied to *romainei* which replaces that species in low desert areas. It is a variable species, and possibly the present interpretation is too conservative.

There is some variation in the size of this species, other than the normal polymorphic variation. Workers from Calmalli and 26.9 mi S of El Arco, in Lower California, are the largest examples seen. The head length of the larger workers from these series is in excess of 1.4 mm. In these large individuals, the sides of the head are strongly convex, the head approaching the orbiculate condition of *placodops* and *intonsus*. Large workers from a sample collected 35 mi S of El Marmolito, Baja California, have the head length somewhat less (about 1.3 mm), but still retain the semiorbiculate shape.

By contrast, specimens from more northern stations tend to be distinctly smaller. Samples from California yield the following maximum head length: 1.25 mm (Midway Well, Death Valley; Shaver's Well, Riverside Co.), 1.18 mm (Granite Mts., San Bernardino Co.), 1.15 mm (Coon Hollow, Riverside Co.) and 1.05 mm (Marble Mts., San Bernardino Co.). In these more northern samples the sides of the head, even in the largest workers, are straight or but slightly convex. Rarely are individuals with suborbiculate heads encountered.

The pattern of erect hairs is subject to great variation. The samples from central Lower California generally have six, or fewer, hairs on the malar area in frontal view. The scape hairs are numerous and at right angles to the long axis of that segment. The fore femur has numerous short erect hairs on the anterior face. The seta count for the hind tibia is in excess of 30. The cotypes from Yuma, Arizona, are similar but the hairs of the scape are finer, and are mostly reclinate; the fore femur is without erect hairs on the anterior face. The hind tibia have far fewer erect hairs, the seta count ranging from 15–20. Specimens from the Granite Mts. have 10 or more erect hairs on the malar area, the fore femur with numerous hairs on the anterior face and a seta count of 30 or more for the hind tibia. The few specimens from Sonoyta, Sonora, have the scape setae exceptionally fine; many of these are subappressed and it is difficult to achieve a meaningful seta count. In this sample the fore femur lacks erect hairs on the anterior face and the setae of the hind tibia are from 12–18.

Although the third tergum typically is uniformly covered with fine appressed pubescence, producing the characteristic gastric sheen, this is by no means con-

TABLE 5

Activity of Reproductives of *M. flaviceps* Wheeler

Locality	Date	Activity
ARIZ., Dateland	27 Oct. 1952	♂♂ in nest
ARIZ., near Casa Grande	Dec. 1964	♂♂, ♀♀ in nest
CALIF., Fan Hill	26 Jan. 1967	♂♂, ♀♀ in nest
CALIF., 3 mi NE Cadiz	30 Jan. 1967	♂♂, ♀♀ in nest
CALIF., 1.5 mi N Thousand Palms	5 Feb. 1967	♂♂, ♀♀ in nest
CALIF., 3 mi E Thousand Palms	16 Feb. 1963	mating flight after rain
CALIF., Shaver's Well	8 Mar. 1964	♂♂, ♀♀ in nest
CALIF., 3 mi W Shaver's Well	26 Mar. 1966	♂♂, ♀♀ in nest
CALIF., 7.1 mi N Indio	12 Oct. 1968	♀♀ in nest
CALIF., Shorty's Well	4 Nov. 1967	♂♂, ♀♀ in nest
CALIF., Shorty's Well	11 Nov. 1969	♂♂, ♀♀ in nest
CALIF., Deep Canyon	1 Dec.	♀♀ in nest
CALIF., Palm Springs	17 Dec. 1917	♀♀ in nest
B. CALIF., Bahia San Luis Gonzaga	19 Feb. 1969	♂♂, ♀♀ in nest
B. CALIF., 11 mi E. Tecate	3 May 1964	♂♂ in nest

stant. A few of the smallest workers from El Arco and Calmalli have the pubescence greatly reduced and it is absent (save a few widely scattered hairs) in the majority of the sample from El Marmolito.

The color of this species is quite variable. Southernmost samples from Lower California have the head and thorax brownish-red, the propodeum, legs and petiole darker; the infuscation sometimes extends over the entire thoracic dorsum and the top of the head. Specimens from Bahia San Luis Gonzaga, Baja California, are very extensively infuscated. The head, thorax and legs are light reddish in specimens from Shaver's Well, with the propodeum and petiole slightly darker. Samples from Death Valley have the head, thorax and legs light reddish, brighter than those from Shaver's Well, with only the petiole a little darker.

Workers of *flaviceps* from the Mojave Desert are very similar to those of *romainei* from Utah and central Arizona. The characteristic punctation of the vertex of *romainei* become weaker and sparser than in the more eastern populations of that species. They may be confused with *flaviceps*. In general, *flaviceps* workers from the Mojave Desert have twelve or fewer erect hairs on the malar area. There is, however, sufficient variation to make this character uncertain.

The erect pronotal hairs of *flaviceps* seem consistently less than 0.5 × MOD. In *romainei* there is less constancy, but those populations in which the hairs are 0.5, or less × MOD are eastern. The specimens from Utah and central Arizona have longer hairs, 0.57–0.62 × MOD.

EREMNOCYSTUS New Subgenus

Diagnosis: Worker and female with septemdentate mandibles; eyes little, if any, longer than first flagellomere; wings of sexuals with numerous fine, erect white hairs on membrane; small concolorous blackish or dark brownish species.

Description: Worker: Mandible with seven teeth; ocelli distinct; eye small, maximum length hardly exceeding that of first flagellomere; clypeus about twice wider than long; fewer than six hairs on malar area in frontal view; pubescence reduced, not obscuring tergal surfaces (exception: *colei*, n. sp.) and very sparse on head; monochromatic blackish to brownish, lower third of head often yellowish. *Female:* Similar to worker, except for usual caste characters; wings with abundant fine, erect whitish hairs on membrane; wing fringe absent (exception: *creightoni* Snelling). *Male:* Wing membrane with abundant fine, erect, whitish hairs; aedeagus without setae; mandible usually without defined denticles basad of apical tooth.

Type Species: Myrmecocystus creightoni Snelling 1971.

Entymology: Eremnos (Gr., swarthy, dark) + *Kystis* (Gr., bladder), reflecting the uniformly dark color of these honey ants, their most important field recognition characteristic.

Included Species: M. colei, n. sp.; *M. creightoni* Snelling 1971; *M. hammettensis* Cole 1938; *M. lugubris* Wheeler 1909; *M. perimeces*, n. sp.; *M. tenuinodis*, n. sp.; *M. yuma* Wheeler 1912.

This subgenus includes all the small, uniformly dark species. Their small size (largest workers 6 mm or less in length) and distinctive coloration render them easily recognizable in the field. They superficially resemble the dolichoderine species, *Conomyrma insana* (Buckley).

Eremnocystus is the least widely distributed subgenus of *Myrmecocystus*. One species is found in southwestern Idaho and I have samples of what may prove to be another species from Washoe County, Nevada. The bulk of the species occur in southern California. Two species are found in the Mojave Desert, two are found in the Colorado Desert, one occurs in the valleys between the Transverse Ranges and one is known from the coastal sand dunes around Bahia San Quintin in Baja California.

The treatment afforded the group here is not wholly satisfactory. The small size, obscure habits and disjunct ranges of the component species have resulted in their rarity in collections, even though the species may be quite common where they occur. Most of the species are wholly allopatric with one another. The only area of known sympatry is that of Yuma, Arizona, where *tenuinodis* and *yuma* are found, often nesting within a few meters of one another. Adjacent, but apparently wholly allopatric species are *lugubris, creightoni* and *colei*. Both *hammettensis* and *perimeces* appear to be well outside the known ranges of other species.

The current distribution pattern suggests the possibility that these populations could be treated, for the most part, as subspecies. However, the lack of material of an intermediate nature and the constancy of characters within a population do not support such an interpretation. Too, characters used here to differentiate the species are of the same magnitude as those used elsewhere in this revision.

It appears that the subgenus may once have had a wider, and more continuous, distribution and probably consisted of a single species, such as *creightoni*. With increasing aridity in the southwestern United States populations may have become isolated and evolved along restricted lines which became increasingly exaggerated in the absence of disruptive gene flow from other populations. No doubt, too, some selective pressure has been exerted by the larger, and more aggressive, diurnal foragers of the subgenus *Endiodioctes*. The largest and hairiest member of *Eremnocystus* is *colei*. This species is found in the Los Angeles Basin and the Cajon Canyon area of San Bernardino County. In this area the only competing diurnal forager is *wheeleri* in the subgenus *Endiodioctes*. In southwestern Idaho *hammettensis* shares diurnal foraging with *kennedyi*, another species of *Endiodioctes*. Slightly

larger size and abundant erect pilosity are characteristic of *hammettensis*.

Few data are available on the foraging habits of *hammettensis*. The one colony which I found in Owyhee County, Idaho, was taken before noon on a warm day (ambient temperature approx. 85°F.). Workers were foraging on nearby plants at this time and active excavation within the colony was indicated. The habits of *colei* are somewhat better known. This species is an active forager and may be found foraging during the warm midday hours at ambient temperatures up to about 90°F. Both of these species, then, are active out of the nest at midday.

Other species of *Eremnocystus* forage in the cooler morning and afternoon hours. They usually emerge shortly after sunrise, dispersing rapidly over the surface and working into low vegetation. At least one species *(tenuinodis)* may develop short foraging files to a concentrated food resource. Surface activities continue until the ambient temperature reaches about 80°F and by the time the temperature rises to 85° all foragers have returned to the nest. Soil surface temperatures of about 100°F elicit a pronounced stress reaction and temperatures in excess of 110° are quickly fatal.

During the hot middle portions of the day, the ants remain away from the surface, usually retreating to depths of 10–15 cm. Often the entrance is blocked by soil particles. When temperature has dropped to a tolerable level in late afternoon or early evening, foraging activity is resumed until full darkness, by which time all workers have again returned to the nest. In the southern deserts the hottest part of the year is usually from the end of June to about the middle of September. During this season conditions may not be suitable for days or even weeks, and the ants may wholly curtail surface activities. Aestivation during the hottest summer period appears to be normal for these species.

Those species of *Eremnocystus* which appear to be wholly matinal and crepuscular are all characterized by a reduction in the erect body hairs and in appressed pubescence. These species also appear to be relatively short-legged, though I have not made measurements to confirm this impression. Relatively long legs and an abundance of erect and appressed body hairs seem to be adaptations which are favorable to ants active during the hot periods of the day. The hairs and pubescence are highly reflective and presumably function to deflect both heat and light. The diurnal foraging species, when moving across a very hot surface (one in excess of 110°F) dart rapidly from one raised object, pebble, twig, etc. to another. Upon reaching such an object, the ant stops atop it for several seconds. During this process the body is held as high from the substrate as possible, often with the gaster elevated. Such actions take advantage of the sharp reduction in temperature within a few millimeters of the surface. The two diurnal species of *Eremnocystus, colei* and *hammettensis,* do possess an abundance of erect hairs and appressed pubescence. Their legs appear to be relatively longer than in the other species of *Eremnocystus* and they exhibit heat avoidance reactions as discussed above. None of these characteristics apply to the remaining *Eremnocystus*.

Eremnocystus appears to be a derivative of *Endiodioctes,* through reduction in body size, pubescence and pilosity and loss of the wide range of polymorphism evident in that subgenus. These smaller species are less aggressive foragers and their occupation of the matinal-crepuscular temporal niche may be a response to competitive pressure by the species of *Endiodioctes*. It is possibly significant that the matinal-crepuscular species occur in areas where there are two or more species of *Endiodioctes*. The two *Eremnocystus* species which forage diurnally both are found in habitats where there is but a single species of *Endiodioctes*.

No attempt has been made here to divide the species of *Eremnocystus* into species groups. Two species, *colei* and *perimeces,* might form monotypic groups. Another group might consist of *lugubris* and *tenuinodis* and a fourth group would include the remaining species, *creightoni, hammettensis* and *yuma*. However, I do not feel that I know the species sufficiently well to be satisfied that these groups would be natural ones. When the sexual forms are better known it may be possible to define species groups.

KEY TO SPECIES OF *EREMNOCYSTUS*

WORKERS

1. Antennal scape and dorsum of propodeum without fully erect hairs 2
   Antennal scape, usually, and dorsum of propodeum, always, with fully erect hairs (in *M. perimeces* the propodeal hairs may be short and inconspicuous; this species has an unusually elongate head, CI 70–81) 3
2. Pronotum and mesonotum with at least eight conspicuous, fully erect, white hairs; petiolar scale strongly compressed in profile, crest distinctly notched ..... *lugubris* Wheeler
   Pronotum and mesonotum each with no more than two fully erect hairs; petiolar scale not notably compressed, crest slightly concave or flat, but not conspicuously notched ..... *creightoni* Snelling

3. Scape and/or tibia, usually both, with conspicuous fully erect hairs; *or,* head moderately broad, CI 80 or more 4
   Scape and tibia without erect hairs *and* head unusually elongate, CI 70–81 ..... *perimeces,* n. sp.
4. Scape with conspicuous erect or semierect hairs; femora and tibiae with abundant erect hairs, some present on dorsal femoral surfaces; petiolar scale variable, but often compressed with summit distinctly notched 5
   Scape with no erect hairs, except at apex; femora and tibiae with few erect hairs, none on dorsal femoral surfaces; petiolar scale thick in profile, crest flat or slightly convex ..... *yuma* Wheeler
5. Scape with scattered erect and many semi-erect hairs; malar area with two or three erect hairs in frontal view, rarely as many as six present 6
   Scape with abundant fully erect hairs; malar area with numerous (10+) erect hairs ..... *hammettensis* Cole
6. Appressed pubescence abundant on frons and third tergum; petiolar scale thick, at level of spiracle distinctly more than twice the length of the spiracle, crest flat or convex ..... *colei,* n. sp.
   Appressed pubescence sparse on frons and third tergum, notably sparser on second than first; petiolar scale thin, at spiracular level less than twice the length of the spiracle, crest conspicuously notched *.tenuinodis,* n. sp.

FEMALES

1. Mesoscutum finely, densely and uniformly punctate 2
   Mesoscutal punctation not uniform, punctures often of two sizes, with a large median impunctate area *or* with widely scattered punctures *or* with impunctate disc and median longitudinal punctate zone 3
2. Punctures on sides of clypeus subcontiguous, very coarse, distinctly coarser than those of upper half of mesopleura; occiput distinctly shiny, polished, with scattered fine punctures; mid and hind femora without fully erect hairs except a few along lower side ..... *creightoni,* n. sp.
   Punctures on sides of clypeus distinctly separated, no coarser than those of upper half of mesopleura; occiput slightly shiny, densely tesselate, with fine obscure punctures; mid and hind femora with conspicuous fully erect hairs on all faces ..... *colei,* n. sp.
3. Fourth segment of maxillary palp elongate-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 .. 4
   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 5
4. Mesopleura uniformly shiny, with scattered coarse punctures; scutellum shiny, sparsely punctate; fifth segment of maxillary palp uniformly broad, not conspicuously narrowed near apex; frontal lobes with scattered coarse punctures ..... *hammettensis* Cole
   Mesopleura, at least in lower half, with abundant fine, round punctures; scutellum with abundant fine punctures; fifth segment of maxillary palp broad, conspicuously narrowed in apical one-fourth; frontal lobes with abundant fine punctures ..... *tenuinodis,* n. sp.
5. Face with abundant fine punctures between eyes and frontal lobes; clypeus shiny, polished; appressed gastric pubescence whitish; mesopleural hairs about as long as those of mesoscutum ..... *yuma* Wheeler
   Face with sparse punctures between eyes and frontal lobes; clypeus dull, densely sculptured; appressed gastric pubescence brownish; mesopleural hairs conspicuously longer than those of mesoscutum, little shorter than those of scutellum ..... *perimeces,* n. sp.

MALES

Since males are unknown for a majority of the species, it would be futile to present a key at this time. Refer to the descriptions for the characteristics of the males of *colei, creightoni* and *hammettensis.*

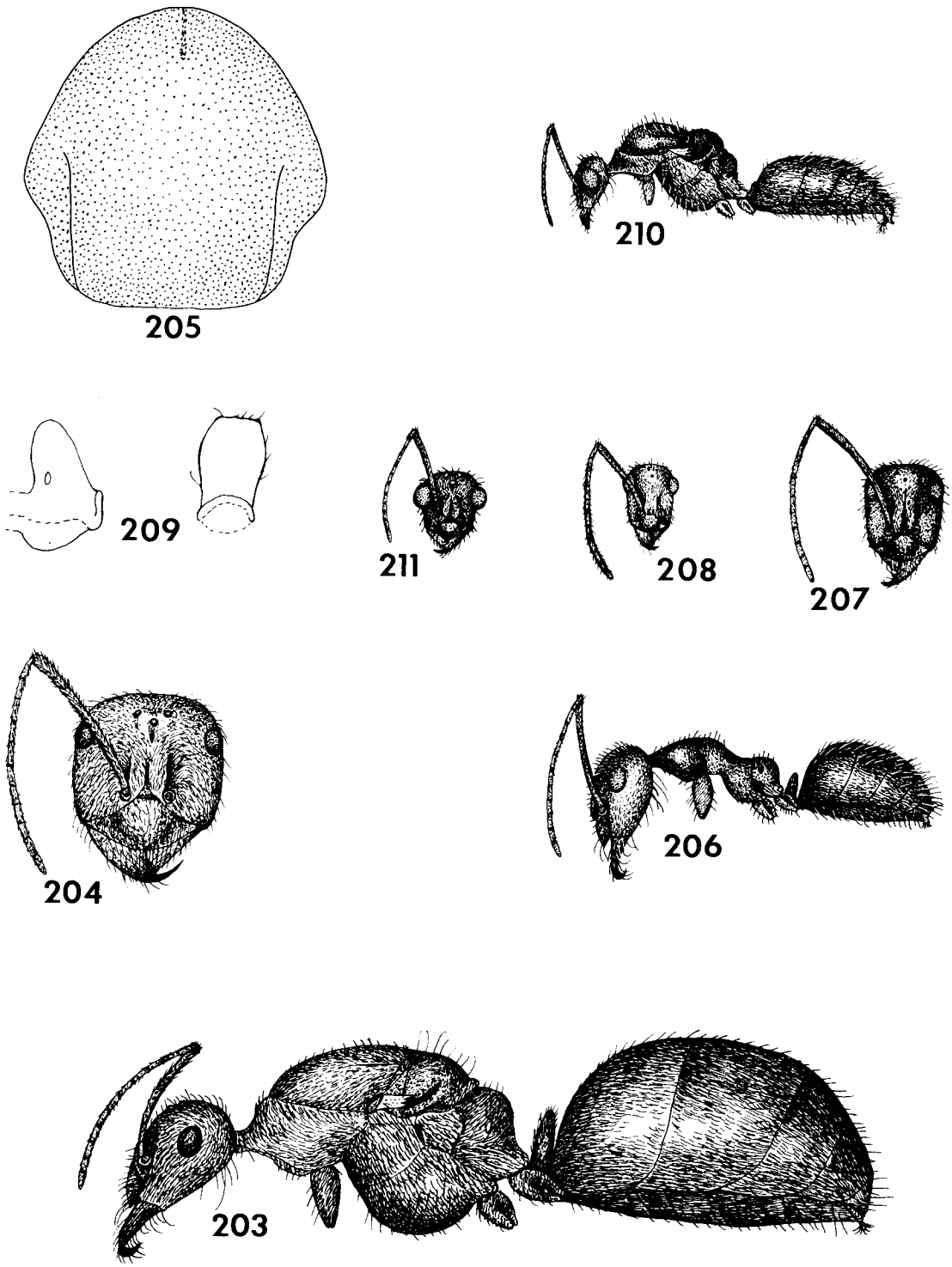
Myrmecocystus (Eremnocystus) colei new species

Figures 203–211, 255–258

Diagnosis. Worker: Scape with a few scattered erect hairs; dorsum of propodeum with erect hairs; petiolar scale erect but not compressed; erect pronotal hairs apically acuminate; hind femur with numerous erect hairs on inner face. *Female:* Mesoscutum finely, densely, uniformly punctate; occiput shiny, with scattered fine punctures; mid and hind femora without conspicuous erect hairs except on ventral margin. *Male:* Forewing without marginal fringe beyond stigma; hindwing without marginal fringe; petiole not, or scarcely, emarginate.

WORKER. *Measurements.* HL 0.76–1.26 (1.06); HW 0.60–1.13 (0.93); SL 0.90–1.33 (1.20); WL 1.10–1.66 (1.46); PW 0.46–0.73 (0.66).

Head: In all sizes from distinctly to slightly longer than wide, CI 77–93 (87); in full face view, sides



FIGURES 203–211. *M. colei*. 203, female, lateral view; 204, head of female, frontal view; 205, mesoscutum of female, distribution of punctures; 206, major worker, lateral view; 207, head of major worker, frontal view; 208, head of minor worker, frontal view; 209, petiole of major worker, lateral (left) and posterior (right) views; 210, male, lateral view; 211, head of male, frontal view.

straight (barely convex in largest workers), slightly convergent toward mandibular insertions; occiput flat with corners rounded, but distinct; shorter than scape, SI 105–121 (112). Eye small, slightly longer than first flagellomere; OMD 1.25–1.75 (1.45) × EL. Mandible septendentate, occasionally with intercalary denticle between basal and penultimate basal teeth.

Thorax: Moderately robust, PW 0.39–0.48 (0.47) × WL. Mesonotum, in profile, evenly convex from front to back except in largest workers where it is abruptly declivitous behind. Basal face of propodeum distinct, sharply rounded into the longer posterior face.

Petiole: Scale erect, in profile about twice higher than thick; posterior face straight, anterior rather abruptly narrowed in upper third; crest narrow in frontal view, flat in smallest workers, slightly concave in largest; from above, about twice wider than long.

Vestiture: Pubescence sparse on malar area and clypeus; sparse to abundant on frontal lobes and abundant on occiput, but not obscuring surface; abundant and long on thoracic dorsum and pleura, but sparser and finer on propleura, loosely appressed to subappressed; abundant, but not concealing integument, on first three terga (sparser on third tergum of some minors), sparse on remaining segments.

Scape, inner face of fore femur, outer faces of middle and hind tibiae with fine suberect to erect hairs; malar area, in frontal view, with a few reclinate to suberect hairs; clypeal disc, front of head and occiput with numerous erect hairs, those of occiput about half as long as minimum eye diameter. Pronotum and mesonotum with conspicuous fully erect hairs, usually fewer than 15 on each segment, shorter than those of occiput; posterior half of propodeal dorsum with at least 10 fully erect short hairs. All terga with numerous erect, short hairs, progressively longer caudad.

Integument: Clypeus shiny, with scattered fine piligerous punctures; remainder of head moderately shiny, lightly shagreened. Thorax lightly shagreened, moderately shiny, more so on sides. Gaster moderately shiny, distinctly though finely shagreened.

Color: Integument light to dark brownish, appendages lighter; mandibles, clypeus and lower portions of malar area yellowish.

FEMALE. *Measurements.* HL 1.40–1.46; HW 1.36–1.43; SL 1.36–1.43; EL 0.36–0.40; OMD 0.53–0.56; WL 2.8–3.1; PW 1.8–2.0.

Head: As broad as, or broader than, long; CI 100–104; in full face view with sides straight, not convergent toward mandibular insertions; occiput flat or slightly convex, corners narrowly rounded; as long as, or longer than, scape, SI 96–100. Eye a little longer than first flagellomere; OMD 1.33–1.42 × EL. Ocelli subequal; IOD 3.0–3.3 × OD; OOD 2.6–3.0 × OD. Mandible septendentate. Penultimate maxillary palpal segment elongate-triangular, greatly narrowed apically; segment three narrowed basally and apically, otherwise uniform in breadth; segment four uniformly broadened from base to apex.

Thorax: Robust, PW 0.58–0.67 × WL. Mesoscutum low in profile, somewhat flattened and gently curved into profile of scutellum; scutellum gently convex, a little more strongly sloping behind; propodeum with distinct transverse basal horizontal face and precipitous posterior face, their juncture sharply rounded.

Petiole: In profile, compressed above, crest sharp; in frontal view, sides convergent toward crest, crest broadly and deeply angularly excised; from above about three times wider than thick.

Vestiture: Pubescence sparse on clypeus; abundant elsewhere on head, thorax and gaster; long, subappressed to reclinate on occiput, pleura and propodeum.

Scape with abundant short, reclinate hairs; anterior femur without erect hairs on inner face; middle and hind tibiae with abundant suberect hairs. Malar area, in frontal view, with 6–8 long, erect yellowish hairs; clypeus with numerous erect yellowish hairs of highly variable length; frons with numerous erect yellowish hairs; occipital hairs much longer, some more than 0.5 × MOD; scutum with numerous widely spaced erect yellowish hairs, less than 0.5 × MOD; scutellum with longer erect hairs, some equal to MOD; metanotum with a few long erect hairs; propodeum with a few short erect hairs on dorsal face; pleura with scattered long erect yellowish hairs, more numerous below; petiolar scale with numerous fine whitish hairs; first three terga with short, erect yellowish hairs, becoming more abundant from first to third; subsequent terga with hairs longer, sparser than on third. Wing membranes with fine whitish hairs, costal margin of forewing, to stigma, with sparse fringe.

Integument: Clypeus polished, with coarse setigerous punctures; remainder of face shiny (but somewhat obscured by pubescence), with dense fine piligerous punctures and scattered coarse, setigerous punctures; malar area with abundant coarse, elongate punctures; occiput duller, closely shagreened, and with fine, close punctures. Mesoscutum shiny, uniformly finely, densely punctate; scutellum shiny, evenly, more sparsely punctate; pleura duller, closely shagreened and with abundant fine and sparser, coarser punctures; propodeum dull, densely shagreened, with dense fine, obscure punctures; terga shiny, lightly shagreened and with abundant fine punctures.

Color: Brownish, mesosoma darker; mandibles, sides of clypeus and lower half (or less) of malar area, yellowish.

MALE. *Measurements.* HL 0.63–0.73; HW 0.60–0.66; EL 0.26; SL 0.66–0.76; OMD 0.16–0.20; WL 1.30–1.66; PW 0.80–0.90.

Head: Margins nearly parallel below eyes, not notably convergent toward mandibular bases; head a little longer than broad, CI 90–95 (95), a little shorter than scape, SI 105–110 (105); occiput gently convex,

with distinct lateral angles. Eye large, OMD 0.63–0.75 (0.63) × EL; ocelli subequal; IOD 3 × OD; OOD 1.5–2.0 × OD. Mandibles with preapical cleft and low preapical tooth, margin edentate or with one or two minute denticles.

Thorax: Stout, PW 0.53–0.57 × WL. Mesoscutum broad, anterior face vertical, anterior half strongly convex, posterior half more flattened; scutellum nearly vertical behind; propodeum with transverse, horizontal basal area and vertical posterior face, their juncture angulate.

Petiole: In profile, cuneate; crest, seen from front, nearly flat or with obscure median emargination; in dorsal view, about twice wider than long.

Vestiture: Appressed white pubescence sparse on head; more abundant and somewhat yellowish on thoracic dorsum; more abundant, whitish, on pleura and propodeum; denser on first three terga.

Erect hairs sparse, conspicuously longer on occiput than elsewhere on head, those of scutellum longer than elsewhere on thorax; disc of first tergum with a few erect yellowish hairs; remaining terga with a more numerous, conspicuously longer yellowish hairs. Wing membrane, with numerous very short whitish hairs; fringe hairs present along costal margin of forewing to stigma.

Terminalia: Figures 256–258.

Type Material. Holotype worker, allotype male, 12 ♀♀, 73♂♂ and 29 ♀♀ paratypes: San Gabriel R., 500′, Irwindale, Los Angeles Co., CALIF., 22 Feb. 1963 (R. H. Crandall and R. R. Snelling) in LACM. Additional paratypes: 8♂♂, 27♀♀, type locality, 24 Feb. 1963 (R. R. Snelling; LACM). Three paratypes to each of the following collections: AMNH, GCW, MCZ, MNHG, and USNM.

Distribution. Known only from coastal and intermediate valleys of southern California (Fig. 368).

Additional Material. UNITED STATES. California: Los Angeles Co.: Altadena, 10 Apr. 1954 (R. H. Crandall; LACM); Eaton Canyon, San Gabriel Mts., 5 Feb. 1963 (R. H. Crandall; RHC). *San Bernardino Co.:* Cajon Canyon, 1000′, 21 Apr. 1969 (R. R. Snelling, #69–118; LACM).

Etymology. Dedicated to Professor Arthur C. Cole, Jr., a warm and generous colleague.

Ecology. This ant is known to occur in the Coastal Sagebrush phytocenose, along stream drainages, up to areas where this habitat grades into the Oak-Juniper-Joshua Tree Association. Nests are constructed in compacted clayey soil, usually overlain with gravel or coarse sand. Foraging activities appear to be fully diurnal, with workers active out of the nest at midday. The workers are assiduous scavenger-predators and also collect large quantities of nectar from flowers. Activity of the reproductives is summarized in Table 6.

Discussion. This species does not appear to be very closely related to any of the other species of *Eremnocystus*. In the abundant appressed pubescence it is most like *hammettensis,* but workers of that species possess numerous fully erect hairs on the scapes and cheeks. The female *colei* has the mesoscutum densely and uniformly covered with fine punctures while that of *hammettensis* has the scutum sparsely and coarsely punctate. In *colei* females the penultimate segment of the maxillary palp is broad basally and tapers to a narrow apex; it is nearly parallel-sided in *hammettensis*.

TABLE 6

Activity of Reproductives of:

Locality	Date	Activity
M. colei Snelling		
CALIF., Irwindale	22 Feb. 1963	♂♂, ♀♀ in nest
CALIF., Irwindale	24 Feb. 1963	♂♂ in nest
CALIF., Cajon Cyn.	21 Apr. 1969	♂♂ in nest
M. creightoni Snelling		
CALIF., 2 mi S Pearblossom	12 Feb. 1967	♂♂, ♀♀ in nest
CALIF., Dos Palmas	8 Mar. 1970	♀♀ in nest
CALIF., 6 mi SE Pearblossom	16 Mar. 1972	♀♀ in nest
CALIF., 4 mi SE Pearblossom	20 Mar. 1966	♀♀ on ground after rain
CALIF., Short Cyn.	3 Nov. 1967	♀♀ in nest
M. hammettensis Cole		
IDA., Hammett	30 May 1932	♂♂, ♀♀ in nest
M. perimeces Snelling		
B. CALIF., 0.5 mi N El Molino	29 Mar. 1971	♀ on ground
M. tenuinodis Snelling		
CALIF., 3 mi E Thousand Palms	16 Feb. 1963	mating flight after rain
CALIF., 5 mi E Thousand Palms	16 Feb. 1963	mating flight after rain

Myrmecocystus (Eremnocystus) creightoni Snelling

Figures 212–220, 259–262

Myrmecocystus lugubris, Wheeler and Wheeler 1968, Entomol. Soc. Amer. Ann. 61:213 (larva) *(misidentification)*.

Myrmecocystus creightoni Snelling 1971. Contr. Sci., L.A. Co. Mus., 214:6–11. ♀♀♂; Wheeler and Wheeler 1973. Ants of Deep Canyon, 120.

Diagnosis. Worker: Antennal scape with numerous fine, reclinate hairs, standing hairs absent or confined to apical one-sixth; dorsal face of propodeum without erect hairs; pronotum with two or no erect hairs. *Female:* Mesoscutum finely, uniformly densely punctate; wings without marginal fringe hairs. *Male:* Tibiae and scape without erect hairs; wings with marginal fringe hairs.

WORKER. *Measurements.* HL 0.73–1.03 (0.90); HW 0.60–0.93 (0.80); SL 0.80–1.13 (1.00); WL 0.96–1.50 (1.30); PW 0.40–0.63 (0.56).

Head: Sides straight (slightly convex in largest workers), converging slightly toward mandibular insertion, longer than broad in all sizes, CI 78–93 (88); somewhat shorter than scape, SI 108–138 (125). Occiput broadly flattened in frontal view, with poorly indicated lateral corners. Eye small, about as long as first flagellomere; OMD 1.36–2.00 (1.45) × EL. Mandible with seven teeth on cutting margin, rarely with a minute intercalary denticle between basal and penultimate teeth.

Thorax: Slender to moderately robust, PW 0.36–0.50 × WL (0.41). In larger workers rear of mesonotum dropping sharply to metanotum. Basal face of propodeum as long as posterior face or slightly shorter, juncture of two faces distinctly rounded.

Petiole: Erect, in profile about twice higher than thick, not at all cuneate, summit rounded; crest flat in frontal view, not, or barely, impressed in middle; in dorsal view about twice as wide as thick.

Vestiture: Pubescence scattered on malar area, frons and occiput, nowhere concealing surface, longer than OD; longer and denser on thorax, especially on side of propodeum, longer and denser on gaster, but usually not concealing surface, sparse at sides of terga.

Hairs on scape abundant, reclinate (rarely fully erect); occipital hairs shorter than maximum thickness of hind femur; thoracic dorsum usually lacking erect hairs, but three or four inconspicuous ones may be present toward sides; petiolar crest without conspicuous erect hairs; first tergum with erect discal hairs shorter than minimum thickness of hind femur; inner face of fore femur without erect hairs; outer face of middle and hind tibiae with few or no erect hairs.

Integument: Polished on clypeus, malar area and frons, duller on occiput, with scattered fine piligerous punctures on frons, clypeus and malar area, those on malar area often coarse and elongate. Thorax less shiny than head, densely shagreened, especially on sides of propodeum; gaster moderately shiny, densely and finely shagreened.

Color: Uniformly medium to dark brownish, legs lighter; mandibles and lateral clypeal lobes lighter, often yellowish.

FEMALE. *Measurements.* HL 1.40; HW 1.43–1.46; SL 1.33; EL 0.40–0.43; OMD 0.50; WL 2.7–2.9; PW 1.8–1.9.

Head: In full face view with margins straight, converging slightly toward mandibular insertions, broad, CI 102–104; a little longer than scape, SI 90–93. Occiput, in frontal view, broad, flat, with rounded lateral angles. Eye small, barely longer than first flagellomere; OMD 1.15–1.25 × EL. IOD 3 × OD; OOD 3.5 × OD. Mandible with seven teeth.

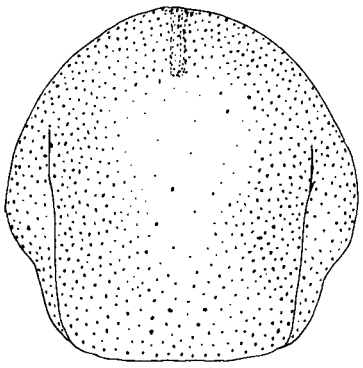
Thorax: Robust, PW 0.65–0.66 × WL. In profile, posterior two-thirds of mesoscutum slightly convex, more flattened caudad, posterior margin below anterior margin of scutellum; scutellum, in profile, broadly convex; metanotum not protruding.

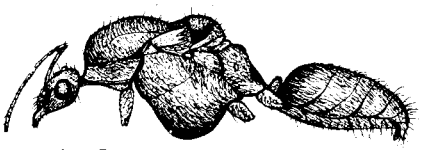
Petiole: In profile, compressed, about twice as high as thick at level of spiracle, crest thin; in frontal view, deeply notched; from above about 3.5 × wider than thick.

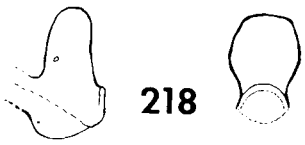
Vestiture: Cephalic pubescence yellowish, as long or longer than an ocellar diameter, much of it reclinate rather than appressed; scattered, not obscuring surface except on malar area above mandibular insertions. Thoracic and gastric pubescence white, appressed to reclinate; long, not concealing surface, but quite dense on gaster.

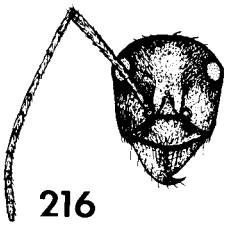
Scape hairs reclinate; malar area with a few long erect hairs in frontal view; thoracic dorsum with numerous erect yellowish hairs, longest on scutellum; erect hairs on disc of first tergum no longer than basal thickness of hind tibia; petiolar scale with a few short erect hairs on crest; fore femur without erect hairs on inner face; middle and hind tibiae with abundant suberect hairs on outer face. Wings without marginal fringe, but membrane with abundant short, erect hairs.

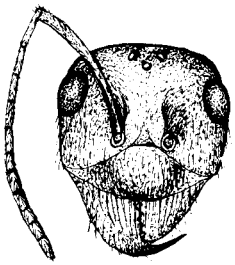
Integument: Head shiny, with coarse setigerous punctures on clypeus and upper half of malar area; frons and occiput with fine, well separated piligerous punctures; frontal lobes with dense, fine, punctures. Pronotum finely and densely punctate; mesopleura moderately shiny, densely shagreened, with fine punctures peripherally and scattered coarse, setigerous punctures; metapleura duller, densely shagreened, abundantly punctate, punctures finer than those in middle of mesopleura; mesoscutum densely, finely punctate, except for sparsely punctate area along midline, punctures of parapsis sparser than those of disc; mesoscutellar punctures equal to those of mesoscutum, sparser in middle; metanotum dull, closely shagreened and micropunctate; propodeum slightly shiny, roughened and closely shagreened. Gaster moderately shiny, with fine, dense piligerous punctures.

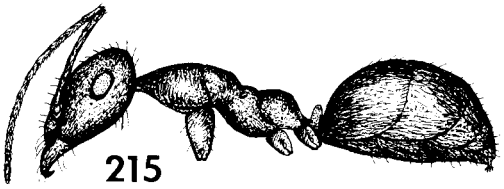


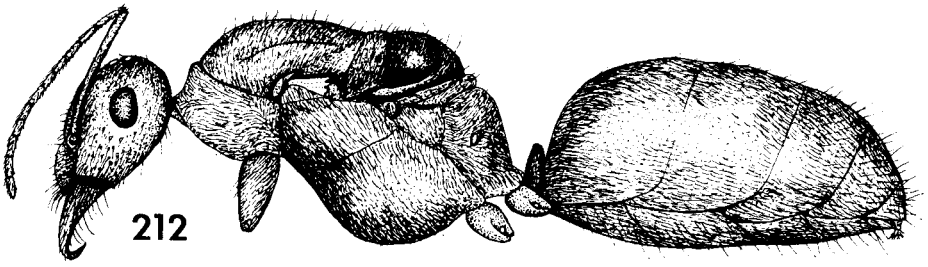












FIGURES 212–220. *M. creightoni*. 212, female, lateral view; 213, head of female, frontal view; 214, mesoscutum of female, distribution of punctures; 215, major worker, lateral view; 216, head of major worker, frontal view; 217, head of minor worker, frontal view; 218, petiole of major worker, lateral (left) and posterior (right) views; 219, male, lateral view; 220, head of male, frontal view.

Color: Uniformly light brownish except for yellowish mandible, lateral clypeal lobes and lower half, or less, of gena. Wings hyaline, veins and stigma light brownish.

MALE. *Measurements.* HL 0.63–0.71; HW 0.60–0.63; SL 0.70–0.73; EL 0.23–0.25; OMD 0.13–0.15; WL 1.53–1.66; PW 0.93–1.00.

Head: In full face view, sides strongly convergent toward mandibular insertions, margins straight; head a little longer than broad, CI 90–94; distinctly shorter than scape, SI 114–115; OMD 0.56–0.60 × EL; ocelli subequal to one another; IOD 3.5–4.0 × OD; OOD 2.5–3.0 × OD. Mandibular margin simple, with preapical notch and two small denticulae basad, apical tooth as broad at base as long. Clypeus usually without preapical transverse depression.

Petiole: Scale in profile higher than long, evenly thick from base to near summit where it is narrowly rounded to slightly angulate; crest, seen from front, angulate at sides, broadly and rather deeply emarginate; in dorsal view, about 2.25 × wider than long.

Vestiture: White, appressed pubescence long, sparse on head and thoracic dorsum; more abundant on thoracic pleura, particularly on propodeum; longest on gaster, but nowhere concealing surface.

Erect hairs sparse, short on head and thorax, yellowish. Middle of first tergum, in profile, with abundant very short, suberect whitish hairs; terga with scattered long to very long yellowish hairs, especially caudad and ventrally. Fore and hind wings fringed along apical and hind margins.

Integument: Head shiny, with scattered fine punctures. Mesoscutum shiny with sparse, fine punctures; propodeum, meso- and metapleura duller, densely shagreened, with scattered fine punctures; scutellum with a few very fine punctures. Gaster shiny, finely piligerously punctate.

Color: Uniformly light to very dark brownish, appendages and mandibles lighter. Wings hyaline, veins and stigma light brownish.

Terminalia: Figures 260–262.

Type Material. Holotype, allotype, and numerous paratypes of all castes, 2 mi S Pearblossom, 3500′, Los Angeles Co., CALIF., 12 Feb. 1967 (R. R. Snelling). Holotype, allotype, most paratypes in LACM; paratypes in AMNH, GCW, MCZ, MNHG, REG, USNM.

Distribution. Known only from California, low elevations in the mountain ranges along western fringes of Mojave and Colorado deserts (Fig. 368).

Localities. UNITED STATES. California: Kern Co.: Short Cyn., 3500′, 3 Nov. 1967 (R. R. Snelling, No. 67–270; LACM); Freeman, 3100′, 3 May 1952 (W. S. Creighton; AMNH, LACM). *Los Angeles Co.:* 2 mi S Pearblossom, 3500′, 12 Feb. 1967 (R. R. Snelling; LACM; type series of *creightoni*); same locality, 20 Mar. 1966 (R. R. Snelling; LACM); 4 mi SE Pearblossom, 4300′, 20 Mar. 1966 (R. R. Snelling; LACM); 6 mi SE Pearblossom, 3500′, 16 Mar. 1972 (R. R. Snelling, No. 72–8; LACM). *San Bernardino Co.:* 7 mi SE Joshua Tree, 7 Sept. 1967 (R. J. Hamton; LACM, RJH). *Riverside Co.:* Dos Palmas, 3700′, 8 Mar. 1970 (G. C. and J. Wheeler, Nos. Calif. 854, 857; GCW); Black Hill, 3000′, 9, 11, Mar. 1970 (G. C. and J. Wheeler; Nos. Calif. 863, 868, 871; GCW); Riverside, May 1973 (B. Pullen; LACM); 8.6 mi E Temecula, 7 Mar. 1973 (R. Duffield; LACM).

Ecology. This species has been found in areas ranging from Juniper-Sagebrush Desert to Coastal Sagebrush. Elevation extends from about 850′ to 4300′. Nest sites vary from compact clayey soil to coarse sand and are marked by a low crater. Those which are located on slopes and in heavy soil usually are not more than about three feet deep and repletes are present in the lower chambers. Nests situated in the deep sand of stream beds may exceed depths of four feet.

Foraging by this species is both matinal and crepuscular. Workers emerge shortly before sunrise and continue to be active until the surface temperature reaches about 75–80°F. In the afternoon, activity is resumed about 30–45 minutes prior to sunset, sometimes as much as 90 minutes before sunset if the soil surface is cool enough. Aphids on low vegetation are solicited for honeydew and nectar is gathered directly from plants. Large quantities of arthropod fragments are brought back to the nest.

Mating flights are known to take place in early spring after a light rain. The time of day at which the flight occurs is not known. The seasonal presence of sexuals is noted in Table 6.

Discussion. This species appears to be most closely allied to *yuma*. Workers differ from those of that species in lacking erect hairs on the dorsum of the propodeum. In addition, workers of *yuma* possess six-eight erect hairs each on the pronotum and mesonotum; rarely a pair of very short, fine hairs may be present on the pronotum of *creightoni*, but the mesonotum seems always to lack erect hairs. Although *lugubris* workers also lack erect hairs on the pronotum and mesonotum, the petiolar scale is much more compressed than in *creightoni*.

The female of *creightoni* has the mesoscutum uniformly closely and finely punctate, without a defined median impunctate area. In this respect it agrees with the females of *colei*, but the mid and hind femora of *colei* have abundant erect hairs on all surfaces. The shape of the fourth and fifth segments of the maxillary palpus is as in *yuma*. The punctures of the upper half of the head are coarser and much sparser than in that species.

Males are poorly known in this subgenus. Those of *hammettensis* and *colei* lack fringe hairs on the apical margin of the forewing, present in *creightoni*. Males are not known for *lugubris, perimeces, tenuinodis* and *yuma*.

The larva has been described, as *lugubris*, by Wheeler and Wheeler (1968). The description was based on material from the type nest originally misidentified by me.

Myrmecocystus (Eremnocystus) hammettensis Cole

Figures 221–229, 263–266

Myrmecocystus yuma, Cole 1934. Psyche 41:225. ♀ *(misidentification)*.

Myrmecocystus hammettensis Cole 1938. Amer. Midl. Nat. 19:678–681. ♀♀♂; Creighton 1950. Bull. Mus. Comp. Zool. 104:443.

Diagnosis. Worker: Scape, malar area and propodeum with abundant erect hairs; petiolar scale erect but not compressed; erect pronotal hairs abundant, acuminate; hind femur with abundant erect hairs on inner face. *Female:* Mesoscutum polished, with scattered coarse, piligerous punctures; occiput shiny, with scattered fine punctures; mid and hind femora with abundant erect hairs on all faces; forewing with abundant fine, erect, very short hairs on membrane. *Male:* Forewing with fringe hairs along costal margin to vein A; hindwing with fringe on posterior margin; membrane with inconspicuous erect hairs or none; scape, hind femur and tibia with erect hairs; petiolar crest with broad, shallow median emargination.

WORKER. *Measurements.* HL 0.66–1.10 (1.08); HW 0.60–1.10 (1.07); SL 0.73–1.16 (1.13); WL 0.80–1.43 (1.33); PW 0.40–0.70 (0.70).

Head: Varying from distinctly longer than wide in smallest workers to as long as wide in largest, CI 85–100 (99); in full face view, sides nearly straight and slightly convergent toward mandibular base in smallest, gently convex in largest; occiput flat, broadly rounded at sides; shorter than scape, SI 103–117 (105). Eye small, only slightly longer than first flagellomere; OMD 1.43–1.88 (1.73) × EL. Mandible septendentate, sometimes with intercalary denticle between basal and penultimate basal teeth.

Thorax: Moderately robust, PW 0.44–0.53 (0.53) × WL. Mesonotum, in profile, gently and evenly convex from front to back. Basal face of propodeum distinct, juncture with posterior face subangulate to narrowly rounded.

Petiole: Scale, in profile, erect, about twice higher than thick, somewhat compressed above; crest narrowed above in frontal view, without median emargination or with shallow, broad one; from above about twice wider than thick.

Vestiture: Pubescence sparse on head, a little denser on occiput than elsewhere; long and dense, but not concealing surface, on thorax; dense on first two terga, sparse on third and following segments, except in some large workers which may possess a dilute sheen on third.

Erect hairs numerous on all head surfaces, with 10+ on malar area; scape and all surfaces of femora and tibiae with abundant erect hairs; promesonotum with abundant erect hairs, metanotum with few or none; propodeum with abundant erect hairs on summit of declivity and usually a few along sides of declivity. Petiolar scale with erect hairs along sides and on crest. Terga with numerous discal hairs, becoming progressively longer on succeeding segments.

Integument: Clypeus shiny, with scattered coarse and fine piligerous punctures; remainder of head less shiny, very lightly and irregularly shagreened, with scattered piligerous punctures; frontal lobes without conspicuous dense, fine punctures. Thorax slightly shiny, with obvious, dense shagreening. Gaster slightly shiny, with fine, often obscure shagreening.

Color: Light brownish to blackish brown, appendages lighter; mandibles, sides of clypeus and adjacent portion of malar area yellowish, mandibular teeth dark.

FEMALE. *Measurements.* HL 1.30; HW 1.43; SL 1.26; EL 0.36; OMD 0.53; WL 2.90; PW 1.56.

Head: Broader than long, CI 110; in full face view sides very slightly convex and slightly narrowed toward mandibular bases; occiput flat in frontal view, broadly rounded at sides; slightly longer than scape, SI 98. EL 1.57 × length of first flagellomere; OMD 1.45 × EL. Lateral ocelli slightly smaller than anterior ocellus; IOD and OOD 3.0 × OD. Mandible septendentate. Penultimate maxillary palpal segment nearly parallel sided, but margins slightly convergent in apical fourth; fourth segment evenly broadened from base, broadest preapically, narrowed toward apex, greatest width about twice basal width.

Thorax: Robust, PW 0.68 × WL. Posterior half of mesoscutum flattened and continuous with scutellum, forming an even plane, abruptly rounded toward metanotum along posterior margin. Basal portion of propodeum sloping and broadly rounded onto declivitous face.

Petiole: In profile, somewhat compressed above, crest narrowly rounded; in frontal view, sides a little convergent above; median emargination angulate, deep, broad; from above about 3 times wider than long.

Vestiture: Pubescence sparse, decumbent on head and most of thorax, dense, long, appressed on propodeum, first three terga with pubescence sparse, but sufficiently dense to impart a feeble sheen, virtually absent from following segments.

Scape, femora and tibiae with abundant erect hairs on all surfaces. Malar area with numerous erect and suberect hairs in frontal view; short, erect hairs present on all remaining head surfaces, occipital hairs longest, at least a few as much as 0.5 × MOD. Scutum with scattered erect hairs, longest less than 0.5 × MOD; scutellum with scattered erect hairs, some more than twice longer than longest scutal hairs; pleura with scattered erect hairs; propodeum with erect hairs on base

and at sides of declivity; petiolar scale with erect hairs on crest and sides. All terga with sparse fully erect hairs, longer and coarser caudad.

Membrane of forewing with numerous very short erect hairs; fringe hairs present to apex of apical cell on forewing, present on posterior margin of hind wing.

Integument: Clypeus polished and shiny basally, apical half slightly shiny and closely shagreened, with coarse setigerous punctures; frontal lobes and frons polished, shiny, frontal lobes with fine, close punctures in middle and scattered coarse punctures at sides; frons with scattered setigerous punctures; occiput moderately shiny, shagreened, with variably spaced, coarse setigerous punctures; malar area moderately shiny and lightly shagreened above, duller and closely shagreened below, with scattered elongate, coarse, setigerous punctures above, these becoming obscured by shagreening below.

Mesoscutum polished, with scattered coarse setigerous punctures and a few dense fine punctures posteromedially; parapsis shiny, with sparse setigerous punctures. Scutellum polished and shiny, with scattered coarse setigerous punctures over disc and a narrow transverse band of dense punctures anteriorly. Pleura moderately shiny, but with irregular polished and shiny areas and with scattered coarse setigerous punctures. Propodeum densely shagreened and slightly shiny, with scattered obscure punctures. First tergum shiny, with sparse, fine piligerous punctures; second tergum shiny over much of disc but with irregular areas of light shagreening laterad and basad, with sparse piligerous punctures, especially sparse in middle; third tergum shiny, with sparse fine piligerous punctures, sparser than on first tergum.

Color: Medium brown, sides of scutum and pleura darker; appendages light brown; mandibles and clypeus yellowish; wings whitish hyaline, veins and stigma light brown.

MALE. *Measurements.* HL 0.70; HW 0.66; EL 0.26; SL 0.70; OMD 0.16; WL 1.33; PW 0.86.

Head: Mandible with preapical cleft and two teeth on cutting margin. Margins of head, in frontal view, distinctly convergent toward mandibular bases; head a little longer than broad, CI 95; as long as scape, SI 100; occiput distinctly convex, with poorly indicated lateral angles. Eye large, OMD 0.63 × EL; lateral ocelli slightly larger than anterior, IOD 3.0 × OD; OOD 2.0 × OD.

Thorax: Stout, PW 0.65 × WL. Mesoscutum broad, anterior face convex in profile, posterior half of dorsal surface flattened; scutellum, in profile, strongly convex, its anterior margin rising above posterior margin of scutum, not abruptly declivitous behind. Basal portion of propodeum broadly rounded onto oblique posterior face.

Petiole: In profile, cuneate, crest thin; crest, seen from front, with broad shallow median emargination; in dorsal view, about twice wider than long.

Vestiture: Pubescence sparse on head, noticeably denser on occiput, on malar area and behind eye; abundant on pronotum and anterior declivity of mesoscutum; long and dense on propodeum; long and moderately dense on first two terga, sparse on remainder.

Scape with numerous fine erect hairs; femora and tibiae with numerous coarser erect hairs on all surfaces; all head surfaces with fine erect hairs; thorax with sparse, short erect hairs, a few present on propodeum; petiolar scale with short, fine erect hairs; first tergum with a few short, fine erect hairs; second tergum with erect hairs similar but a little more abundant; third and following segments with hairs long, but sparse. Forewing with a few short erect hairs in costal cell; forewing with fringe along costal margin to apex of apical cell; hindwing with fringe along posterior and apical margins.

Color: Head brownish, thorax darker, gaster concolorous with head; appendages light brown. Wings whitish hyaline, veins and stigma yellowish brown.

Terminalia: Figures 264–266.

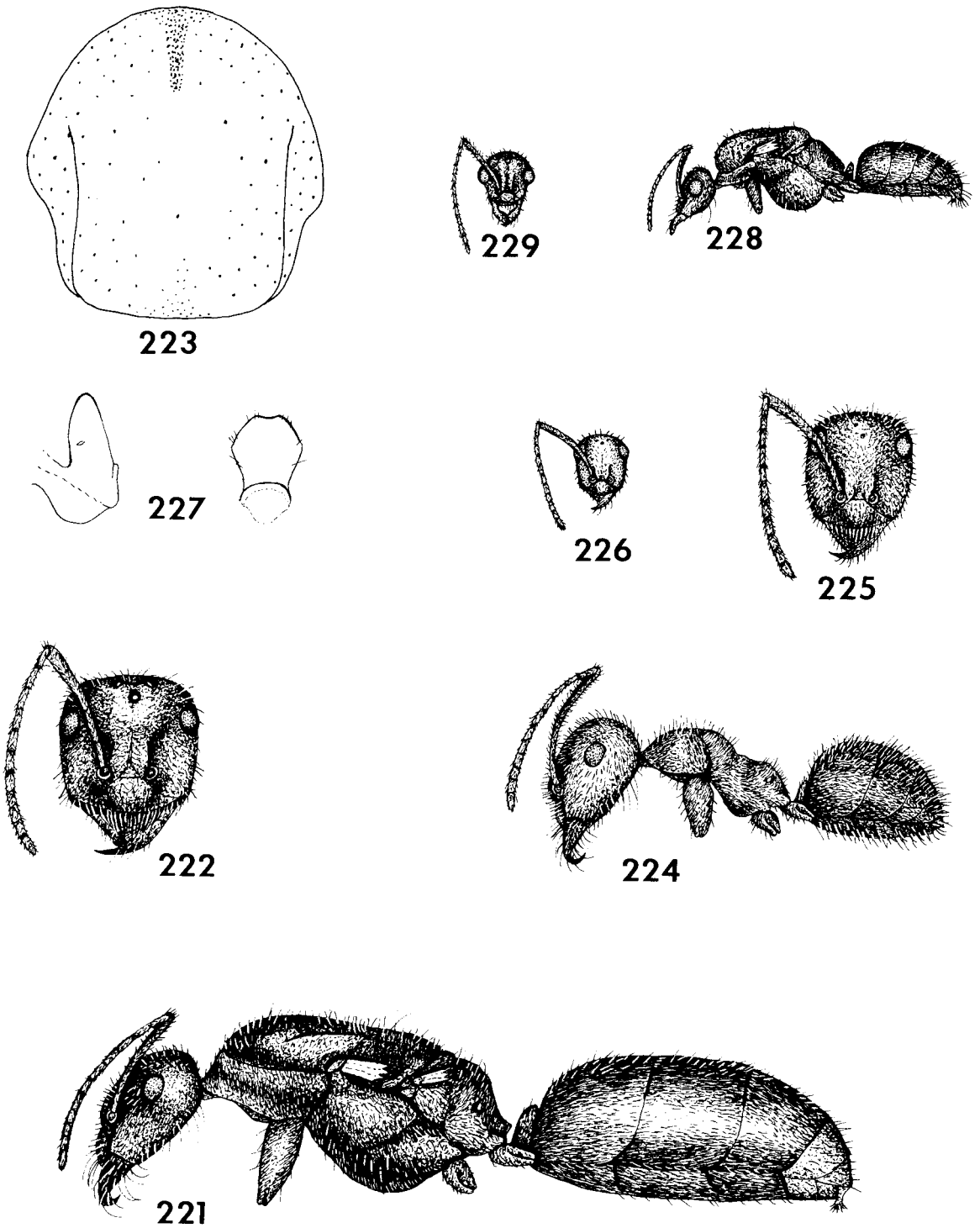
Type Material. Idaho: Elmore Co.: Hammett, 30 May 1932 (A. C. Cole, Jr.), holotype worker and paratypes of all castes. Holotype and most paratypes in LACM, paratypes in AMNH, MCZ, and USNM.

Distribution. Southwestern Idaho to central Nevada and east central California (Fig. 368).

Localities. UNITED STATES. Idaho: Owyhee Co.: 3.3 mi S Given's Hot Springs, 20 June 1967 (R. R. Snelling, No. 67–170; LACM). *Elmore Co.:* Hammett, 30 May 1932 (A. C. Cole; AMNH, LACM, MCZ, USNM,; types of *hammettensis*); 12 mi W Mountain Home, 19 June 1953 (W. F. Barr; USNM). *Nevada: White Pine Co.:* 2 mi N McGill, 6000′, 15 July 1970 (G. C. and J. Wheeler, No. Nev. 1338; GCW). *California: Mono Co.:* 16 mi N Bishop, 4600′, 2 May 1971 (R. J. Hamton, *et al.;* LACM, RJH).

Ecology. The type series was collected on a plain of mixed *Artemisia* and *Bromus,* in an area of deep sand. The nests were noted to be populous and possessed crateriform tumuli 8–15 cm in diameter. The presence of repletes was noted, as was that of males and females on 30 May 1932 (Table 6).

The colony found near Given's Hot Springs was in an area of Saltbush-Greasewood Semidesert, the soil very compact and clayey. The tumulus was crateriform and consisted of fine soil particles. At 1000 hrs the ambiant temperature was approximately 85°F; *hammettensis* workers were located outside of the nest. These were foraging on nearby vegetation; some were seen taking nectar. A few workers were also seen removing debris from the nest. This may be a species in which diurnal activity is usual. The presence of



FIGURES 221–229. *M. hammettensis*. 221, female, lateral view; 222, head of female, frontal view; 223, mesoscutum of female, distribution of punctures; 224, major worker, lateral view; 225, head of major worker, frontal view; 226, head of minor worker, frontal view; 227, petiole of major worker, lateral (left) and posterior (right) views; 228, male, lateral view; 229, head of male, frontal view.

abundant erect body hairs and dense pubescence suggests this may be so. These hairs presumably function to radiate excess heat and stabilize body temperatures.

Discussion. The worker of this species is readily recognized by the abundance of erect hairs on the dorsal body surfaces and all appendages. The only other abundantly hairy species is *colei,* in which there are seldom more than two or three erect hairs on the malar area and the scape has only scattered erect hairs.

The female differs from those of all species of *Eremnocystus,* as far as known, in the polished, very sparsely punctate areas of the first and second terga. The polished and sparsely punctate pleura appear also to be unique.

The lack of fringe hairs on the apical margin of the forewing will separate the male of *hammettensis* from that of *creightoni,* as will the presence of a number of erect hairs on the scape. The male of *colei* also lacks erect hairs on the scape and the scutum and scutellum are uniformly closely punctate, rather than with extensive impunctate areas.

Myrmecocystus (Eremnocystus) lugubris Wheeler

Figures 230–233

Myrmecocystus lugubris Wheeler 1909. Jour. N.Y. Entomol. Soc. 17:98. ♀; Wheeler 1912. Psyche 19:176; Creighton 1950. Bull. Mus. Comp. Zool. 104:443; Creighton 1956. Amer. Mus. Novit. 1807:1–4 *(in part);* Cole 1966. B. Young Univ. Sci. Bull. 7:21; La Rivers 1968. Occ. Papers, Biol. Soc. Nev. 17:9.

Diagnosis. Worker: Scape and propodeal dorsum without erect hairs; malar area without erect hairs or with fewer than 5 on each side; pronotum and mesonotum with at least 8 conspicuous fully erect hairs; hind femur without erect hairs on upper surface. *Female:* unknown. *Male:* unknown.

WORKER. *Measurements.* HL 0.72–0.97 (0.78); HW 0.62–0.97 (0.68); SL 0.75–1.02 (0.85); WL 0.82–1.42 (1.15); PW 0.42–0.65 (0.46).

Head: Distinctly longer than broad in smallest workers to as broad as long in largest, CI 86–100 (87); usually shorter than scape, rarely slightly longer, SI 97–113 (109); in frontal view, sides of head straight, little narrowed toward mandibular insertions, slightly convex in largest workers; occiput, in frontal view, flat, broadly rounded at sides. Eye small, slightly longer than first flagellomere; OMD 1.22–1.75 (1.46) × EL. Mandible septendentate.

Thorax: Moderately stout, PW 0.40–0.51 (0.40) × WL. Mesonotum, in profile, nearly straight in smallest workers to moderately convex in largest, but not abruptly declivitous behind. Basal face of propodeum flat, narrowly rounded into posterior face, latter about twice as long as basal face.

Petiole: Scale, in profile, about twice higher than thick, crest narrowly rounded; from front, sides convergent above, emargination shallow, angulate; from above, about twice wider than thick.

Vestiture: Cephalic pubescence short, scattered, a little denser on occiput; thoracic pubescence abundant but not concealing surface even on pleura and propodeum; first three terga with abundant pubescence, producing sheen; third and following segments with scattered pubescence.

Cephalic hairs restricted to clypeus, frontal lobes and occiput; rarely, one or two erect hairs on malar area near mandibular insertions; longest occipital hairs less than 0.5 × MOD. Pronotum and mesoscutum with eight or more erect hairs each; metanotum and summit of propodeal declivity without erect hairs. Crest and sides of petiolar scale usually without erect hairs, rarely one or two very fine erect hairs. First and second terga with scattered short, erect, discal hairs, third and following with longer erect hairs.

Scape without erect hairs or, rarely, fewer than eight very fine short reclinate hairs; fore femur without erect hairs on inner face; all femora without erect hairs on upper surface; tibiae usually without erect hairs on outer face, rarely with up to eight fine reclinate hairs.

Integument: Clypeus polished and shiny, with scattered setigerous punctures; frontal lobes moderately shiny, finely shagreened and with sparse fine setigerous punctures; frons and occiput shinier, with scattered fine, setigerous punctures; malar area moderately shiny, with scattered elongate, setigerous punctures, denser near eyes and mandibular insertions. Thorax slightly shiny, densely shagreened; propodeum a little duller. Terga slightly shiny, finely and densely shagreened and with abundant fine, obscure piligerous punctures.

Color: Light brownish to blackish brown, appendages paler; mandibles and sides of clypeus often yellowish.

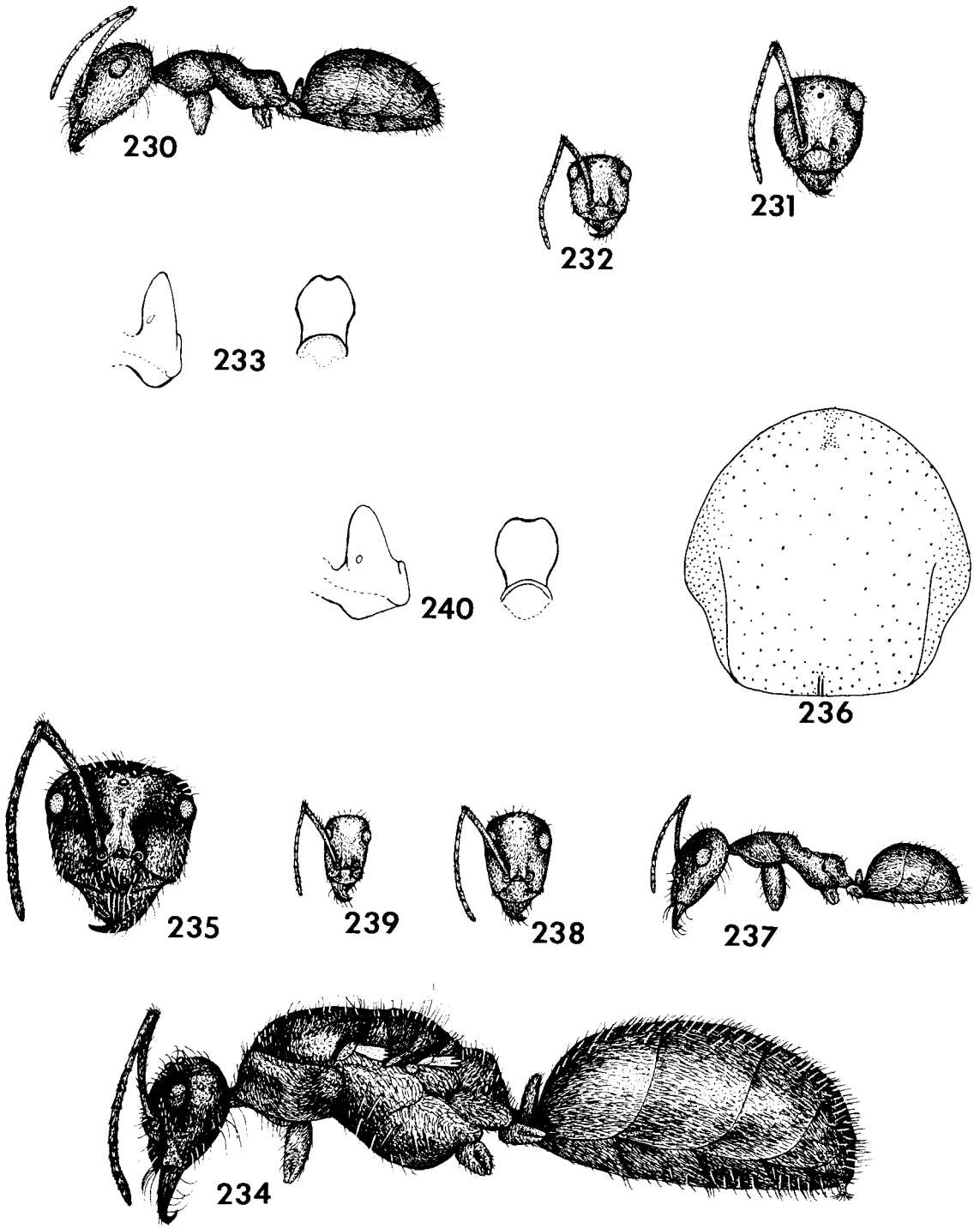
FEMALE: *Unknown.*

MALE. *Unknown.*

Type Material. Described from an unspecified number of worker specimens from Otis, San Bernardino Co., CALIF., collected 16 Sept. 1908 by J. C. Bradley. Cotype material in AMNH and MCZ. Lectotype, by present designation, agreeing with above basic description, parenthetical data and label data in AMNH, lectoparatypes in AMNH, MCZ.

Distribution. Mojave Desert of California and Nevada (Fig. 368).

Localities. UNITED STATES. Nevada: Nye Co.: AEC Nevada Test Site, Mercury, 19 Apr. 1971 (LACM). *California: Inyo Co.:* Mesquite Spg., 1600′, Death Valley Natl. Mon., 30 Apr. 1952 (W. S. Creighton; AMNH, LACM, USNM); Ashford Mill, 0′, Death Valley Natl. Mon., 23 Apr. 1952 (W. S. Creighton; AMNH, LACM); same locality, 2 Nov. 1970 (J. P. Donahue; LACM); same locality, 5 Nov. 1967 (R. R. Snelling, No. 67–282, LACM); Beatty Jct., −200′, Death Valley Natl. Mon., 25 Jan. 1968 (G. C. and J. Wheeler, No. Calif. 294; GCW); Shorty's Well, −100′,



FIGURES 230–233. *M. lugubris*. 230, major worker, lateral view; 231, head of major worker, frontal view; 232, head of minor worker, frontal view; 233, petiole of major worker, lateral (left) and posterior (right) views. FIGURES 234–240, *M. perimeces*. 234, female, lateral view; 235, head of female, frontal view; 236, mesoscutum of female, distribution of punctures; 237, major worker, lateral view; 238, head of major worker, frontal view; 239, head of minor worker, frontal view; 240, petiole of major worker, lateral (left) and posterior (right) views.

Death Valley Natl. Mon., 4 Nov. 1967 (R. R. Snelling, No. 67–281; LACM); Stovepipe Wells, Death Valley Natl. Mon., 12 Mar. 1931 (A. H. Sturtevant; USNM). *San Bernardino Co.:* Otis, 16 Sept. 1908 (J. C. Bradley; AMNH, MCZ; cotypes of *lugubris*).

Ecology. Little is known about this species. The type locality is Mojave Desert Creosote Bush Desert. Most of the samples available are from areas of Saltbush-Greasewood Desert. Nests are located in fine sand, with a crateriform tumulus up to 10 cm in diameter. Workers forage both matinally and crepuscularly and are general food gatherers. Repletes have been collected from nests in Death Valley.

Within Death Valley, where the species is common, the elevation range is from −200′ to 1600′. At Ashford Mill, in Death Valley, I found workers departing from the nest and running along a single trail toward a foraging area. The trail was very poorly defined and it is not certain it can be properly called a trail. It might be that this was merely the most commonly used route to a known foraging area.

Since the sexual forms are unknown, it follows that nothing is known of flight activities. Presumably mating flights take place after spring and/or autumnal rains.

Discussion. As indicated in my discussion of *yuma*, I do not accept the synonymy of that form with *lugubris* as proposed by Creighton (1956). The worker of this species is easily recognized by the characteristics given above under *Diagnosis*. The sexual forms are unknown.

Myrmecocystus perimeces new species

Figures 234–240

Diagnosis. Worker: Recognizable by the unusually elongate, narrow head; antennal scape without erect hairs; hind tibia without erect hairs on outer face. *Female:* mesoscutum with entire disc with scattered coarse, setigerous punctures only; thoracic pleura with abundant long, erect hairs; clypeus only moderately shiny, densely shagreened, punctures obscure; crest of petiolar scale only slightly excised. *Male:* unknown.

WORKER. *Measurements.* HL 0.80–1.16 (1.06); HW 0.56–0.93 (0.80); SL 0.80–1.10 (1.00); WL 1.1–1.7 (1.4); PW 0.43–0.73 (0.56).

Head: In all sizes distinctly longer than wide, CI 70–81 (75); in full face view, sides straight, only slightly narrowed toward mandibular insertions; occiput barely convex, occipital corners rounded; as long or longer than scape, SI 94–100 (94). Eye small, about as long as first flagellomere; OMD 1.67–2.14 (2.00) × EL. Mandibles septendentate.

Thorax: Slender, PW 0.38–0.47 (0.40) × WL. Mesonotum, in profile, convex, rather sharply sloping behind. Basal face of propodeum broadly rounded into posterior face.

Petiole: Scale erect; in profile, about twice higher than thick, weakly cuneate; in frontal view, crest narrow, weakly or not at all notched in middle; from above, no more than twice wider than thick.

Vestiture: Pubescence very short, scattered, on head, a minute area on vertex denser than elsewhere on head; very fine, rather sparse on pronotum, denser on meso- and metanotum, and especially on pleura and propodeum. First two gastric terga with short, fine abundant pubescence not obscuring surface, remaining segments with a few scattered appressed hairs.

Scape, inner face of fore femur, outer faces of middle and hind tibiae and sides of head without erect hairs; clypeal disc and frons with a few scattered short, erect hairs; occiput with 16–24 erect hairs, less than MOD. Pronotum and mesonotum each with a few hairs (>10), shorter than on occiput; propodeum with a variable number (usually >10) of very fine erect hairs. First two terga with scattered short, stiff hairs on disc; following segments with scattered longer hairs.

Integument: Clypeus polished, with sparse, coarse punctures; remainder moderately to strongly shiny, but not polished, lightly shagreened, with sparse to scattered fine punctures, denser on frontal lobes. Thorax rather strongly shiny, lightly shagreened; propodeum duller, more conspicuously shagreened. Gaster shiny, lightly shagreened.

Color: Uniformly light to dark brownish, appendages lighter; mandibles and lower part of cheeks yellowish.

FEMALE. *Measurements.* HL 1.63; HW 1.73; SL 1.53; EL 0.43; OMD 0.63; WL 3.7; PW 2.2.

Head: Broader than long, CI 94; in full face view, sides straight, converging slightly toward mandibular insertions; occiput slightly, evenly convex, corners well rounded; longer than scape, SI 94. Eye small, slightly longer than first flagellomere; OMD 1.46 × EL. Ocelli subequal; IOD 4.3 × OD; OOD 4.0 × OD. Mandible with seven teeth. Penultimate segment of maxillary palp broadest at base, strongly tapering toward apex; segments three and four ribbon-like, about equally broad throughout their lengths.

Thorax: Robust, PW 0.59 × WL. Apical two-thirds of mesocutum, in profile, barely convex, posterior margin below anterior margin of scutellum; scutellum barely convex, except at extreme base, strongly sloping toward rear; propodeum with broad shallow impression at summit of declivity.

Petiole: In profile elongate-cuneate, anterior and posterior faces strongly sloping toward crest; in frontal view, sides of crest rounded, middle shallowly excised; in dorsal view, about twice as wide as thick.

Vestiture: Pubescence sparse on clypeus, malar area and frons, dense on occiput, but not concealing surface; sparse and short on most of pronotum, conspicuously longer and denser along dorsal margin; long,

sparse on sides of mesoscutum and pleura, absent from mesoscutal disc; sparse on scutellum and metanotum; slightly shorter, sparse on propodeum, denser above and around gland opening; abundant on discs of first four gastric terga and sterna.

Scape with about 20 fully erect hairs on outer face. In frontal view, sides of head without erect hairs; occiput with numerous stiff, erect hairs less than 0.5 × MOD, with a few longer hairs in ocellar area; frontal lobes with numerous short, fine hairs; clypeus with sparse hairs of variable length. Mesoscutum with sparse long hairs about half as long as MOD: scutellum with sparse longer hairs of variable length, some longer than MOD; metanotum and propodeum with sparse hairs about as long as those of scutum; numerous long hairs on mesopleura, many as long as or longer than, MOD. Numerous short hairs on petiolar scale: Gastric terga with numerous short, stiff hairs, shortest on first, becoming a little longer caudad, those of first segment less than 0.5 × MOD. Inner face of fore femur without conspicuous long erect hairs, though a few short, fine hairs are visible; outer faces of mid and hind tibiae with abundant erect hairs.

Integument: Face shiny, finely shagreened, but clypeus conspicuously duller, much more strongly shagreened, clypeus with scattered coarse punctures; frontal lobes finely, closely punctate; frons with fine, scattered punctures; malar area with scattered punctures, denser below, coarser than those of frontal lobes; occiput densely, finely punctate. Mesoscutal disc polished, with scattered coarse punctures; parapsis with well separated punctures about equal to those of clypeus; scutellum slightly shiny, uniformly closely punctate, punctures equal to those of lateral area of mesoscutum; pleurae and propodeum duller than scutellum, roughened, with scattered coarse, setigerous punctures and denser, finer punctures; propodeum and terga densely micropunctate.

Color: Uniformly blackish-brown; mandibles, apical middle of clypeus, lower part of cheeks, flagellum and legs lighter.

MALE. Unknown.

Type Material. Holotype and paratype workers (from two colonies), El Molino, 0.5 mi. S, Bahía San Quintín, 0–50′, Baja Calif., MEXICO, 29 March 1970 (E. M. Fisher), in LACM. Additional paratypes, all Baja Calif.: 1♀, same data as holotype, stray; 32 workers, Bahía San Quintín, 21 May 1952 (W. S. Creighton; LACM); 25 workers, San Antonio del Mar, 0′, 27 May 1952 (W. S. Creighton; LACM). Paratypes in AMNH, LACM, MCZ, USNM.

Distribution. Known only from coastal sand dunes around Bahía San Quintín, northern Baja California, Mexico (Fig. 368).

Additional Locality. MEXICO. Baja California: Ensenada, 1 Apr. 1931 (A. H. Sturtevant; USNM).

Etymology. Mekos (Gr., length) + *peri-* (Gr., excessive), because of the exceptionally elongate head.

Ecology. Coastal sand dunes. The series from San Antonio del Mar bears the notation: "circular crater 4 inches diameter in sand."

Probably similar to other species of *Eremnocystus*, a crepuscular and/or matinal forager. The single deälate female, taken in March, indicates a mating flight following spring rains (Table 6).

Discussion. This unique species does not appear to be closely related to other members of the subgenus *Eremnocystus*. The greatly elongated head is diagnostic in all sizes of the worker caste. The mesoscutal sculpturation of the female is most similar to that of *yuma*, but *perimeces* may be immediately separated from that, and all other species, by the finely and closely roughened clypeus which is not at all shiny. All other species, whose females are known, have the greater part of the clypeus shiny, very lightly shagreened, with scattered, conspicuous punctures.

Myrmecocystus (Eremnocystus) tenuinodis
new species

Figures 241–247

Myrmecocystus lugubris, Creighton 1956. Amer. Mus. Novitates 1807:1–4. *(in part, misidentification)*

Diagnosis. Worker: Petiole strongly compressed; fully erect hairs present on propodeal dorsum, often present on scape; femora, including inner face of fore and dorsal face of hind femora, and tibiae with abundant erect hairs. *Female:* Mesoscutum shiny, median area with scattered punctures, parapsis with denser, but still sparse punctures; fore femur with reclinate or erect hairs on all surfaces; fore and hind wings with erect membrane hairs; forewing without fringe hairs; hind wing with fringe hairs on posterior margin. *Male:* Unknown.

WORKER. *Measurements.* HL 0.70–1.03 (0.83); HW 0.63–1.00 (0.76); SL 0.73–1.03 (0.86); WL 0.86–1.43 (1.03); PW 0.40–0.63 (0.50).

Head: In all sizes varying from distinctly to slightly broader than long, CI 82–96 (92), slightly shorter than, or as long as scape, SI 100–113 (104); in frontal view sides straight or feebly convex in largest workers; occiput, in frontal view, barely convex, sides broadly rounded. Eye small, barely longer than first flagellomere; OMD 1.39–1.68 (1.43) × EL. Mandible septendentate.

Thorax: Moderately robust, PW 0.42–0.50 (0.48) × WL. Mesonotum, in profile, gently convex, not abruptly sloping behind. Propodeum higher than long, basal face broadly rounded into posterior face, latter about twice as long as former.

Petiole: Scale erect, about thrice higher than thick; crest sharp; crest, in frontal view, narrowed above,

weakly angularly emarginate; from above, more than twice wider than thick.

Vestiture: Cephalic pubescence short, sparse on occiput, scattered elsewhere; thoracic pubescence generally sparse, a little denser on pleura and propodeum. First two terga with pubescence sufficiently dense to form sheen; third and following segments with scattered pubescence, occasionally none at all.

Malar area usually with a few (up to six) erect hairs visible in frontal view; clypeus, frontal lobes and occiput with fine, acuminate erect hairs, longest occipital hairs about equal to 0.5 × MOD. Pronotum and mesonotum with numerous standing hairs; metanotum without erect hairs; basal face of propodeum with a cluster of fine, erect hairs at juncture with posterior face. Petiolar crest with a few short, fine, erect hairs. First two terga with sparse erect hairs. Scape usually with abundant fine reclinate hairs, rarely with scattered fully erect hairs; inner face of fore femur and dorsal face of hind femur with erect hairs; hind tibia usually with abundant erect hairs on outer face, but may be reduced or lacking in small individuals.

Integument: Clypeus polished and shiny; frontal lobes shiny to moderately shiny, lightly shagreened, with scattered fine, obscure punctures; frons moderately shiny, lightly shagreened; occiput duller, more densely shagreened; malar area moderately shiny, more closely shagreened near eyes and mandibular insertions, with scattered fine punctures. Thorax slightly shiny, closely shagreened, more strongly so on propodeum. First tergum slightly shiny, densely shagreened; second segment shinier and more lightly shagreened; remaining segments shinier and more weakly shagreened than second.

Color: Light to dark brownish, gaster sometimes slightly darker than head and thorax; appendages paler; mandibles, sides of clypeus and malar area near mandibular bases, yellowish.

FEMALE. *Measurements.* HL 1.36–1.40; HW 1.43–1.46; SL 1.26–1.30; EL 0.40; OMD 0.50; WL 2.9–3.0; PW 1.8–1.9.

Head: Slightly broader than long, CI 104; malar margins, in frontal view, straight, slightly narrowed toward mandibular bases; occiput flat in frontal view, sides slightly angulate, broadly rounded; a little longer than scape, SI 93. Eye a little longer than first flagellomere; OMD 1.25 × EL. Lateral ocelli slightly larger than anterior ocellus; IOD 3.0 × OD; OOD 3.3 × OD. Mandible septendentate. Penultimate segment of maxillary palp broadest in middle, more narrowed apically than basally; fourth segment strongly clavate, preapical width more than twice basal, outer margin nearly straight, inner strongly sinuate.

Thorax: Robust, PW 0.61–0.65 × WL. Posterior half of mesoscutum flattened and continuous with anterior half of scutellum, posterior half of scutellum strongly sloping, flat; metanotum, barely convex in profile, not protruberant; propodeum with distinct horizontal basal area, abruptly rounded onto posterior face.

Petiole: In profile, sharply cuneate, crest narrow; in frontal view, sides slightly narrowed above, crest deeply, angularly notched; from above, about three times wider than higher.

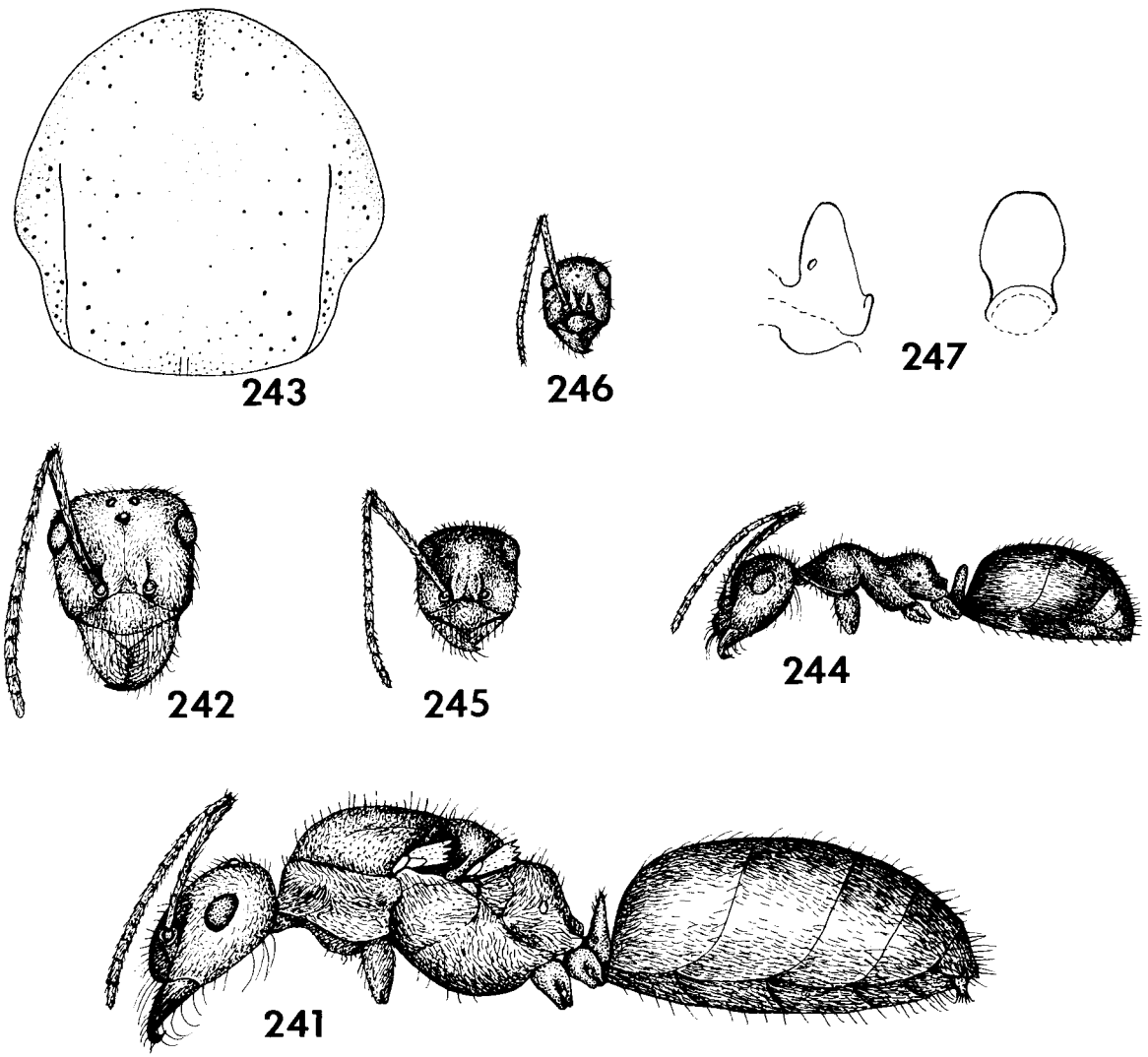
Vestiture: Clypeus with little or no pubescence; pubescence of frontal lobes short, sparse; malar area with sparse, coarse pubescence near mandibular bases; head otherwise with fine, widely scattered pubescence. Thoracic pubescence longer, sparse on sides of mesoscutum; fine and sparse on pleura; a little denser, coarser and decumbent on propodeum. Gastric sheen pronounced on first tergum, distinctly less developed on second, third and fourth segments.

Malar area with abundant subdecumbent coarse hairs in frontal view (longer hairs from gular area are usually visible in frontal view); cephalic hairs otherwise confined to clypeus, frontal lobes and occiput, longest occipital hairs about 0.5 × MOD. Mesoscutal hairs abundant, but rather sparse, longest hairs about equal to 0.5 × MOD; scutellum with numerous hairs, longest more than 2 × longest scutal hairs; pleura with scattered long, erect hairs, about equally abundant above and below; propodeum with short erect hairs above and on sides. Petiole with short erect hairs on crest and sides. Terga with sparse, short, erect hairs, progressively longer on succeeding segments. Scape with numerous suberect and scattered erect hairs. Fore femur with numerous suberect and sparse erect hairs on inner face; hind femur with sparse, short erect hairs on dorsal face; hind tibia with abundant fully erect and suberect hairs on outer face.

Wing membrane with scattered, very short, fully erect hairs; fringe hairs present, but sparse, on posterior margin of hind wing.

Integument: Clypeus shiny, subpolished, with sparse, coarse punctures; frontal lobes shiny, lightly shagreened, with irregularly spaced, fine punctures; frons shiny, subpolished to polished, with scattered fine punctures; occiput duller, lightly shagreened, with scattered finer punctures; malar area shiny, lightly shagreened, densely and finely punctate below, above with scattered coarse punctures.

Mesoscutum shiny, disc subpolished to polished and with widely scattered coarse punctures; parapsis duller, lightly shagreened, with irregularly spaced, mixed, coarse and fine punctures; scutellum shiny, lightly shagreened, with uniformly spaced coarse setigerous punctures. Propodeum slightly shiny, strongly shagreened. First tergum moderately shiny, with fine, dense, piligerous punctures; second tergum shinier, more sparsely and finely punctate; third tergum similar to second.



FIGURES 241–247. *M. tenuinodis*. 241, female lateral view; 242, head of female, frontal view; 243, mesoscutum of female, distribution of punctures; 244, major worker, lateral view; 245, head of major worker, frontal view; 246, head of minor worker, frontal view; 247, petiole of major worker, lateral (left) and posterior (right) views.

Color: Light brownish, gaster a little lighter than head and alitrunk; appendages lighter; mandibles and sides of clypeus yellowish.

MALE. *Unknown.*

Type Material. Holotype and paratype workers: 1.9 mi N Thousand Palms, 190′, Riverside Co., CALIF., 5 Feb. 1967 (R. R. Snelling). Holotype and most paratypes in LACM; three paratypes each in AMNH, MCZ, USNM.

Etymology. Tenuis (L., thin) + *nodus* (L., knot), because of the thin petiolar node as viewed in profile.

Distribution. Mojave and Colorado Deserts, from southern Nevada to northern Sonora; probably also in northern Baja California (Fig. 368).

Additional Localities. UNITED STATES. Nevada: Churchill Co.: Sand Mt., 4000′, 1 July 1970 (G. C. & J. Wheeler, No. Nev., 1220; GCW). *California: Riverside Co.:* 3 & 5 mi E Thousand Palms, 100′, 16 Feb. 1963 (W. S. Creighton; LACM); 3 mi E Thousand Palms, 100′, 21 Feb. 1972 (R. R. Snelling; No. 72–2; LACM); Garnet, no date (A. H. Sturtevant; USNM); Carrizo Cr. Cyn., 1000′, 29 Feb. 1963 (W. S. Creighton; LACM). *Arizona: Yuma Co.:* 5 mi E Yuma, 500′, 21 Oct. 1952 (W. S. Creighton; AMNH, LACM); 12 mi E Yuma, 190′, 31 Mar. 1967 (R. R. Snelling;

LACM). *MEXICO. Sonora:* 5 mi E San Luís, 300′, 23 Oct. 1952 (W. S. Creighton; AMNH, LACM).

Ecology. The habitats of this ant are all in areas of Creosote bush or Creosote bush-Bur sage Desert, at elevations up to at least 4000 feet. The nests are surmounted by low craters up to 20 cm in diameter and are located in areas of fine sand.

Foraging is both matinal and crepuscular. The foragers have been taken at nectaries of *Coldenia* sp. (Boraginaceae) near Yuma and on *Malacothrix* sp. (Asteraceae) at the type locality. They seem to limit their activities to low vegetation, none having been taken more than one meter above ground level. At Yuma, also, workers were seen carrying immature cicadellids (mostly first or second instar) back to the nest. Arthropod fragments are commonly found in the debris around the nest. Repletes have been taken from nests at the type locality.

Creighton took females of this species in flight on 16 Feb. 1963, after a recent rain which soaked the surface to a depth of about six inches. His notes do not indicate time of day of the flights (Table 6).

Near Thousand Palms I found foraging files of this ant. On both occasions, the files were irregular, with ants well-spaced, and often running parallel with, but about a centimeter to either side of the path.

Surface activity by this ant is largely during the spring and autumnal months. There apparently is little or no foraging done between the middle of May and the middle of October. Marked nests located near Thousand Palms which were visited during this period were always closed and the tumuli in disrepair. Summer-long aestivation may be normal for this and other hot desert species.

Discussion. Although the petiolar scale is almost as thin, in profile, as it is in *lugubris,* this species has a number of conspicuous erect hairs on the dorsum of the propodeum. There are also numerous erect hairs on the extensor surfaces of the hind femur and tibia. The hind femur of *lugubris* has no erect hairs on the extensor surface and few or none on that surface of the tibia. The petiolar scale is thinner than is that of *yuma* from which *tenuinodis* also differs in the more pilose legs.

In the female the mesoscutum is impunctate in the middle, by which it may immediately be separated from those of *creightoni* and *colei.* The distinctly clavate fourth segment of the maxillary palp will separate the female from that of all species except *hammettensis,* but in that species the upper half of the mesopleura is polished between scattered coarse, somewhat elongate punctures and the scutellum has extensive areas of very sparse punctation. The summit of the first tergum, in the middle, and the disc of the second are moderately shiny and uniformly, closely micropunctate in *tenuinodis,* but polished and very sparsely punctate in *hammettensis.*

Myrmecocystus (Eremnocystus) yuma Wheeler

Figures 248–254

Myrmecocystus yuma Wheeler 1912. Psyche 19:174. ♀. Creighton 1950. Bull. Mus. Comp. Zool. 104:450.
Myrmecocystus lugubris, Creighton 1956. Amer. Mus. Novitates 1807:1–4 *(in part).*

Diagnosis. Worker: Scape without conspicuous erect hairs; propodeum with cluster of fully erect hairs at juncture of basal and posterior faces; erect pronotal hairs with blunt apices; hind femur without erect hairs on flexor surface and few or none on extensor surface; petiolar scale not strongly compressed. *Female:* Scape with few or no erect hairs; mesoscutum largely impunctate in median area, the scattered punctures much coarser than those of the densely and uniformly punctate scutellum; frontal lobe finely, densely and uniformly punctate. *Male:* Unknown.

WORKER. *Measurements.* HL 0.76–1.00 (0.83); HW 0.73–1.00 (0.83); SL 0.80–1.03 (1.00); WL 1.00–1.33 (1.20); PW 0.50–0.66 (0.57).

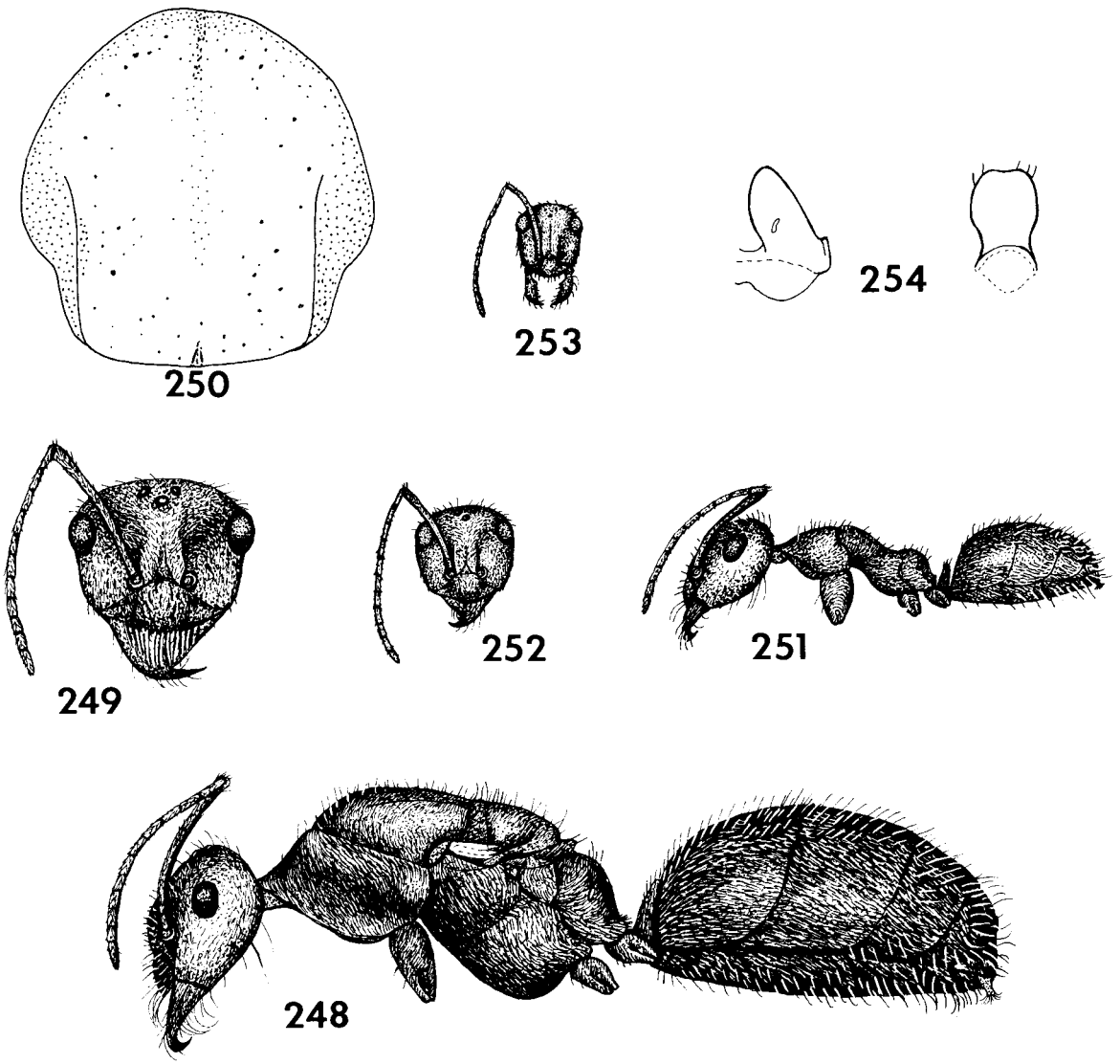
Head: Little broader than long or as broad as long, CI 92–100 (100); a little shorter than scape, SI 103–120; in frontal view, sides slightly convex and a little narrowed toward mandibular insertions; occiput, in frontal view, evenly and gently convex from side to side, without lateral angulations. Eye small, barely longer than first flagellomere; OMD 1.37–1.57 (1.47) × EL.

Thorax: Moderately robust, PW 0.43–0.53 (0.47) × WL. Mesonotum, in profile, nearly flat, without posterior angulation or abrupt convexity. Propodeum higher than long, basal face broadly rounded onto posterior face.

Petiole: Scale erect, thick in profile, a little more than twice higher than thick, summit rounded; crest, in frontal view, flat, sometimes with a very weak, angular, median notch; from above, about twice wider than thick.

Vestiture: Cephalic pubescence scattered, a little more evident, but still quite sparse, on frontal lobes and occiput; thoracic pubescence sparse, a little denser on propodeum; gastric sheen evident on first two terga, dilute sheen often present on third tergum of larger workers; remaining terga with scattered pubescence or none.

Malar area normally without erect hairs, occasionally one or two present near mandibular base; clypeus, frontal lobes and occiput with sparse erect hairs, longest occipital hairs more than 0.5 × MOD. Pronotum and mesonotum each with ten or more standing hairs, metanotum with fewer than six short erect hairs; basal face and side of propodeum with scattered erect hairs. Crest of petiole with a few erect hairs. Terga with sparse erect hairs, progressively longer on succeeding segments. Scape without erect hairs except near apex, elsewhere with a few very fine reclinate hairs; inner face of fore femur and dorsal face of hind femur with-



FIGURES 248–254. *M. yuma*. 248, female, lateral view; 249, head of female, frontal view; 250, mesoscutum of female, distribution of punctures; 251, major worker, lateral view; 252, head of major worker, frontal view; 253, head of minor worker, frontal view; 254, petiole of major worker, lateral (left) and posterior (right) views.

out erect hairs; hind tibia without fully erect hairs, but a variable number of fine, decumbent hairs.

Integument: Clypeus polished and shiny, with scattered fine punctures; frontal lobes lightly shagreened and shiny, with sparse, fine punctures; frons and occiput shiny, obscurely shagreened; malar area mostly shiny, a little duller and more distinctly shagreened near mandibular base. Thorax moderately shiny, distinctly shagreened, more distinctly so on the slightly shiny propodeum. First tergum slightly shiny, closely shagreened; second tergum shinier, more weakly shagreened; third tergum moderately shiny and shagreened in large workers, shiny and very weakly shagreened or polished in smaller.

Color: Light to dark brownish, gaster usually a little darker than head and thorax; appendages lighter; mandible, sides of clypeus and malar area near mandibular base, yellowish.

FEMALE. *Measurements*. HL 1.40; HW 1.53; SL 1.23; EL 0.40; OMD 0.53; WL 3.0; PW 1.73.

Head: Broader than long, CI 109; in frontal view, malar margin straight, very slightly convergent toward mandibular base, occiput gently and evenly convex in frontal view, without evident lateral angles; distinctly longer than scape, SI 88. Eye 1.5 × first flagellomere; OMD 1.33 × EL. Lateral ocelli slightly larger than anterior ocellus; IOD 4.5 × OD; OOD 6.0 × OD. Mandible septendentate. Penultimate maxillary palpal

segment broader near middle than at either base or apex; fourth segment nearly parallel-sided, preapical width about one-fourth greater than basal width.

Thorax: Robust, PW 0.57 × WL. Posterior half of mesoscutum flattened and continuous with anterior portion of scutellum, posterior half of scutellum more strongly sloping. Metanotum distinctly protuberant. Propodeum with narrow basal face.

Petiole: In profile, distinctly narrowed above, crest narrow; in frontal view, sides a little convergent above, median emargination narrow, deep, angulate; from above, about three times wider than thick.

Vestiture: Cephalic pubescence thin; scattered on clypeus; sparse on frons; denser, but still sparse, on frontal lobes; sparse on malar area; short and sparse on occiput. Thoracic pubescence thin, densest on pronotum, sides of mesoscutum, pleura and propodeum. First four terga with pronounced sheen.

Malar area with a few scattered short erect hairs and two or three longer decumbent hairs near mandible; clypeus with sparse erect and scattered suberect shorter hairs; frontal lobes with sparse erect hairs; longest occipital hairs more than 0.5 × MOD. Scutum with scattered erect hairs, longest equal to about 0.5 × MOD; scutellum with scattered hairs, some about twice as long as longest scutal hairs; pleura with a few erect hairs, especially above; metanotum with a few erect hairs; propodeum with a few erect hairs above and on sides; petiolar scale with erect hairs on crest and sides. All terga with sparse, short erect hairs, progressively longer on succeeding segments. Antennal scape with numerous decumbent to suberect short hairs. Inner face of fore femur without erect hairs; dorsal face of hind femur with decumbent to suberect hairs, a few erect hairs near apex; hind tibia with abundant suberect hairs on outer face.

Wings not present on one specimen studied.

Integument: Clypeus shiny, subpolished; with sparse, coarse, setigerous punctures and scattered fine piligerous punctures; frontal lobes shiny, finely, densely and uniformly punctate; frons moderately shiny, finely, densely and uniformly punctate; occiput slightly shiny, finely and irregularly punctate; malar area shiny, coarsely and closely punctate, duller below. Mesoscutum shiny and subpolished, disc with scattered coarse punctures and a narrow band of fine, sparse punctures along midline; parapsis uniformly densely and finely punctate. Scutellum shiny, with scattered, coarse punctures on either side of midline, otherwise with uniformly sparse, fine punctures. Propodeum moderately shiny, strongly shagreened. First tergum moderately shiny, densely and finely punctate on disc; second and third terga similar, but piligerous punctures much finer; fourth tergum a little shinier and more sparsely punctate.

Color: Medium brown, gaster blackish brown, appendages lighter; mandibles and sides of clypeus yellowish.

MALE. *Unknown.*

Type Material. Cotype worker series from Yuma, Yuma Co., ARIZONA, collected 26 Nov. 1910, by W. M. Wheeler. Lectotype worker, by present designation, agreeing with above description, parenthetical data and label data, in AMNH. Lectoparatypes in AMNH, LACM and MCZ.

Distribution. Mojave and Colorado Deserts of southern Nevada, southern California, western Arizona, northwestern Sonora and northeastern Baja California (Fig. 368).

Localities. UNITED STATES. Nevada: Clark Co.: Valley of Fire, 2000′, 15 Mar. 1970 (G. C. & J. Wheeler, No. Nev. 644; GCW); Cottonwood Cove, 800′, Lake Mohave, 10 Dec. 1970 (G. C. & J. Wheeler, No. Nev. 1507; GCW). *California: San Bernardino Co.:* 10.7 mi N Earp, 375′, 2 April 1967 (R. R. Snelling; LACM); 27 mi E Twentynine Palms, 13 Oct. 1963 (R. R. Snelling; LACM); Golden Crown Mine, 22 Feb. 1968 (R. J. Hamton; LACM, RJH); Yermo, 27 April 1952 (W. S. Creighton; AMNH, LACM, USNM); Pisgah Crater, 11 March 1961 (Norris & Heath; LACM). *Riverside Co.:* Fried Liver Wash, 1700′, 26 April 1952 (W. S. Creighton; AMNH, LACM, USNM); 3 mi NE Old Dale Jct., 6 April 1967 (R. J. Hamton; RJH); 13 mi N Desert Center, 22 Feb. 1968 (R. J. Hamton; RJH). *San Diego Co.:* 4 mi S Borrego, 16 Feb. 1964 (R. R. Snelling; LACM). *Arizona: Yuma Co.:* Yuma, 26 Nov. 1910 (W. M. Wheeler; AMNH, LACM, MCZ, cotypes *yuma*); same locality, 10 July 1965 (A. C. Cole, No. Az-410; ACC, USNM); 12 mi E Yuma, 190′, 31 Mar. 1967 (R. R. Snelling; LACM). *MEXICO: Baja California:* 20 mi N San Felipé, 200′, 15 June 1952 (W. S. Creighton; LACM); 5 mi N San Felipé, 0′, 16 June 1952 (W. S. Creighton; AMNH, LACM); San Felipé, 0′, 14 June 1952 (W. S. Creighton; LACM).

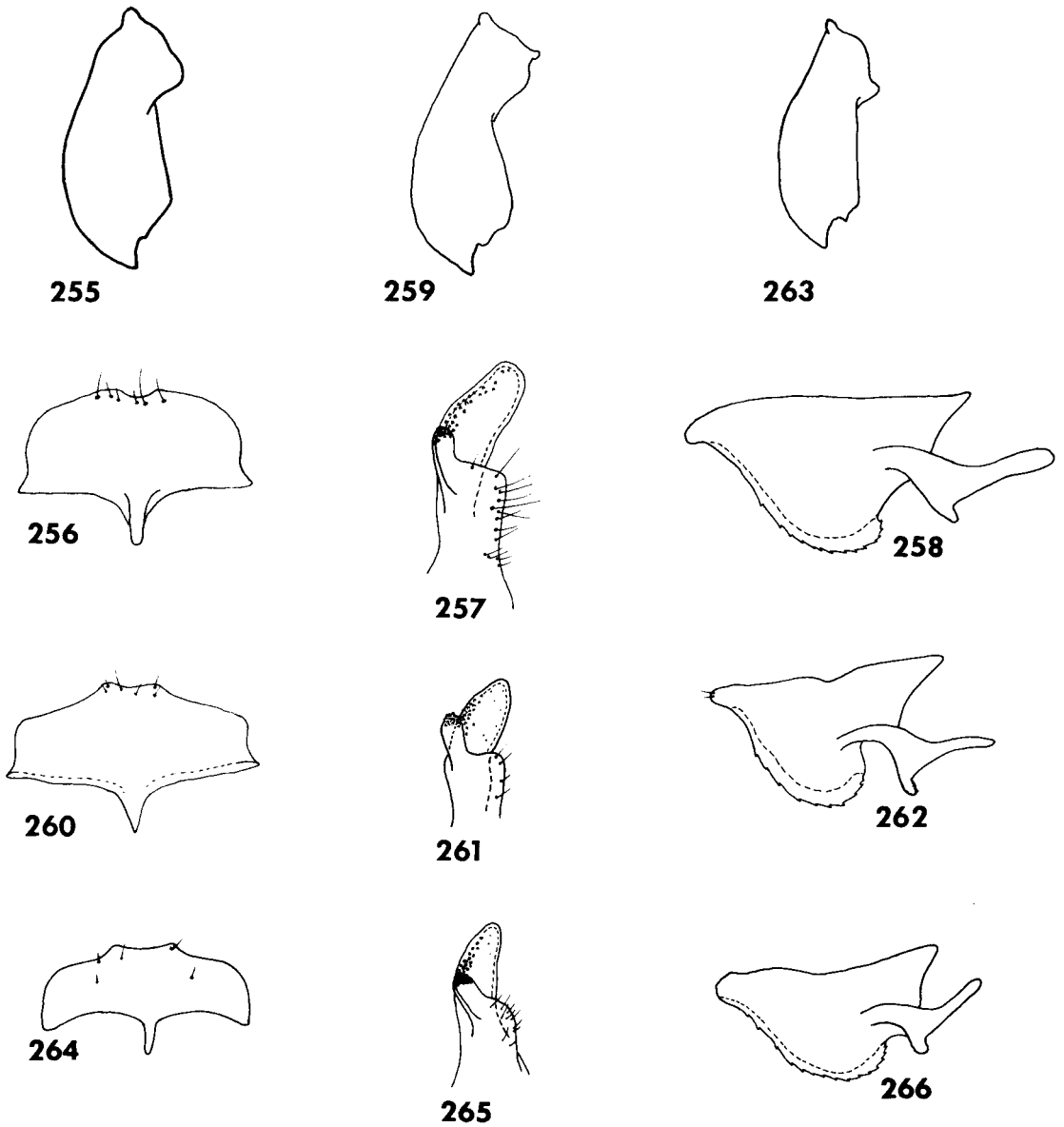
Ecology. Wheeler (1912) observed that nests at the type locality were surmounted by craters three to four inches in diameter and that remains of dead insects were abundant around the edges of the craters. From the latter he surmised the ant to be predatory.

Nests are usually, if not always, located in sand, either coarse or fine. Craters seem not to exceed 10.5 cm in diameter. Bits of twigs and leaves are sometimes found about the margins of the tumulus, as noted by Wheeler, but whether these were placed there by the ants or wind-blown is not known.

Little is known of the foraging behavior of this ant. Wheeler believed the species to be predatory. Since I have observed workers visiting flowers and soliciting both aphids and pseudococcids for honeydew, it would appear that the food gathering habits do not differ materially from those of other *Eremnocystus*. I have observed workers foraging both during early morning and late afternoon.

All collections of this species have been made in Creosote bush and Creosote bush-Bur sage Desert and at elevations ranging from sea level to 2000 feet.

Discussion. Creighton (1956) synonymized this species with *lugubris* based on a study of type material of both forms and of samples which he collected in Arizona and California in 1952. He carefully examined



FIGURES 255–266. Male mandible, seventh sternum, volsella and aedeagus, respectively. 255–258, *M. colei;* 259–262, *M. creightoni;* 263–266, *M. hammettensis.*

the separatory characters utilized by Wheeler (1912) and Creighton (1950) and found them worthless. While I agree that the traditional method of separation is ineffectual, I cannot agree that the two ants are conspecific. Had Creighton had available to him females from the colonies he collected he doubtless would have realized that he had four species rather than one. With the Creighton material before me, it is evident that, in addition to *lugubris* and *yuma,* he also had samples of *creightoni* and *tenuinodis*. The recognition of these two latter species, prompted by female characteristics, enabled me to separate once again *lugubris* and *yuma*.

Although there is some variation in the profile of the petiolar scale, that of *yuma* is definitely thicker than that of *lugubris*. A notch is usually not present on the crest of the scale in *yuma*. When a notch is present, it is weak. The petiolar scale of *lugubris* rarely has a weak notch, more often a very distinct one.

Of far greater utility is the fact that the dorsum of the propodeum of *yuma* always has six or more fully erect hairs, while none are present here in *lugubris*. Both possess a number of fully erect hairs on the pronotum and mesonotum. The punctures of the frontal lobes are finer and closer in *yuma* than in *lugubris,* while in

the latter species the discal hairs of the first tergum are shorter and stiffer.

SUBGENUS *MYRMECOCYSTUS* WESMAEL, *s. str.*

Diagnosis. Worker and *female:* With mandible basically nine-toothed; eye large, EL usually conspicuously greater than length of first flagellomere; wings of sexuals without fine erect hairs on membrane; male mandible often denticulate; worker and female concolorous light yellow to brownish yellow, male light to medium brown.

Description. Worker: Mandible basically nine-toothed, but may be eight- or ten-toothed; eye large, always exceeding length of first flagellomere; ocelli much reduced or absent; pubescence and erect hairs variable, sparse or abundant; integument basically yellowish, may be extensively infuscated so ant appears light brown, but never ferruginous and/or blackish. *Female:* Similar to worker except for usual caste characters; ocelli present, distinct; wings without erect white hairs on membrane. *Male:* Wings as in female; mandible normally with at least one denticle basad of apical tooth, often two or three; aedeagus without setae.

Type Species: Myrmecocystus mexicanus Wesmael 1838. Monobasic.

Included Species: M. ewarti Snelling 1971; *M. melanoticus* Wheeler 1914; *M. mexicanus* Wesmael 1838; *M. navajo* Wheeler 1908; *M. pyramicus* M. Smith 1951; *M. testaceus* Emery 1893.

Discussion. To this subgenus are assigned the distinctly yellowish nocturnal species. In two species *(melanoticus* and *mexicanus)* the yellow color may be extensively overlaid with brown, but even in the darkest of these there is no approach to the condition of the species of *Endiodioctes* or *Eremnocystus*.

The basic number of mandibular teeth is nine. Such species as *melanoticus, mexicanus* and *navajo* normally possess nine-toothed mandibles, but there is variation in these from eight to ten. The usual number of teeth in *testaceus* is eight and in the two derived species, *ewarti* and *pyramicus,* it is seven. Variation in the three latter species usually is expressed by the presence of one or two additional denticles (one in *testaceus,* two in *ewarti* and *pyramicus*).

Eye length is also somewhat variable, but it always exceeds that of the first flagellomere. In a few species *(mexicanus, navajo, testaceus)* it may be as little as 1.05 times the length of the first flagellomere, but, even in these species, is normally in excess of 1.2 times. The eye is relatively larger in the two species *ewarti* and *pyramicus,* which I consider to be most derived, at least 1.5 × the first flagellomere. In these same two species the OMD is shorter than in species of the other groups, not exceeding 1.15 × EL.

Within this subgenus the most widely distributed species is *mexicanus* and this is apparently the most primitive. The mandibles of the worker possess nine teeth and the most common variant form of dentition exhibits an increase to a decemdentate condition. Far less commonly, an octodentate variant appears in some colonies. Very closely related to *mexicanus* is the southern species *melanoticus.* In this species the basic number of mandibular teeth is still nine, but variants with eight teeth are common, while a ten-toothed variant is very rare. This species is as hairy as *mexicanus* and similar to it in size, but apparently a little less polymorphic. A third species closely related to these is *navajo.* It is smaller in stature and a little less polymorphic than *mexicanus.* In *navajo* the vestiture is reduced, especially the erect hairs of the appendages. The mandibles are most commonly with nine teeth, but some individuals exhibit a reduction to eight in one or both mandibles. The most striking deviation from *mexicanus* lies in the displacement of the eyes toward the top of the head; in most workers the upper eye margin is coincident with the occipital margin in full face view. These three species comprise the *mexicanus* group.

The *pyramicus* group consists of the two species *ewarti* and *pyramicus.* The mandibles of these two species are basically septendentate, with one or two smaller denticles sometimes present, the pilosity is greatly reduced, especially on the thorax, and the eyes are displaced toward the top of the head. The eyes are large, consistently at least 1.5 × the first flagellomere. In profile, the metanotum is greatly depressed; the basal face of the propodeum is flat and slopes to the metanotum, so that the juncture of the basal and posterior faces appears to be projected upward. These are the smallest species in the subgenus and are limited to the western range of the subgenus.

The third species group contains but a single western species, *testaceus,* which ranges from southern Washington to northern Baja California. This ant is fully as hairy as *mexicanus,* but is a little smaller, more robust and less polymorphic. The mandibles are basically octodentate, but one additional tooth is sometimes present. The eyes are large, usually about 1.25 × the first flagellomere, but ranging from 1.05–1.40. In this species the metanotum is not depressed (depressed in *mexicanus* group species) and the propodeum is higher than long, with the juncture of the basal and posterior faces abruptly rounded, sometimes subangulate.

The evolutionary sequence of this subgenus may have started with a widely distributed *mexicanus*-like form. A tendency toward loss of a single mandibular tooth and some reduction of polymorphism would result in *melanoticus.* The *navajo* form is also a straightforward derivative through reduction in size and in amount of vestiture; the eyes are displaced toward the top of the head. Progression of the same features seen in *navajo* results in the *ewarti* and *pyramicus* characteristics in which eye size and reduction of vestiture are most ex-

treme. The characteristic thoracic profile of these two species is an exaggeration of characteristics present in *mexicanus* and foreshadowed in *navajo*. An independent line appears to be that of the monotypic *testaceus* group. Here, the number of mandibular teeth is reduced to eight, but the body is as hairy as in *mexicanus*, the eyes are about as large as in *mexicanus* and are not displaced dorsad. However, the thorax is stouter, the metanotum is not depressed and the propodeum is higher than long, with the dorsal face flattened.

Predictably, those species which are widely distributed are also those which occur in the widest range from Piñon-Juniper Woodland to Saltbush-Greasewood Shrub. On the other hand *ewarti* is a species of Creosote bush Shrub and Creosote bush-Bur sage Shrub and *pyramicus* is found largely in Sagebrush Steppe.

All of the species forage mostly between sundown and sunrise. They may emerge on overcast days, as *testaceus* commonly does. Foraging is usually initiated as a mass exodus in which workers quickly scatter in all directions. Aphids and pseudococcids are solicited for honeydew and the exudates from cynipid galls are gathered. These are supplemented by visits to floral and extrafloral nectaries. Protein sources are largely the scavenged remains of other arthropods; the ants rarely function as predators. When occasion permits they will scavenge on dead vertebrates. All species are known to form repletes.

Refuse chambers are rare in nests. Debris from the nests is usually carried to the surface and dropped at random some distance from the entrance. Often it is dropped from the summit of the crateriform superstructure.

Tumuli are normally present, as regular craters, and consist of the coarsest grains available. Fine sand is usually scattered at random beyond the tumulus. Tumuli of *melanoticus*, *mexicanus* and *navajo* examined immediately after rains have been noted to be little worn and the particles may be agglutinated.

KEY TO SPECIES OF *MYRMECOCYSTUS*

Workers

1. Dorsal surface of propodeum strongly, angularly projected upward over posterior two-thirds; erect hairs very sparse, with few or none on outer face of hind tibia; upper eye margin little below upper margin of head . . . 2
   Dorsal surface of propodeum either flat or evenly convex, often abundantly hairy; upper eye margin usually well below upper margin of head 3
2. With at least two erect pronotal hairs as long as apical breadth of scape; first tergum with a few erect hairs on disc; hind tibia with a few erect hairs on outer face beyond basal third . . . . . *ewarti* Snelling
   Erect pronotal hairs, when present, shorter than apical breadth of scape; first tergum without erect discal hairs; hind tibia without erect hairs on outer face beyond basal third . . . . . *pyramicus* M. Smith
3. Head, pronotum and gaster with abundant appressed pubescence; mid and hind tibiae usually with numerous erect hairs along apical half of outer face; upper eye margin often distinctly below occipital corner; if metanotal suture impressed, HL exceeds 1.3 mm 4
   Head, pronotum and gaster shiny, with little or no appressed pubescence; mid and hind tibiae with not more than 3 or 4 erect hairs beyond basal third of outer face, usually none; upper eye margin coincident with occipital corner; metanotal suture deeply impressed and dorsal face of propodeum convex . . . . . *navajo* Wheeler
4. Large, highly polymorphic species, HL 1.0–2.0 mm or more, usually in excess of 1.3 mm; metanotal suture usually impressed and propodeum as long as high or longer, juncture of dorsal and posterior faces broadly rounded 5
   Smaller, moderately polymorphic species, HL 0.8–1.4 mm; metanotal suture not impressed, propodeum higher than long, juncture of dorsal and posterior faces abruptly rounded, often subangulate . . . . . *testaceus* Emery
5. Eye with numerous erect hairs which are longer than diameter of ocular facets; mandible with eight or nine teeth; color uniformly brownish, gaster a little darker . . . . . *melanoticus* Wheeler
   Eye with erect hairs, when present, very diffuse, length less than diameter of ocular facets; mandible with nine or ten teeth; color usually distinctly yellow, but may be extensively brownish in southern populations . . . . . *mexicanus* Wesmael

Females

1. Penultimate maxillary palpal segment broadest in middle, narrowed basally and apically; hind femur without erect hairs on dorsal surface; hind tibia with hairs reclinate, not fully erect 2
   Penultimate maxillary palpal segment broadest well basad of middle, gradually narrowed toward apex or parallel-sided; hind femur with erect hairs on dorsal surface; hind tibia with abundant fully erect and suberect hairs 4
2. Antennal scape with abundant fully erect, coarse hairs; OOD 2 × OD; ocelli large, OD greater than 0.15 mm . . . . . *navajo* Wheeler
   Antennal scape with reclinate fine hairs; OOD 3 × OD; ocelli normal, OD less than 0.12 mm 3

3. Mesoscutum, between parapsides, with numerous very fine piligerous punctures and scattered coarse setigerous punctures; parapsis with abundant fine punctures only slightly coarser than those of disc; first tergum with scattered erect hairs on disc ..... *ewarti* Snelling
   Mesoscutum, between parapsides, with scattered very fine piligerous punctures and scattered coarse setigerous punctures; parapsis with dense punctures conspicuously coarser than fine discal punctures; first tergum without erect discal hairs ..... *pyramicus* M. Smith
4. Thorax and gaster brown, legs usually yellowish; HW usually less than 1.85 mm; penultimate segment of maxillary palp slender, parallel-sided ..... *testaceus* Emery
   Thorax and gaster light brownish yellow, legs concolorous with thorax; HW 1.90 mm or more, usually more than 2.0 mm; penultimate segment of maxillary palp distinctly broader basally ..... *mexicanus* Wesmael

MALES

1. Scape and tibia without conspicuous standing hairs; hind wing with fringe hairs on posterior margin 2
   Scape always and tibia usually with conspicuous standing hairs; posterior margin of hind wing (a) without fringe hairs, (b) with a few on basal one-fourth or (c) with a complete fringe 3
2. Forewing with fringe hairs present on apical margin; forewing with discoidal cell; HL less than 0.8 mm ..... *ewarti* Snelling
   Forewing without fringe hairs on apical margin; forewing without discoidal cell; HL in excess of 0.9 mm ..... *pyramicus* M. Smith
3. Occipital hairs shorter than maximum diameter of lateral ocellus; posterior and/or apical margins of hind wing with at least a few long fringe hairs 4
   Many occipital hairs longer than maximum diameter of lateral ocellus; hind wing without fringe hairs .... *testaceus* Emery
4. Small species, HW less than 0.8 mm; scape with scattered erect hairs, tibia with numerous decumbent hairs; apical margin of forewing without vestiges of fringe ..... *navajo* Wheeler
   Large species, HW greater than 0.9 mm; scape and tibia usually with abundant erect or suberect hairs; *if* erect hairs reduced or absent, then apical margin of forewing with vestiges of a fringe ..... *mexicanus* Wesmael and *melanoticus* Wheeler

MEXICANUS GROUP

Myrmecocystus (Myrmecocystus) melanoticus Wheeler

Figures 267–273, 318, 319, 330, 331

Myrmecocystus mexicanus var. *melanoticus* Wheeler 1914. Jour. N.Y. Entomol. Soc. 22:57. ♀♂.

Diagnosis. Worker: Numerous fully erect hairs on malar area, thoracic dorsum and appendages; propodeal dorsum evenly convex, juncture of dorsal and posterior faces broadly rounded; metanotal groove distinct; eye with numerous erect hairs longer than diameter of facets. *Female.* Unknown. *Male.* Forewing without fringe hairs on apical margin; eye with numerous erect hairs longer than diameter of facets.

WORKER. *Measurements.* HL 1.10–1.83 (1.50); HW 0.63–1.73 (1.30); SL 1.47–2.03 (1.80); WL 2.0–3.0 (2.4); PW 0.6–1.2 (0.9).

Head: Longer than broad in all sizes, CI 76–96 (87); distinctly shorter than scape, SI 110–136 (120). In frontal view, margins slightly convergent toward mandibular insertions in smaller workers, slightly to moderately convex in larger workers; top of eye much below top of occiput, occipital angle barely indicated in large workers, not at all in smallest, occipital margin flat. Eye moderately large, 1.08–1.50 (1.50) × length of first flagellomere; OMD 1.20–1.57 (1.20) × EL. Mandible with eight or nine teeth, space between penultimate and basal teeth often larger in area than basal tooth.

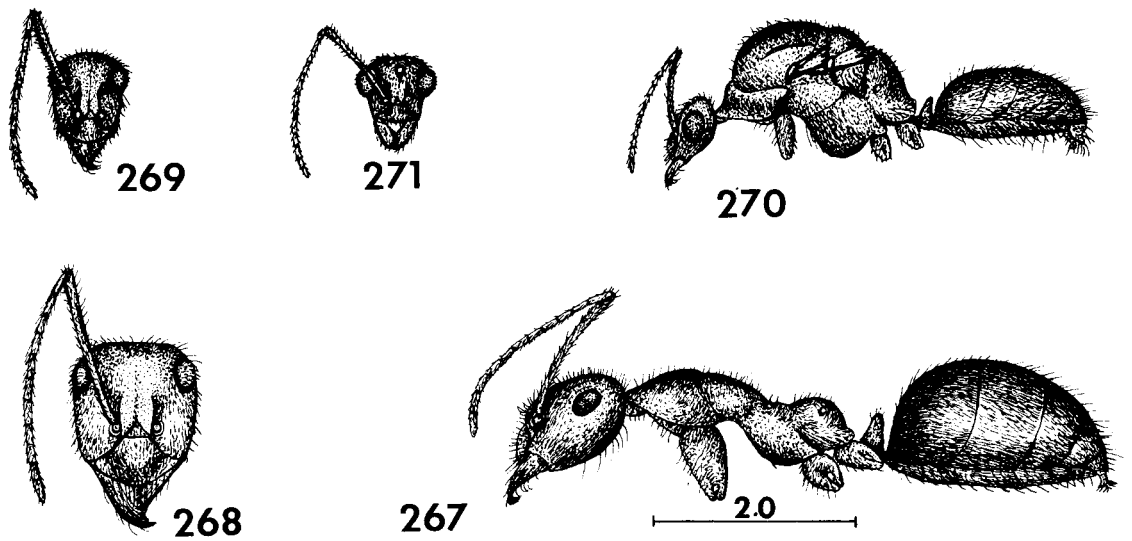
Thorax: Slender, PW 0.32–0.40 (0.36) × WL. Basal face of propodeum gently to strongly convex, without clearly demarked juncture with posterior face. Metanotal depression present.

Petiole: Cuneiform in profile, crest bluntly rounded; from front, crest narrow, either not notched or with a broad, shallow concavity.

Vestiture: Dorsa of head, thorax and first three terga with abundant fine, appressed pubescence, longest on front of head.

Malar area with ten or more erect hairs on each side; erect hairs on head mostly less than 0.10 mm, except beneath and along clypeal apex. Eye with scattered erect hairs which are longer (0.025–0.037 mm) than the diameter of an ocular facet. Erect hairs of thoracic dorsum numerous, evenly distributed, of about equal length, longest about 0.10 mm. Petiolar node with conspicuous short erect hairs. Discal hairs abundant on terga, about 0.10 mm on disc of second, longer along apical margins and on apical segments. Sterna with hairs sparser and longer. Appendages with abundant short (less than 0.10 mm) erect to suberect hairs, including lower and inner surfaces of fore femur.

Integument: Front of head moderately shiny, closely micropunctate and with scattered coarser shallower punctures (from which arise the erect hairs); micropunctures coarser on frontal lobes. Clypeus shinier than frons, with coarse and fine punctures closely interspersed, median line shinier, less closely punctate.



FIGURES 267–271. *M. melanoticus*. 267, major worker, lateral view; 268, head of major worker, frontal view; 269, head of minor worker, frontal view; 270, male, lateral view; 271, head of male, frontal view.

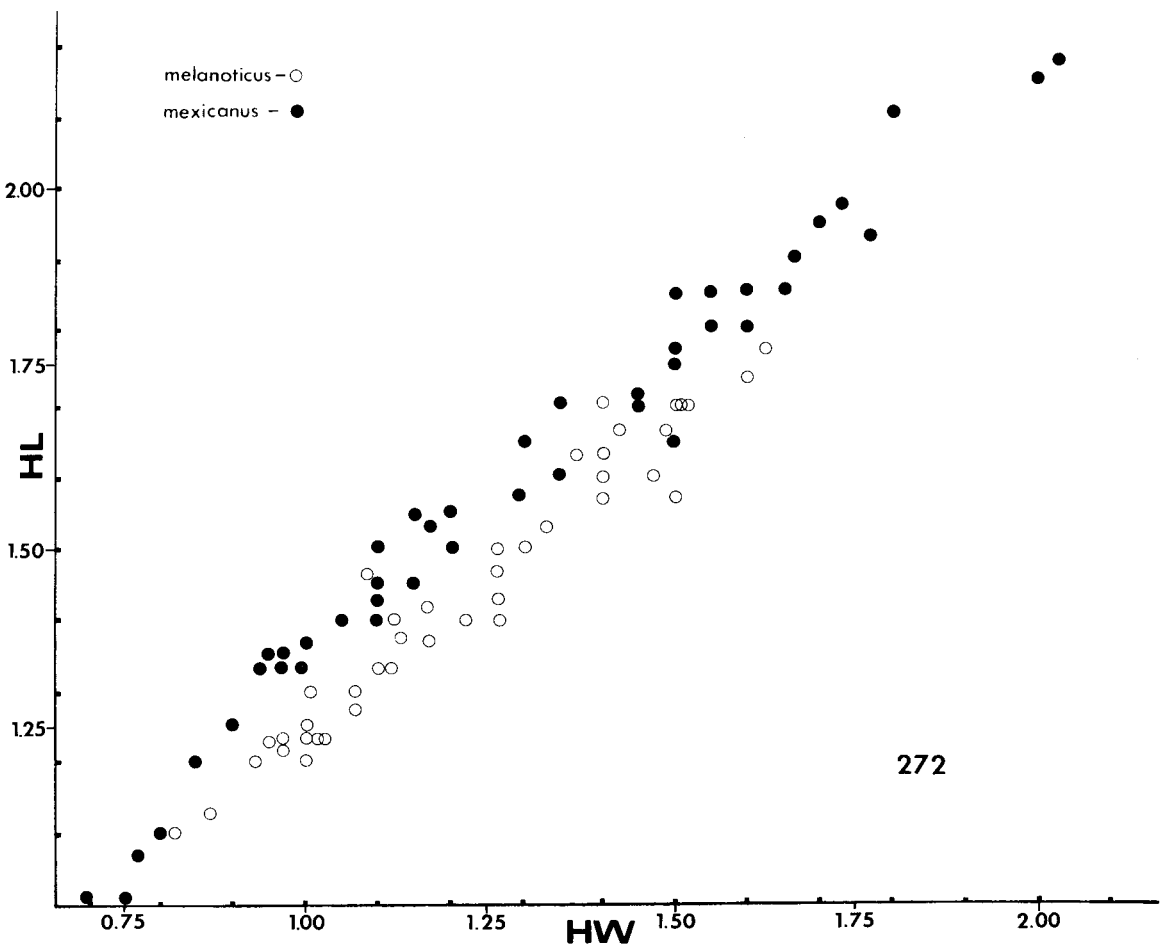


FIGURE 272. Sample regression of head length (HL) on head width (HW) in *M. melanoticus* (open circles) and *M. mexicanus* (solid circles).

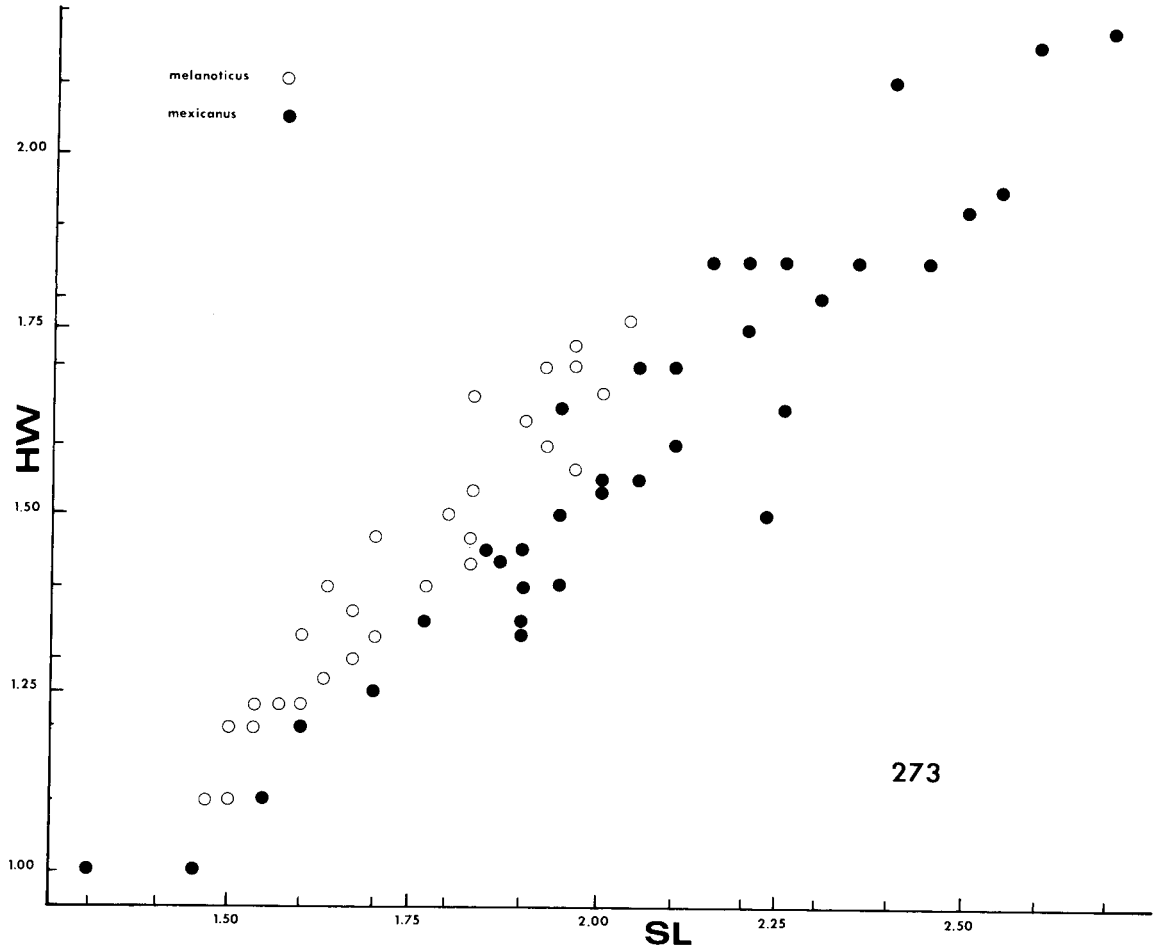


FIGURE 273. Sample regression of scape length (SL) on head width (HW) in *M. melanoticus* (open circles) and *M. mexicanus* (solid circles).

Integument otherwise finely shagreened and slightly shiny.

Color: Light to medium yellowish brown, appendages and lower portions of face usually contrastingly lighter; gaster usually a little darker.

FEMALE. *Unknown.*

MALE. *Measurements.* HL 0.83–0.97 (0.97); HW 0.77–0.93 (0.93); SL 0.93–1.17 (1.17); EL 0.37–0.40 (0.40); WL 2.0–2.3 (2.3); PW 1.2–1.3 (1.2).

Head: In frontal view sides of head slightly convergent toward mandibular insertion; head slightly longer than broad, CI 92–97 (97); distinctly shorter than scape, SI 112–121 (121); OMD 0.46–0.58 (0.58) × EL. Anterior ocellus a little smaller than lateral ocellus; IOD 2.7–3.0 (3.0) × OD; OOD 2.0–2.3 (2.3) × OD. Mandible with preapical notch and two or three poorly defined teeth basad.

Thorax: Moderately robust, PW 0.57–0.60 × WL. Propodeum without defined basal face.

Petiole: Cuneate in profile; crest, in frontal view, broadly notched; from above about twice wider than long.

Vestiture: Erect hairs yellowish, abundant on all body surfaces and appendages; longest scutellar hairs shorter than MOD. Fore and hind wing without fringe hairs.

Pubescence apparently generally distributed and fully appressed, dense on first three terga (available specimens are very badly rubbed).

Integument: Slightly shiny, lightly shagreened, with abundant micropunctures; clypeus roughened and dull; scutellum smoother and shinier than scutum.

Color: Uniformly light brownish, appendages more yellowish. Wings hyaline, veins and stigma yellowish.

Terminalia: Figures 319, 330, 331.

Type Material. Described by Wheeler from an unspecified number of specimens collected at Pachuca, Hidalgo, MEXICO, by W. M. Mann. Five workers and one male, marked as cotypes, are in the MCZ; four workers and two males, unmarked, are in the USNM. A Lectotype worker and lectoallotype male have been marked and returned to the MCZ; the remaining lectoparatype material in the LACM (one worker) and MCZ (three workers). The USNM specimens, although

indubitably of the original species, were not clearly marked as types and are here excluded.

Distribution. MEXICO. Known only from the States of Hidalgo and Puebla (Fig. 369).

Specimens Studied. MEXICO. Hidalgo: Pachuca, 8000′ (W. M. Mann; MCZ, USNM); Hwy. 85, ca. 6 mi W Pachuca, 8250′, 13 July 1973 (R. R. Snelling & T. W. Taylor; No. RRS 73-103; LACM). *Puebla:* 13 mi NW San Martin Texmelucan, 8600′, 29 June 1961 (L. B. Carney; KU), "at light"; 1.5 mi E Azumbilla on road to Lagunas, 6700′, 19 July 1973 (R. R. Snelling & T. W. Taylor; No. RRS 73-115; LACM).

Ecology. Little is known of this species. Elevation ranges from 6700–8600 feet. The specimens taken by L. B. Carney were "at light," indicating nocturnal foraging, as expected.

Sample No. RRS 73-103 was taken on an arid hilltop in a maguey field at the summit of Hwy. 85; the knoll, although surrounded by maguey plantings, was uncultivated, several acres in extent, and consisted largely of arborescent *Yucca* and *Acacia*. The nest was marked by a circular crateriform tumulus consisting of coarse particles of uniform size; the entrance was about 15 mm in diameter. No ants were foraging at 1530 when the nest was discovered, although the sky was cloudy and there were scattered light rain showers. Repletes, secured within 45 cm of the surface, were apparently known to local residents, who identified them as *"venitas."*

Sample No. RRS 73-115 was also taken in an area adjacent to maguey plantings, but the habitat was less severely stripped of native vegetation, especially on nearby slopes, too steep for cultivation. At 1200 hours the sky was heavily overcast; workers of *melanoticus* were foraging on nearby plants, some gathering nectar, others scavenging. The tumulus was lower than that of 73-103, composed of finer particles and the entrance smaller.

Discussion. It is my opinion that this species is the same as Wesmael's *mexicanus,* a conclusion based largely on distributional evidence. Since the problem appears insoluble, I have elected not to modify the traditional interpretation of Wesmael's name.

The relationship between *melanoticus* and *mexicanus* is a very close one and the above problem may be purely academic. It is quite possible that the two species may prove to be one when more material from central Mexico becomes available. Additional samples from western Puebla and Hidalgo, as well as from Tlaxcala, Mexico, and Querétaro may clarify the status of these names.

Although *melanoticus* is a darker form, *mexicanus* becomes darker in the southern portions of its range, and samples from near Dolores Hidalgo, in the State of Guanajuato, are nearly as dark as *melanoticus*. The size of *melanoticus* is, to judge from the material available, notably less variable than that of *mexicanus*. I also regard it as a smaller species, even though its size is completely overlapped by that of *mexicanus*. In all sizes of workers, especially among the smaller individuals, the head appears less elongate. Thus, about 75% of the *melanoticus* studied have a CI in excess of 81, while this is true of about 35% of the *mexicanus* workers. The CI of both species are plotted in Fig. 272. As will be seen, the regression zone of *melanoticus,* while contiguous with and, to some extent lapped by that of *mexicanus,* persistently presents higher values. Similarly, *melanoticus* possesses a relatively shorter scape and when SL is plotted against HL (Fig. 273) yields a consistently lower value than does *mexicanus*.

The number of mandibular teeth is variable in both species, varying from eight to ten. However, while the mandible of *melanoticus* most commonly has nine teeth, specimens with eight on one or both mandibles are common. Ten mandibular teeth is a very rare occurrence in this species. Conversely, while *mexicanus* typically also has novemdentate mandibles, individuals with ten (or even eleven) teeth are common; an eight-toothed mandible is rare. As a rule, the space between the basal and subbasal teeth is larger in area than the basal tooth in *melanoticus,* smaller in *mexicanus*.

In the length of the hairs on the eyes these ants appear to be different. In *melanoticus* there are ten or more erect hairs in the central part of the eye; these hairs are from 0.025–0.037 mm long and exceed the diameter of the eye facets. Scattered erect hairs are present on the eyes of *mexicanus,* but even in the largest individuals are less than 0.017 mm in length.

It is possible that *melanoticus* is nothing more than a geographic segregate of *mexicanus,* a subspecies. I do not believe this to be true, since *mexicanus* in the southern parts of its range, shows little demonstrable tendency to assume the characteristics of *melanoticus,* other than in color. Thus the Cephalic Index and Scape Index of *mexicanus* remain "normal" as does the length of the ocular hairs. Neither does the mandibular dentition vary toward the *melanoticus* condition. If a subspecies situation were the case, then I would expect to find such tendencies in southern populations of *mexicanus*. I have thus chosen to accord full specific status to *melanoticus* until such a time as additional material permits a complete re-evaluation of this form.

Myrmecocystus (Myrmecocystus) mexicanus Wesmael

Figures 272–281, 316, 317, 328, 329

Myrmecocystus mexicanus Wesmael 1838. Bul. Acad. roy. Sci. Belg. 5:756–761; Emery 1893. Zool. Jahrb. f. Syst. 7:666; Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:356–358; Wheeler 1912. Psyche 19:173, 178; Mallis 1941. Bull. So. Calif. Acad. Sci. 40:81; Creighton 1950. Bull. Mus. Comp. Zool. 104:446; Cook 1953. The Ants of California, 339–340; Cole 1954. Jour. Tenn. Acad. Sci. 29:285; Cole 1966. Brigham Young Univ. Sci. Bul. 7:21, 22; Wheeler and Wheeler 1968. Ann. Entomol. Soc. Amer. 61:213 *(larva);* Wheeler and Wheeler 1973. Ants of Deep Canyon, 122–124, Fig. 47.

Myrmecocystus melliger var. *hortus-deorum* McCook 1881. Proc. Phil. Acad. Sci. 75. ♀♀♂ McCook 1882. The Honey Ant of the Garden of the Gods, Phila. :75. NEW SYNONYMY.

Myrmecocystus hortus-deorum, Forel 1886. Ann. Soc. Entomol. Belg. 30:202. ♀♀♂.

Myrmecocystus mexicanus var. *horti-deorum*, Emery 1893. Zool. Jahrb. f. Syst. 7:666; Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:358–360; Wheeler 1912. Psyche 19:173, 178, 179; Cole 1934. Ann. Entomol. Soc. Amer. 27:396 (Fig. 4), 402; Mallis 1941. Bull. So. Calif. Acad. Sci. 40:81; Cole 1942. Amer. Midl. Nat. 28:386; Cook 1953. The Ants of California, :346–350.

Myrmecocystus mexicanus "Slave" (sic!) var., Fenner 1895. Entomol. News 5:216.

Myrmecocystus mexicanus subsp. *hortideorum*, Creighton 1950. Bull. Mus. Comp. Zool. 104:446; Cole 1954. Jour. Tenn. Acad. Sci. 29:285; Gregg 1963. The Ants of Colorado: 643, 648–651.

Diagnosis. Worker: Propodeal dorsum evenly convex, abundantly hairy; metanotal suture usually distinctly impressed; HL usually in excess of 1.3 mm; eye with few or no erect hairs, when hairs present, less than 0.017 mm long. *Female.* Penultimate segment of maxillary palp broadest basally; hind tibia with abundant fully erect hairs; HW more than 2.0 mm. *Male.* Scape and tibia with conspicuous erect hairs; occipital hairs shorter than maximum diameter of lateral ocellus; apical margin of forewing with vestiges of fringe; HW more than 0.9 mm.

WORKER. *Measurements.* HL 1.00–2.17 (1.80); HW 0.70–2.03 (1.40); SL 1.30–2.70 (2.20); WL 1.6–3.8 (2.9); PW 0.55–1.30 (1.1).

Head: Longer than broad in all sizes, CI 70–94 (78), much shorter than scape, SI 114–149 (122). In frontal view, malar margins straight and subparallel in small workers, in largest workers widest at level of antennal sockets, convergent toward mandibular insertions below; occipital margin flat or slightly convex, usually well above top of eye, sometimes barely so in smallest workers. Eye large, 1.09–1.20 (1.14) × length of first flagellomere; OMD 1.09–1.72 (1.37) × EL. Mandible usually with nine teeth, but commonly with ten, rarely with eight; space between basal and subbasal teeth not exceeding size of basal tooth.

Thorax: Slender, PW 0.30–0.37 (0.36) × WL. Basal face of propodeum gently to strongly convex, broadly rounded into posterior face. Metanotal depression sometimes weak in largest workers, but usually well defined.

Petiole: In profile, robust cuneiform, with rounded crest; crest, in frontal view, weakly or not at all notched.

Vestiture: Dorsa of head, thorax and gaster with abundant fully appressed pubescence, well separated on head and thorax, denser on propodeum and first three terga.

Head with numerous erect hairs, malar area with ten or more erect hairs; longest cephalic hairs less than 0.17 mm long in largest workers, except beneath and along clypeal margin; eye with very sparse, very short (less than 0.017 mm long) hairs, or none. Erect hairs on thoracic dorsum evenly distributed, longest (up to 0.20 mm in largest workers) on pronotum, shortest (about ⅓ length of longest pronotal hairs) on metanotum and propodeum. Petiolar node with numerous short, erect hairs. Terga with abundant erect hairs, progressively longer on succeeding segments, sparser and longer on sterna. Appendages with abundant erect hairs, including inner and lower surfaces of fore femur.

Integument: Front of head moderately shiny, with well separated micropunctures and scattered coarse, shallow punctures, micropunctures coarsest on frontal lobes. Clypeus shinier than frons, lightly shagreened, with sparse coarse punctures, with ill-defined median impunctate line. Integument otherwise lightly to moderately shagreened, moderately shiny.

Color: Highly variable, from wholly pale yellowish to light yellowish-brown with gaster darker (see *Discussion*).

FEMALE. *Measurements.* HL 1.90–2.50; HW 1.90–2.55; SL 1.85–2.50; EL 0.60–0.80; OMD 0.66–0.90; WL 4.2–5.6; PW 2.35–3.15.

Head: Slightly longer than broad to slightly broader than long, CI 91–108; a little shorter than to a little longer than scape, SI 89–109. Head broadest at level of lower eye margin, sides in frontal view straight or slightly convex, evenly narrowed toward mandibular insertions; occiput slightly convex in frontal view, broadly rounded at sides. Eye large, about 1.3 × first flagellomere; OMD 1.07–1.28 × EL; OOD 2.3–3.6 × OD; IOD 1.6–2.4 × OD. Mandible with nine or ten teeth. Penultimate segment of maxillary palp broadest a little before middle, slightly narrowed toward base, more strongly narrowed toward apex.

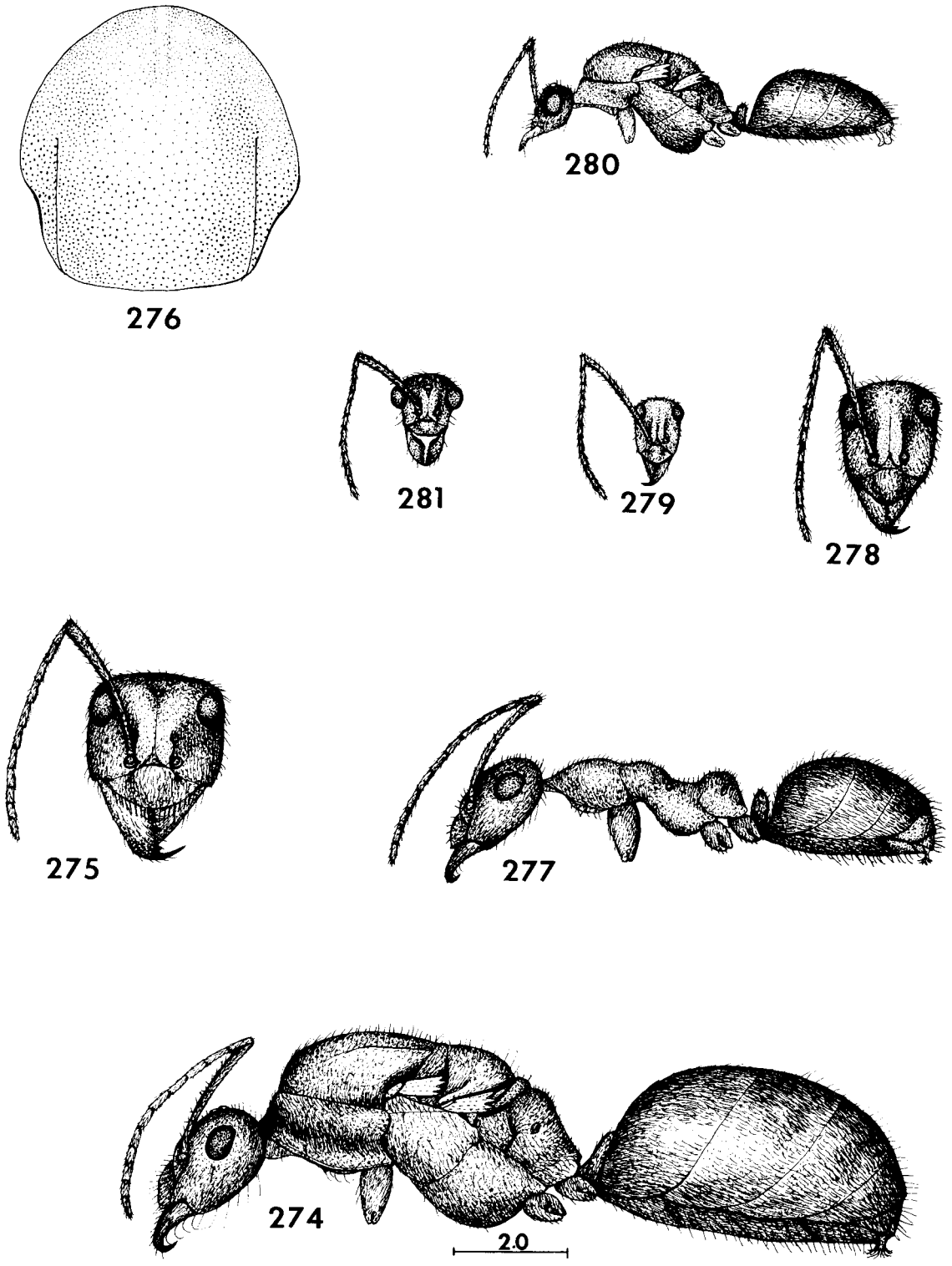
Thorax: Robust, PW 0.53–0.61 × WL. In profile, scutum flattened behind, scutellum convex, not in line with posterior part of scutum.

Petiole: In profile, compressed-cuneate; crest sharply notched in frontal view; from above, about twice wider than long.

Vestiture: Cephalic pilosity about as described for worker. Mesoscutum and scutellum with scattered, long (up to 0.23 mm) erect hairs arising from coarse punctures; pleura with scattered long erect hairs; propodeum with a few short (up to 0.10 mm) erect hairs on upper third. Petiolar scale with numerous erect hairs. Discs of terga with abundant stiff erect hairs, progressively longer on succeeding segments; sterna with hairs longer, more numerous on apical half; appendages, including inner and lower surfaces of fore femur, with abundant erect and suberect hairs of moderate length. Wings without fringe hairs on apical or posterior margins.

Pubescence general, nowhere concealing surface.

Integument: Clypeus shiny, coarsely punctate, punctures elongate, of varying size; frontal lobes, frons



FIGURES 274–281. *M. mexicanus*. 274, female, lateral view; 275, head of female, frontal view; 276, mesoscutum of female, distribution of punctures; 277, major worker, lateral view; 278, head of major worker, frontal view; 279, head of minor worker, frontal view; 280, male, lateral view; 281, head of male, frontal view.

and occiput moderately shiny, closely micropunctate. Malar area duller, coriaceous, closely punctate, punctures elongate.

Pronotum moderately shiny, micropunctate, with scattered coarser punctures. Disc of mesoscutum densely, finely punctate, with scattered coarser punctures; parapsis similar, but with coarser punctures a little more numerous. Scutellum polished between fine, dense punctures. Pleura shinier, more sparsely punctate above, punctures fine. Propodeum slightly shiny, shagreened, with fine, dense punctures.

First three terga shiny, densely and finely punctate.

Color: Yellowish to yellowish ferruginous, with variable brownish infuscations on occiput, thoracic dorsum and abdominal terga. Wings yellowish hyaline, veins and stigma ferruginous to light brownish.

MALE. *Measurements.* HL 0.90–1.23; HW 0.73–1.17; SL 1.07–1.53; EL 0.37–0.50; OMD 0.20–0.27; WL 2.05–3.10; PW 1.00–1.47.

Head: Longer than broad, CI 83–95; in frontal view, sides straight or slightly concave, convergent toward mandibular insertions; distinctly shorter than scape, SI 116–130; occiput, in frontal view evenly convex, without lateral angles. Eye large; OMD 0.50–0.67 × EL; OOD 1.07–1.53 × OD; IOD 2.05–3.10 × OD. Mandible with one or more preapical teeth.

Thorax: Robust, PW 0.45–0.53 × WL. Propodeum with distinct basal and posterior faces.

Petiole: In profile, cuneate and sharp-crested to broadly rounded above; in frontal view, crest with more or less distinct angular notch.

Vestiture: Erect hairs sparse on head and thorax; those of occiput short (up to 0.10 mm), much shorter than MOD; a few longer (up to 0.16 mm) on malar area. Scutal hairs about equal to those of occiput, longer (up to 0.16 mm) on scutellum; hairs very sparse on pleura, little, if any, longer than on scutum. Propodeum commonly without erect hairs except near valvule, but a few very short hairs may be present on basal face. Petiolar node with sparse, short erect hairs. Terga with sparse, fully erect hairs, up to 0.10 mm on disc of second segment; sterna with hairs more numerous, longer, up to 0.23 mm on second segment. Appendages with sparse to abundant erect and suberect short hairs; forewing with or without apical fringe hairs; hind wing with or without fringe hairs along apical and posterior margins.

Pubescence general but sparse, densest on occiput, propodeum and first three terga.

Integument: Head moderately shiny, lightly coriaceous, without conspicuous punctation. Mesoscutum moderately shiny, with dense micropunctures and scattered coarse punctures; scutellum shinier, punctures less distinct than on scutum; pleura moderately shiny, with scattered coarse punctures. Terga moderately shiny, with abundant micropunctures on discs.

Color: Yellowish, often with brownish infuscation of varying extent on dorsa of head and thorax, gaster often largely brownish. Wings whitish hyaline to slightly brownish, veins and stigma whitish to yellowish.

Terminalia: Figures 317, 328, 329.

Type Material. Wesmael's specimens were from an unknown locality in Mexico; no types were ever designated and no original material is known to exist. McCook's *hortus-deorum* material came from the Garden of the Gods, near Colorado Springs, Colorado. No original material is known to exist. Neotype worker and 31 neoparatype workers, here designated: MEXICO, State of Chihuahua: 21 mi SW Jimenez, 23 Dec. 1958 (A. S. Menke & L. A. Stange). Neotype and neoparatypes in LACM; two neoparatypes each in AMNH, MCZ, and USNM.

Distribution. Central Mexico north to Colorado and Utah, westward to California and Lower California (Figs. 369, 370).

Localities. UNITED STATES. Colorado: El Paso Co.: Colorado Springs and vicinity (incl. Garden of the Gods, Red Rock Cyn. and Manitou), 5900–6800′, numerous dates and collectors (AMNH, GCW, LACM, MCZ, REG, USNM); Colorado City, 6000′, 25 July 1903 (W. M. Wheeler; GCW); Bear Creek, S of Colorado City, 18 Aug. 1903 (W. M. Wheeler; GCW). *Mesa Co.:* Grand Junction, 4500′, 8 May 1949 (R. E. Gregg, No. 76; LACM, REG, USNM); Colorado Natl. Mon., 6000′, 2 July 1963 (T. C. Emmel; LACM). *Utah: Emery Co.:* [Gunnison Butte, Green River, 7 May 1932 (J. A. Rowe) Rees and Grundmann, 1940]. *Grand Co.:* Arches Natl. Mon., 23 June 1963 (A. S. Menke; UCD); [Thompson, 5150′, no date (Titus?) Cole, 1942]. *San Juan Co.:* [Bluff, 4500′, no date (A. M. Woodbury) Rees and Grundmann, 1940; betw. Bluff and Blanding, 17 Apr. 1968 (R. V. Chamberlin) Rees and Grundmann, 1940]. *Garfield Co.:* Boulder, 7 Oct. 1958 (G. F. Knowlton; LACM); Henry Mts., 18–21 Aug. 1934 (W. S. Creighton; LACM). *Millard Co.:* 30 and 32 mi S Deseret, 14 May 1970 (G. F. Knowlton and D. W. Davis; USU). *Salt Lake Co.:* Garfield, no date (A. O. Garrett; AMNH). *Nevada: Churchill Co.:* 4 mi SW Brady's Hot Spgs., 4000′, 2 June 1965 (R. C. Bechtel; NDA). *Esmeralda Co.:* Goldfield, 5800′, 17 Oct. 1952 (W. S. Creighton, No. 272; LACM). *Nye Co.:* Fairbanks Spgs., 23 June 1951 (I. La Rivers, No. 1350; USNM); 1 mi E Warm Spgs., 19 June 1953 (I. La Rivers; USNM); AEC Nevada Test Site, Mercury, numerous dates (ACC, AMNH, LACM, MCZ, USNM); 3 mi W Rhyolite, no date (A. H. Sturtevant; USNM); Amargosa Desert, nr. Beatty, 8 Mar. 1931 (A. H. Sturtevant; USNM). *Clark Co.:* Kyle Cyn., 5200′, Spring Mts., 10 May 1970 (G. C. and J. Wheeler, No. Nev. 860; GCW); 4.5 mi E Las Vegas, 2 Apr. 1931 (A. H. Sturtevant; USNM); 10 W Las Vegas, 3200′, 1 Apr. 1970 (G. C. and J. Wheeler, No. Nev. 666; GCW). *Texas: Hudspeth Co.:* Sierra Blanca, 8 July 1917 (CU; USNM). *New Mexico: Colfax Co.:* 2 mi S Raton Pass, 7700′, no date (A. C. Cole; LACM) Cole, 1954; Cimarron Cyn., 6700′, 29–31 Aug. 1951 (A. C. Cole, No. A-14; LACM). *Santa Fe Co.:* 6 mi NE Santa Fe, 8000′, 2 Aug. 1964 (F., P. and M. Rindge; AMNH); 4 mi NE Santa Fe, 24 Aug. 1964 (G. C. and J. Wheeler, No. 17; GCW); Santa Fe, no date (Wheeler Exped.; AMNH); same locality, Apr. 1879 (R. Thaxter; AMNH). *Taos Co.:* 18 mi S Taos, 6000′, no date (A. C. Cole; LACM) Cole, 1954. *San Miguel Co.:* Pecos, 5 July (T. D. A. Cockerell; MCZ). *McKinley Co.:* 25 mi E Gallup, 7200′, no date (A. C. Cole; LACM) Cole, 1954. *Lea Co.:* 2 mi E Hobbs, 3750′, no date (A. C. Cole; LACM) Cole, 1954. *Doña Ana Co.:* 28 mi N Las Cruces, 17 Aug. 1952 (A. C. Cole, No. 4401; LACM); Las Cruces, 3900′, July

1961 (L. D. Robertson; USNM). *Sierra Co.:* Caballo, 31 Mar. 1962 (M. Cazier; LACM). *Grant Co.:* 15 mi E Silver City, 6900′, no date (A. C. Cole; LACM) Cole, 1954; Cherry Cr. Camp, 6900′, 13 mi N Silver City, 10 July 1964 (F., P. and M. Rindge; AMNH); McMillan Camp, 7000′, 14 mi N Silver City, 14 July 1964 (F., P. and M. Rindge; AMNH); 20 mi N Silver City, no date (A. C. Cole; LACM) Cole, 1954. *Hidalgo Co.:* Granite Pass, 5 Aug. 1967 (D. E. Rich; LACM); 12 mi E Animas, 4300′, 17 Aug. 1967 (R. R. Snelling, No. 67–239; LACM); 15 mi N Rodeo, 18 Aug. 1963 (C. Chesebrough, J. Franklin and N. McFarland; LACM, OSC, USNM). *Arizona: Cochise Co.:* Bowie, 15 July 1917 (W. M. Wheeler; MCZ); Texas Pass, [=Canyon], 19, 20 July 1917 (W. M. Wheeler; CU, MCZ); same locality, 4800′, 12 Aug. 1967 (R. R. Snelling, No. 67–218; LACM); Benson, 21 July 1917 (W. M. Wheeler; GCW; MCZ); Chiricahua Natl. Mon., 9 Apr. 1963 (G. I. Stage; LACM); 2 mi NE Portal, 9 Mar. 1962 (M. Cazier; LACM); 2.5 mi NE Portal, 4 Aug. 1959 (M. Cazier; AMNH); 2 mi E Portal, 4800′, 16 Aug. 1967 (R. R. Snelling, No. 67–232; LACM); Cave Cr. Ranch, Portal, 18 Aug. 1966 (R. Silberglied; CU): Southwest Research Sta., 5400′, 5 mi W Portal, 5 Aug. 1963 (A. R. Moldenke; LACM); same locality, 25 July 1957 (M. Statham; AMNH); 6.1 mi NE Apache, 4550′, 14 Aug. 1967 (R. R. Snelling, No. 67–222; LACM); Huachuca Mts., 18 Nov. 1910 (W. M. Wheeler; AMNH); Garden Cyn., 5400′, Huachuca Mts., 9 July 1950 (W. S. Creighton; LACM); Ramsey Cyn., Huachuca Mts., no date (W. M. Mann; LACM, USNM); Miller Cyn., 5800′, Carr Cyn., 6200′, Huachuca Mts., 12 Aug. 1969 (R. R. Snelling, No. 69–289; LACM); Montezuma Pass, Huachuca Mts., 17 Nov. 1946 (L. F. Byars; USNM); Hereford, 4200′, no date (W. M. Mann; AMNH, MCZ). *Mohave Co.:* 64 mi NW Nixon Spg., 3500′, 5 July 1969 (R. R. Snelling, No. 69–238; LACM). *Coconino Co.:* Locket Lake, 26 Aug. 1933 (P. Klingenberg; MCZ). *Yavapai Co.:* Granite Dells, 4 mi N Prescott, 19–26 July 1970 (L. M. Martin; LACM); Prescott, 25 July 1948 (C. and P. Vaurie; AMNH); same locality, 16 May 1932 (A. C. Cole; USNM). *Maricopa Co.:* 10 mi W Aguila, 1800′, 6 Apr. 1952 (W. S. Creighton; LACM); Phoenix, no date (R. H. Crandall; USNM). *California: Inyo Co.:* 15 mi N Independence, 24 Aug. 1961 (UCB); 3 mi W Lone Pine, 4400′, 3 May 1952 (W. S. Creighton; LACM); 4 mi W Lone Pine, 18 Mar. 1968 (G. C. and J. Wheeler, No. Calif. 371; GCW); Tuttle Cr., 2 mi SW Lone Pine, 16 May 1969 (J. Powell; UCB). *Los Angeles Co.:* 5 mi SE Palmdale, 28 Nov. 1955 (R. H. Crandall; LACM); Llano, 3300′, 11 Apr. 1952 (W. S. Creighton; LACM); 9 mi N Llano, 2800′, 11 Apr. 1952 (W. S. Creighton; LACM); 2 mi S Pearblossom, 3500′, various dates and collectors (LACM); Los Angeles, no date (colln. T. Pergande; USNM); same locality, no date (Coquillett; USNM). *San Bernardino Co.:* 2 mi E, 4.5 mi S Cima, 27 May 1967 (J. Northern and L. Lester; LACM); 12 mi SE Ivanpah, 1 May 1956 (M. Wasbauer; UCB); Ord Mtn., 18 Apr. 1960 (J. R. Powers; UCB); Daggett, 12 Sept. 1961 (C. S. Bodman; LACM); 5 mi N Adelanto, 12 Apr. 1964 (R. R. Snelling; LACM); Victorville, 12 Dec. 1961 (E. Angell; CDA); same locality, 30 Apr. 1918 (J. C. Bradley; CU); 0.7 mi SE Pioneertown, 4500′, 18 Sept. 1965 (G. R. Noonan; LACM); 1 mi NW Cajon, 3125′, 5 Sept. 1965 (R. R. Snelling; LACM); Quail Spgs., 11 Apr. 1962 (R. P. Allen; LACM); Lower Covington Flat, Joshua Tree Natl. Mon., 26 June 1966 (R. J. Hamton; RJH); Squaw Tank, Joshua Tree Natl. Mon., 20 Mar. 1965 (S. L. Jenkins; LACM); Morongo Valley, 7 Apr. 1963 (R. R. Snelling; LACM); same locality, 29 Mar. 1952 (E. I. Schlinger; USNM); Dry Morongo Cyn., 7 Apr. 1963 (R. R. Snelling; LACM). *Riverside Co.:* 0.5 mi E Salton View, 5000′, Joshua Tree Natl. Mon., 8 Oct. 1967 (R. J. Hamton; RJH); Juniper Flat, 4800′, Joshua Tree Natl. Mon., 8 Oct. 1967 (R. J. Hamton; RJH); Indio, 25 Apr. 1967 (Johnson; CDA). *Imperial Co.:* Salton Sea Beach, 20 Apr. 1950 (E. I. Schlinger and R. C. Bechtel; UCD); 6 mi W Seeley, 24 Apr. 1962 (E. L. Paddock; CDA). *San Diego Co.:* Borrego, 21 Apr. 1960 (J. R. Powers; UCB); same locality; 26 Apr. 1955 (P. D. Hurd; UCB); Borrego State Park, 19 Apr. 1969 (R. R. Pinger; CDA); nr Mountain Palm Spgs., Anza-Borrego St. Park, 12 Aug. 1965 (L. and C. O'Brien; LACM); Split Mtn., 500′, Anza-Borrego St. Park, 18 Apr. 1952 (W. S. Creighton; LACM); Vallecito Mts., 600′, Anza-Borrego St. Park, 18 Apr. 1952 (W. S. Creighton; LACM). *MEXICO. Coahuila:* Cuesta La Muralla, Hwy. 57, 4000′, 9 July 1973 (R. R. Snelling; LACM). *Chihuahua:* 24 mi S Hidalgo del Parral, 23 Dec. 1958 (A. S. Menke and L. A. Stange; neotype series, LACM); Santa Clara Cyn., 5600′, 5 mi W Parrita, 27 June 1947 (C. Michener; AMNH), Cañon Prieto, 6500′–6800′, nr Primavera, 2 July 1947 (R. Schrammel; AMNH). *San Luis Potosí:* San Luis Potosí, 20 May 1879 (E. Palmer; AMNH, MCZ). *Durango:* 10 mi N Durango, 6300′, 23 Mar. 1953 (W. S. Creighton, No. 245; LACM); 5 mi W Durango, 6300′, 16 Mar. 1953 (W. S. Creighton, No. 629; LACM). *Guanajuato:* 19 mi E Dolores Hidalgo, 6400′, 6 Sept. 1970 (E. M. Fisher; LACM). *Baja California:* 3 mi SW Mexicali, 30 Mar. 1963 (G. I. Stage; LACM); 5 mi N San Felipé, 0′, 14 June 1952 (W. S. Creighton; LACM); 2 mi N Puertocitos, 4 Apr. 1966 (E. M. Fischer; LACM).

Ecology. This is the most extensively studied of all the species of *Myrmecocystus.* McCook (1881, 1882) published the results of his studies in Colorado; these were supplemented by Wheeler (1908). Briefly, the species forages at night, less commonly on cool, overcast days. Workers emerge singly and seek out food items. The ants derive much of their sustenance from exudates from galls on oaks (*Quercus* spp.) as well as from aphids and pseudococcids (Homoptera). They also take juices from bruised or broken fruits which may be available, such as those of cacti (*Opuntia* spp.) and nectar from a wide variety of flowers and from extrafloral glands.

The ants are by no means wholly dependent upon nectar and fruit juices, for they are assiduous general scavengers. In general, however, this species seems not to be an active predator. I have rarely observed it attacking live insects. On those occasions when I have made such observations, workers were picking up insects attracted to lights at night. Foragers would rush up to an insect and grasp it with the mandibles. If the prey was much smaller than the ant it was immediately carried away. If of a size approximately equal to that of the ant and struggled, it was released and the ant would dart away.

Most protein material brought to the nest consists of fragments of already dead, often desiccated arthropods. Colonies observed in southern Arizona regularly picked up head capsules of *Pogonomyrmex* spp. from detritus piles around the nests of the harvester ants.

Foraging is an individual matter for the most part. The usual pattern seems to consist of an initial mass exodus of workers at the onset of the foraging period. The workers quickly radiate in all directions. Obviously, if there are previously visited sources of food in a limited area, such as a plant harboring large numbers of aphids, a sizable percentage of the foragers ulti-

mately arrive there, but there are no foraging "trails" as such.

This is a species of the Sonoran and Transition Zones, with most records from areas in the Sonoran. Within the Sonoran Zones, it appears to be about equally abundant in Lower and Upper Sonoran habitats. In Colorado, Gregg (1963) recorded this species (as *mexicanus hortideorum*) from Piñon-Juniper Woodland, Piñon-Cedar-Oak Woodland, Sagebrush Desert, Sagebrush-Greasewood Desert and Saltbush Desert. The elevational amplitude in Colorado was noted to be a little over two thousand feet, but Gregg correctly noted that over the entire range of the species it would be much greater. In southern California, the lowest elevation is below sea level (−225 feet) at Salton Sea Beach and the highest is 5185 feet above sea level at Salton View in Joshua Tree National Monument, less than 45 miles to the north. The greatest elevation record is 8000 feet, 6 mi NE Santa Fe, New Mexico.

McCook (1882), Wheeler (1908) and Gregg (1963) have noted that the tumulus marking the entrance of the nest is crateriform and is constructed of coarse gravel and pebbles (Fig. 350). Occasionally, nests may be situated in fine, deep sand, in which case the tumulus consists of much finer particles, though even then the coarsest particles available are used. Nests of this species seem always to have but a single entrance which may be as much as 2.3 cm diameter at the surface.

Flight activities of the sexual forms are not well documented and most of the available reproductives have been removed from nests. The mating flights occur during summer or fall rainy seasons, apparently in late afternoon or early evening following an afternoon rain. Seasonal activity is given in Table 7.

Discussion. The traditional interpretation of *mexicanus*, and that which is continued here, is probably not correct. I believe Wesmael's specimens most likely belonged to the species here called *melanoticus*. Since the lack of authentic *mexicanus* renders this assumption beyond proof, it seems least disruptive to continue established usage.

The northern populations, extending from Colorado to the Pacific Coast have usually been recognized as a more uniformly yellowish subspecies. I have here synonymized that "subspecies" because I do not believe its continued recognition is defensible. One reason for so doing is based on the broadly clinal nature of the color pattern; because of the existence of such a pattern, it is not possible to define the color forms in such a way as would permit their recognition. An attempt to continue recognition of these color forms results in about one-half the material being impossible of assignment.

More important, however, is the fact that the populations of the "subspecies" *hortideorum* are not equivalent to one another. Workers from Colorado and Utah are, as a rule, more densely hairy than some from California and Lower California. Workers from many western populations have about 16 erect and suberect hairs per 0.50 mm of scape length, a condition about the same as in specimens from Colorado. Specimens in other samples have about half that number. In some areas, such as Pearblossom, Los Angeles Co., Calif., the inhabitants of adjacent nests may differ widely in this regard.

Males from California and Lower California usually possess fringe hairs along the apical margin of the forewing. Those from Colorado do not, a trait which they share with those of "typical" *mexicanus* from southern New Mexico and Arizona and central Mexico. Fringe hairs are wholly lacking from both fore and hind wings in males collected at Cajon Canyon, California. In this regard these males are more like the eastern males of this species. The petiole, however, is not as in the males from Colorado.

Normally the petiole in Colorado males, in profile, is cuneate and sharply crested. Those from California are inconsistent and while it may be as sharply cuneate as in the Colorado males, the petiole is often broadly rounded in profile, but males from any single locality seem to be extremely variable in this character. The few males available from central Mexico consistently possess a broadly rounded petiolar node.

Myrmecocystus (Myrmecocystus) navajo Wheeler

Figures 282–289, 322, 323, 334, 335

Myrmecocystus mexicanus subsp. *navajo* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:360, ♀♀; Wheeler 1913. Psyche, 19:173, 179; Cole 1942. Amer. Midl. Nat. 28:386; Fautin 1946. Ecol. Monogr. 16:299, 307.

Myrmecocystus navajo, Creighton 1950. Bull. Mus. Comp. Zool. 104:449; Gregg 1963. The Ants of Colorado, 651–653; Wheeler and Wheeler 1973. Ants of Deep Canyon, 125, Fig. 48.

Diagnosis. Worker: Dorsum of propodeum evenly convex, with abundant erect hairs; appressed pubescence sparse on head, thorax and gaster; hind tibia with few or no erect hairs on outer face. *Female*. Penultimate maxillary palpal segment broadest in middle, femora without erect hairs on dorsal face; scape with abundant erect hairs. *Male*. HW less than 0.8 mm; apical margin of forewing without fringe hairs; scape with scattered erect hairs.

WORKER. *Measurements*. HL 0.83–1.68 (1.20); HW 0.62–1.57 (1.00); SL 1.00–1.80 (1.45); WL 1.2–2.5 (1.9); PW 0.43–1.05 (0.70).

Head: Distinctly longer than broad in smallest workers, as long as broad in largest, CI 70–100 (81), distinctly shorter than scape, SI 105–138 (121); in frontal view, broadest a little below eyes, sides barely convex, slightly narrowed toward mandibular bases. Occiput, in frontal view, flattened, or slightly convex in small workers, without lateral angles. Eye large, 1.09–

TABLE 7

Activity of Reproductives of *M. mexicanus* Wesmael

Locality	Date	Activity
COLO., Garden of the Gods	2 June 1945	♂♂, ♀♀ (in nest? Gregg, 1963)
COLO., Red Rock Cyn.	16 July 1903	♂♂ in nest
COLO., Red Rock Cyn.	23 July 1903	♀♀ in nest
COLO., Colorado City	25 July 1903	♂♂ in nest
COLO., Manitou	26 July 1906	♂♂, ♀♀ in nest
COLO., Manitou	28 July 1903	♂♂, ♀♀ in nest
COLO., Manitou	18 Aug. 1903	♂♂, ♀♀ in nest
N.MEX., 13 mi NE Silver City	10 July 1964	♀ at light
N.MEX., 14 mi N Silver City	14 July 1964	♀ at light
N.MEX., Granite Pass	July 1961	♀♀ (at light?)
N.MEX., Jornada Exp. Range	July 1973	♂♂, ♀♀ (flight after rain)
N.MEX., 6 mi NE Santa Fe	2 Aug. 1964	♀ at light
N.MEX., Granite Pass	5 Aug. 1967	♀♀ at light
ARIZ., 4 mi N Prescott	19 July 1970	♀♀ at light
ARIZ., Prescott	25 July 1948	♀ at light
ARIZ., S.W.R.S.	25 July 1957	♀ at light
ARIZ., 2.5 mi NE Portal	4 Aug. 1959	♂♂, ♀♀ at light
ARIZ., Portal	18 Aug. 1966	♀ at light
UTAH, Boulder	11 July 1958	♀♀ in nest
CALIF., Joshua Tree Natl. Mon.	9 Aug. 1959	♂♂ at light
CALIF., 15 mi N Independence	24 Aug. 1961	♂♂, ♀♀ at light
CALIF., Cajon Cyn.	5 Sept. 1965	♂♂, ♀♀ in nest
CALIF., 2 mi N Pearblossom	20 Sept. 1967	♂♂ in nest
CALIF., 2 mi N Pearblossom	29 Sept. 1967	♀♀ at light after rain
COAH., Csta. La Muralla	9 July 1973	♀♀ at light after rain
CHIH., Santa Clara Cyn.	27 June 1947	♀ (at light?)
CHIH., Cañon Prieto	2 July 1947	♀ (at light?)
CHIH., 15 mi E Parral	15 July 1947	♀ (at light?)

1.57 × first flagellomere; upper margin coincident with occipital margin; OMD 0.92–1.58 (1.25) × EL. Mandible novemdentate.

Thorax: Slender, PW 0.33–0.43 (0.36) × WL; propodeum higher than long, basal face in profile, evenly convex and shorter than posterior face.

Petiole: Thick in profile, summit rounded, without sharp crest; from behind, summit evenly rounded, without median notch; from above, less than twice wider than long.

Vestiture: Erect hairs present on all cephalic surfaces; longest occipital hairs less than 0.5 × MOD. Thoracic dorsum with numerous erect hairs, longest pronotal hairs about equal to those of occiput, mesonotal hairs shorter; 10 or more erect hairs on propodeum; petiolar scale with six or more short erect hairs; first two terga with numerous erect discal hairs, these as long as those of mesonotum. Scape usually with numerous erect to subdecumbent hairs; tibiae with not more than three erect hairs beyond basal third; femora without erect hairs on dorsal face.

Pubescence very sparse or absent from all surfaces in some small workers, a little more abundant on pleura and propodeum.

Integument: Head polished, or nearly so; punctures fine, very widely scattered, even near mandibular bases. Thoracic dorsum strongly shiny, with scattered obscure fine punctures; pleura and propodeum lightly shagreened, hence a little duller. Terga strongly shiny, very lightly shagreened and with scattered fine punctures.

Color: Light brownish yellow, front of head and thoracic dorsum a little darker, legs paler; mandibular margins ferruginous to brownish.

FEMALE. *Measurements.* HL 1.90–2.02; HW 1.87–1.95; SL 1.73–1.80; EL 0.60–0.63; OMD 0.66–0.73; WL 3.9; PW 2.1–2.2

Head: Longer than broad, CI 96–98; a little longer than scape, SI 90–91. In frontal view, head broadest at level of lower eye margin, sides straight, slightly convergent below. Occiput, in frontal view, flat, broadly rounded at sides. Eye large, about 1.4 × length of first flagellomere; EL 0.86–0.90 × OMD. OOD 2.6–2.8 × OD; IOD 1.8–2.0 × OD. Penultimate segment of maxillary palp broadest in middle, narrowed at each end.

Thorax: Robust, 0.53–0.56 × WL. In profile, posterior half of mesoscutum and anterior four-fifths of scutellum flat, forming a single plane; posterior one-fifth of scutellum sharply sloping.

Petiole: In profile, compressed, crest sharp; from behind, crest with narrow, shallow median notch; from above, about twice wider than long.

Vestiture: Cephalic pilosity about as described for worker, but erect hairs less abundant on malar area,

those of occiput shorter, longest hairs distinctly less than 0.5 × MOD. Pronotum with fine erect hairs on anterior margin and scattered short, erect, coarser hairs on neck and sides; scutum with sparse, short, erect hairs; scutellum with sparse erect hairs, a few about half as long as minimum eye diameter; pleura and propodeum with scattered short erect hairs, about equal to those of scutum. Petiole with sparse erect hairs, shorter than those of scutum, on crest and sides, a few finer hairs on front face. First two terga with short, sparse erect hairs on discs; hairs progressively longer and more abundant on succeeding segments. Scape with abundant erect hairs; fore femur without erect hairs on dorsal and inner faces; these abundant on outer and ventral faces; hind tibia with abundant decumbent to subdecumbent hairs; forewing without fringe hairs; hindwing with a few fringe hairs along basal half of posterior margin.

Pubescence short, fine, sparse on head, but denser and partially decumbent on malar area; very sparse on thoracic dorsum, denser on pleurae and propodeum; short and fine on first three terga, sufficiently dense to impart sheen.

Integument: Cephalic integument, shiny, weakly shagreened between punctures; clypeal punctures coarse, separated by 1–2 puncture diameters, closest along midline; frontal lobes finely and densely punctate and with scattered coarse punctures; frons and occiput a little more coarsely and less closely punctate; malar area with coarse, elongate punctures, interspaces duller than elsewhere on head.

Pronotum moderately shiny between dense, very fine punctures; parapsis with abundant punctures equal to those of frons, a little sparser near parapside, with scattered coarse punctures, shiny; discal area of mesoscutum shinier, with punctures distinctly more separated, a broad central portion sparsely and more finely punctate; scutellum polished, with sparse very fine punctures; pleura moderately shiny, with dense fine punctures. Propodeum slightly shiny, with fine, obscure punctures and strongly shagreened.

First three terga shiny, finely and sparsely punctate.

Color: Yellowish, dorsum more brownish; legs and scapes paler. Wings transparent, whitish, veins and stigma reddish.

MALE. *Measurements.* HL 0.83; HW 0.73; SL 0.96; EL 0.36; WL 1.7; PW 1.1.

Head: Sides distinctly convergent toward mandibular bases; head distinctly longer than broad, CI 88; shorter than scape, SI 86. OMD 9.50 × EL. Anterior ocellus smaller than lateral ocelli; IOD 2.33 × OD; OOD 1.66 × OD. Mandible with preapical notch and two small teeth basad of notch.

Thorax: Robust, PW 0.64 × WL. Basal face of propodeum narrow and broadly rounded onto posterior face.

Petiole: In profile, distinctly higher than long, sharply cuneate; in frontal view, sides distinctly convergent above, with narrow median notch; from above, about twice wider than long.

Vestiture: Sparse erect hairs present on head, shortest on frontal lobes; very fine short hairs on pronotal neck; mesoscutal and scutellar hairs short; pleura with scattered short hairs; propodeum with a few erect hairs at sides and base; scape with numerous erect hairs; fore femur with erect hairs on lower and outer faces only; hind tibia with decumbent hairs on outer face; first two terga with scattered fine erect discal hairs. Fringe hairs present on basal one-half of posterior margin of hind wing only.

Pubescence sparse on head and thorax, a little denser on frons and propodeum; longer and denser on first two terga.

Integument: Slightly shiny, densely shagreened, with a few obvious punctures on scutum and pleurae.

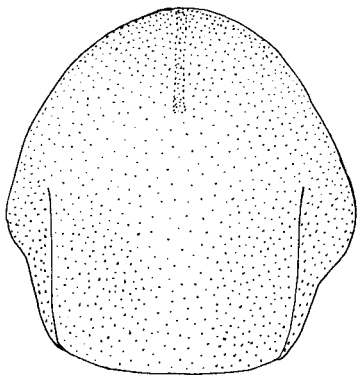
Color: Uniformly light brownish, appendages yellowish. Wings whitish hyaline, veins and stigma light brownish.

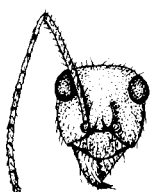
Terminalia: Figures 323, 334, 335.

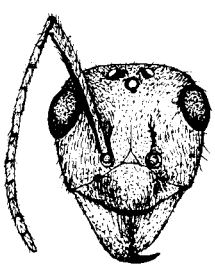
Type Material. NEW MEXICO. Albuquerque, May 1905 (W. M. Wheeler). Lectotype worker, agreeing with above description, parenthetical measurements and type data, by present designation, in AMNH. Lectoparatypes in AMNH, LACM and MCZ.

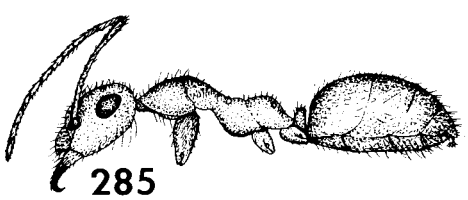
Distribution. Eastern Colorado south to western Texas, westward to southern Utah, Nevada, California and northern Sonora (Fig. 371).

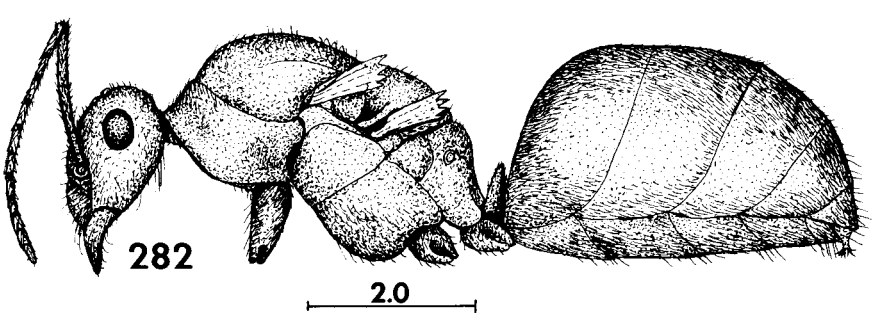
Localities. UNITED STATES. Colorado: Otero Co.: Higbee, 4400′, 2 June 1947 (R. E. Gregg; REG, LACM, USNM); [5 mi N la Junta, 4100′, 23 June 1950, Gregg, 1963]. *New Mexico: Bernalillo Co.:* Albuquerque, 4943′, May 1905 (W. M. Wheeler; type series of *Myrmecocystus mexicanus navajo;* AMNH, LACM, MCZ). *Grant Co.:* 23 mi SW Silver City, 6100′, 7 Sept. 1972 (R. R. Snelling, No. 72–67; LACM). *Doña Ana Co.:* Jornada Exp. Range, 4000′, 24 Apr. 1973 (R. R. Snelling and C. A. Kay, Nos. RRS 73–49, 50; LACM): *County unknown:* "Kenedy, New Mexico, 13 Apr. 1910" (J. D. Mitchell; USNM); "Kennedy, New Mexico" (W. D. Hunter; AMNH, USNM). *Texas: Culberson Co.:* Van Horn, 4010′, 10 July 1950 (R. F. Smith; AMNH); between Pecos R. and Guadalupe Mts., no date, 1920 (F. L. Odenbach; USNM). *Pecos Co.:* Ft. Stockton, 3052′, no date (Judge Williams; MCZ). *Arizona: Cochise Co.:* 5 mi W Portal, 5400′, 6 Aug. 1963 (C. Chesebrough; LACM); Ash Cyn., 5500′, Huachuca Mts., 23 Aug. 1973 (R. R. Snelling, No. 71–43; LACM); Texas Pass [=Canyon], 4800′, Dragoon Mts., 19–20 July 1917 (W. M. Wheeler; MCZ; CU); same locality, 11 Aug. 1967 (R. R. Snelling; Nos. 67–210, 211; LACM); Hereford, 18 Aug. 1958 (D. Luther; LACM). *Graham Co.:* Post Cyn., 5000–6000′, Pinaleño Mts., 18–20 July 1917 (W. M. Wheeler; MCZ); Fort Grant, Pinaleño Mts., 19 July 1917 (CU). *Pima Co.:* Tucson, 2370′, 21–23 July 1916 (USNM). *Yavapai Co.:* Granite Dells, 5300′, 4 mi N Prescott, 18 July 1971 (L. M. Martin; LACM). *Utah: Millard Co.:* 60 mi W Delta, 19 July 1939 (R. W. Fautin; USNM); White Valley, 10 June 1940 (R. W. Fautin, #571; USNM); Millard, 29 June 1945 (V. E. Shelford; USNM). *Juab Co.:* 9 mi E Trout Creek, 17 Aug. 1933 (A. G. Richards; LACM). *Nevada: Nye Co.:* Fairbanks Spgs., 2200′, 15 Apr. 1964 (R. C. Bechtel; NDA). *Lincoln Co.:* 5 mi NE Caliente, 4800′,











FIGURES 282–289. *M. navajo*. 282, female, lateral view; 283, head of female, frontal view; 284, mesoscutum of female, distribution of punctures; 285, major worker, lateral view; 286, head of major worker, frontal view; 287, head of minor worker, frontal view; 288, male, lateral view; 289, head of male, frontal view.

17 May 1970 (G.C. & J. Wheeler; No. Nev. 892; GCW). *Esmeralda Co.:* Lida, 6500′, 28 May 1970 (G.C. & J. Wheeler; No. Nev. 1007; GCW). *California: San Bernardino Co.:* 2 mi N Essex, 3–5 May 1966 (P. A. Opler; UCB); Golden Crown Mine, 22 Feb. 1968 (R.J. Hamton; LACM, RJH). *Riverside Co.:* Piñon Flat, 4000′, 28 Apr. 1969 (G.C. & J. Wheeler, No. Calif. 663, 668; GCW); Dos Palmas, 3700′, 8 Mar. 1970 (G.C. & J. Wheeler, No. Calif. 856; GCW); Nightingale, 4100′, 5 Dec. 1967 (G.C. & J. Wheeler, No. Calif. 253; GCW); T.7S, R.5E, sec. 14, 4500′, 18 Sept. 1969 (G.C. & J. Wheeler, No. Calif. 838; GCW). *San Diego Co.:* 4 mi W Scissors Crossing (on San Felipe Rd.), 4 Aug. 1974 (J. Saunier; LACM). *MEXICO. Sonora:* 35 mi W Sonoita, 26 Nov. 1959 (V. Roth; USNM); Sonoita R., near Gulf [of California], 26 Nov. 1959 (V. Roth; USNM).

Ecology. Gregg (1963) found this species in Short Grass Prairie of the Upper Sonoran of Colorado. The type material came from an area of Saltbush-Greasewood Desert near Albuquerque, New Mexico. Creighton (1950), based on information from Wheeler (1908), noted that this ". . . species makes obscure nests in sandy soil. It does not make a crater but spreads the excavated soil out into a disc." According to Wheeler, too, the colonies are small, of about 100–150 workers.

Some data on foraging activity were reported by Fautin (1946) who studied the species in White Valley, western Utah. Here, the ant was present in the Shadscale and *Tetradymia* Communities. Fautin found that the sensitivity of the workers to heat seemed to be a factor regulating emergence from the nest: "During April they became active just before dark and the time of their activity was progressively delayed until a later hour of the night as the summer temperatures became higher. By midsummer they failed to emerge until near midnight."

The ants appeared at the entrance of the nest when air temperature dropped below 88°F. They were found to leave the mound to begin foraging when air temperature was within a reported range of 52.2°F to 70.5°F, the average being 63.5°F. Fautin found that when ants were exposed to direct sun and an air temperature of 94°F they died within 1–10 min. Unfortunately, no readings were taken of soil surface temperatures which might have yielded more precise data than air temperature can provide.

The habitats of this species range from Creosote bush Scrub in the Lower Sonoran to Upper Sonoran Chaparral; it seems to be most common in Oak-Juniper and Piñon-Juniper Woodlands. The elevational range of *navajo* is poorly known: in New Mexico it ranges from 4000′ to 6100′; in Nevada from 2200′ to 6500′ and in California from about 700′ to 4500′. West of central Arizona the distribution is sporadic, probably limited to suitable habitat elevations in the mountain ranges.

The foraging activities are nocturnal, as usual in this subgenus, and the species solicits aphids and pseudococcids for honeydew as well as foraging nectar directly from plants. Workers may be attracted to sweet baits. Dead arthropods are also collected. Wheeler (1908) reported that he found no repletes in the twenty-two nests which he examined in the vicinity of Albuquerque. Creighton (1950) surmised that repletes undoubtedly are developed. A part of the series from Ft. Stockton, Texas, consists of repletes, and I took repletes from a nest studied at Texas Canyon, Arizona. Although it is possible that the colonies examined by Wheeler may all have been young colonies, I think it more likely that excavation was not complete. Mature colonies number over 1000 individuals, not 100–150.

Wheeler also commented on the lack of a tumulus about the nest entrance. It may be that the nests which he studied were without tumuli due to wind and/or rain action. All the nests which I have seen possess well developed crateriform tumuli composed of coarse grains of sand or fine pebbles.

Little is known of the activities of the sexual forms, summarized in Table 8. Alate females have been taken most commonly at lights. One collection of females made near Scissors Crossing, Calif., on 4 Aug. 1974 bears the note "crepuscular following heavy rain." The enlarged ocelli of the female suggest that mating flights regularly take place during evening or at night.

Discussion. Superficially this species looks like a diminutive *mexicanus*. From that species the worker is separable by smaller size, sparse cephalic pubescence and lack of erect hairs on the extensor surfaces of the femur and tibia. The female differs from that of *mexicanus* chiefly in smaller size and lack of erect hairs on the extensor surfaces of the femur and tibia, the male separable largely by its smaller size.

The node of the petiole of *navajo* workers is usually thinner and with fewer erect hairs than that of *mexicanus,* as noted by Creighton (1950) and Gregg (1963). The differences, however, require comparison and will not always hold up in material from California where some workers of *mexicanus* have narrower and less pilose petiolar nodes. Creighton also commented on the high placement of the eye of *navajo,* its upper border coincident with the occipital angles. This is not always true, even in material from New Mexico. Also, this characteristic occurs in some samples of *mexicanus*.

Populations from Nevada and California differ from those of the eastern parts of the range of the species. In the female and worker castes of these western samples the pubescence of head, thorax and gaster is very sparse and the integument is quite shiny. Specimens from the eastern parts of the range are more pubescent and therefore appear less shiny. Erect hairs are also a little more abundant, especially on the thorax, in the samples from Colorado, New Mexico and Arizona. The few samples available from Utah seem to be of an intermediate character. Some are fully as pubescent as the eastern samples; others are more like those of Nevada

TABLE 8

Activity of Reproductives of:

Locality	Date	Activity
M. ewarti Snelling		
CALIF., 3 mi W Shaver's Well	1 Mar. 1964	♂♂, ♀♀ in nest
CALIF., Deception Cyn.	26 Jan. 1967	♀♀ in nest
M. navajo Wheeler		
COLO., La Junta	23 July 1950	♂♂ in nest
TEX., Van Horn	10 July 1950	♀♀ at light
UTAH, 9 mi E Trout Creek	17 Aug. 1933	♂♂, ♀♀ in nest
ARIZ., 4 mi N Prescott	18 July 1971	♀ at light
ARIZ., Texas Pass	19 July 1917	♀♀ in nest
ARIZ., Texas Pass	20 July 1917	♂♂ in nest
ARIZ., Tucson	21 July 1916	♀ (flight?)
ARIZ., Hereford	18 July 1958	♀ at light
CALIF., 4 mi W Scissors Cross	4 Aug. 1974	♀♀ at light after rain
M. pyramicus M. Smith		
IDA., Hammett	10 Apr. 1932	♂♂, ♀♀ in nest
IDA., 5 mi E Arco	15 June 1967	♀♀ in nest
IDA., Twin Falls	4 Oct. 1932	♂♂, ♀♀ in nest
ORE., 39 mi W Jordan Valley	20 June 1967	♀♀ in nest
NEV., 5 mi W Mullen Gap	27 Sept. 1966	♂♂ in nest

and California. Many, however, cannot be assigned to one or the other. Since both extremes, as well as the intermediates, may be present in the same nest sample, it is safe to assume that we are dealing with a single, variable species. This reduction in vestiture in western samples parallels the situation in the related *mexicanus*.

PYRAMICUS GROUP

Myrmecocystus (Myrmecocystus) ewarti Snelling

Figures 290–298, 326, 327, 338, 339

Myrmecocystus ewarti Snelling 1971. Contr. Sci., L.A. Co. Mus. 214:2–6. ♀♀♂; Wheeler and Wheeler 1973. Ants of Deep Canyon, 120, Fig. 42.

Diagnosis. Worker. Few or no erect hairs on malar area, scape and tibiae (except beneath); propodeum, at juncture of dorsal and posterior faces, angularly produced upward; petiolar scale compressed; erect pronotal hairs present, at least a pair exceeding apical breadth of scape. *Female.* Penultimate maxillary palpal segment narrowed basally and apically; tibiae without erect hairs; OOD 3 × OD; first tergum with erect discal hairs; mesoscutum, between parapsides, with abundant fine piligerous punctures and scattered coarse punctures. *Male.* Forewing with fringe hairs on apical margin; scape and tibiae without erect hairs.

WORKER. *Measurements.* HL 0.76–1.30 (1.23); HW 0.70–1.30 (1.23); SL 0.93–1.36 (1.36); WL 1.10–1.80 (1.70); PW 0.46–0.83 (0.83).

Head: Shape varying from longer than broad in most workers to slightly broader than long in largest workers, CI 88–104 (100); a little shorter than scape, SI 102–136 (110). In frontal view head broadest at lower margin of eyes, sides slightly convex to straight, narrowed toward mandibular insertions. Occiput, in frontal view, somewhat flattened in middle, sides convex, not at all angulate. Eye large, 1.5 × first flagellomere; OMD 0.90–1.15 (0.93) × EL. Mandible with seven distinct teeth, often with a small intercalary denticle between the penultimate and basal teeth.

Thorax: Slender to moderately robust, PW 0.37–0.50 (0.48) × WL. Basal face of propodeum pyramidally produced upward at juncture with posterior face, about half as long as posterior face.

Petiole: Compressed when viewed in profile, crest thin, weakly angularly excised in middle; in dorsal view twice as wide as long.

Vestiture: Erect hairs sparse on head, confined to clypeus, frontal lobes and occipital areas. Erect pronotal pilosity sparse, but with at least a pair of fine, fully erect hairs which are about as long as apical width of scape; mesonotum with 3–6 erect hairs; propodeum without erect hairs at summit of declivity, or with one or two which are less than half as long as those of mesonotum. Petiolar scale with a few very short, inconspicuous erect hairs on crest. Disc of first tergum with scattered, short, fully erect blunt hairs; second and succeeding terga with progressively longer discal hairs. Tibiae with very sparse, fine, decumbent to subdecumbent hairs on outer surfaces, these shorter and finer than the row of gradated bristles on the inner surface.

Pubescence very fine, sparse on head, a little more abundant on occiput, especially behind eyes; thoracic pubescence denser than cephalic, but not obscuring surface, denser on sides of propodeum than elsewhere. First three terga with dense, fine pubescence which does not obscure surface, fourth and fifth with very sparse pubescence.

Integument: Dull, everywhere very finely shagreened, with conspicuous round sparse punctures on clypeus, malar area more densely shagreened, with scattered elongate punctures; frontal lobes with scattered micropunctures.

Color: Light brownish yellow, legs and gaster more yellowish; mandibular margins somewhat ferruginous.

FEMALE. *Measurements.* HL 1.47; HW 1.63; SL 1.42; EL 0.57; OMD 0.52; WL 3.6; PW 1.89.

Head: Broader than long, CI 111; longer than scape, SI 87. In frontal view head broadest behind eyes, sides converging slightly toward mandibular insertions. Occiput, in frontal view flat, with well-rounded corners. Eye large, 1.8 × first flagellomere; OMD 0.91 × EL; IOD 3.0 × OD. Penultimate segment of maxillary palp broadest in middle, narrowed basally and apically.

Thorax: Robust, PW 0.52 × WL. In profile posterior two-thirds of mesoscutum and anterior half of scutellum on same plane; metanotum not protruding.

Petiole: In profile, compressed, crest sharp; in anterior view, distinctly notched; from above, about three times wider than long (not clearly visible in only available specimen).

Vestiture: Erect cephalic pilosity as described for worker; pronotum with a few erect hairs along anterior margin; mesoscutum and scutellum with scattered long, erect yellowish hairs arising from coarse punctures; pleura with about a dozen long, erect yellowish hairs; propodeum without conspicuous erect hairs; first tergum with scattered subdecumbent to erect yellowish hairs on disc; second and following terga with fully erect yellowish hairs longer, a little more abundant; inner face of fore femur without conspicuous fully erect hairs, though 15+ are present on ventral surface; middle and hind tibiae with numerous decumbent, fine yellowish hairs.

Pubescence long, yellowish, appressed to decumbent on head, thorax and appendages; fully appressed and abundant on first three terga, conspicuously sparser on fourth.

Integument: Clypeus sparsely punctate in middle, interspaces smooth and shiny, becoming more closely punctate and with shagreened interspaces toward lateral lobes; frontal lobes shiny, closely micropunctate; front of head shiny, with abundant micropunctures and scattered coarse punctures; occiput dull, densely micropunctate and with sparse coarse punctures; malar area dull, surface lightly shagreened, with abundant micropunctures and numerous coarse punctures, latter becoming ovoid near eye.

Pronotum slightly shiny, densely micropunctate. Parapsis shiny, with abundant micropunctures and sparse coarse punctures; mesoscutal disc shiny, with sparse micropunctures and scattered coarse punctures, with irregular, nearly impunctate area in middle. Scutellum shiny, with scattered micropunctures and a few coarse punctures. Anepisternum shiny, sparsely micropunctate and with scattered coarse punctures; katepisternum similar but punctures slightly finer and a little denser. Propodeum densely shagreened and densely micropunctate.

First three terga shiny, closely micropunctate, punctures coarsest and densest on first, becoming progressively finer and sparser on second and third segments.

Color: Body yellow, dorsum of head and thorax slightly brownish; appendages paler yellow. Wings clear, veins and stigma light yellow.

MALE. *Measurements.* HL 0.66–0.76; HW 0.63; SL 0.73–0.76; EI 0.33; OMD 0.16; WI 1.33–1.43; PW 0.83–1.00.

Head: Margins slightly convergent toward mandibular insertions; head a little longer than broad, CI 90–95; a little shorter than scape, SI 115–121; OMD 0.50 × EL; anterior ocellus little smaller than lateral ocelli; IOD 3.0–3.5 × OD; OOD 1.0–1.5 × OD. Mandible with preapical tooth or preapical notch before apical tooth. Clypeus with or without obscure preapical transverse depression.

Petiole: In profile, distinctly higher than long, sharply cuneate; in frontal view, sides convergent toward narrow, flat, medially notched crest; in dorsal view, about twice as wide as long.

Vestiture: Erect hairs yellowish, sparse on head and thorax, longest on scutellum, where they are about equal to MOD; propodeum without conspicuous erect hairs; tibiae and scape without erect hairs. First two terga with sparse, short erect hairs, third and following segments with conspicuous long, scattered hairs.

Pubescence sparse and inconspicuous on head and thorax, conspicuously denser on propodeum above and on first two terga. Forewing with conspicuous fringe hairs from stigma to apex, around apical margin to vein Cu-A; apical and posterior margins of hind wing fringed.

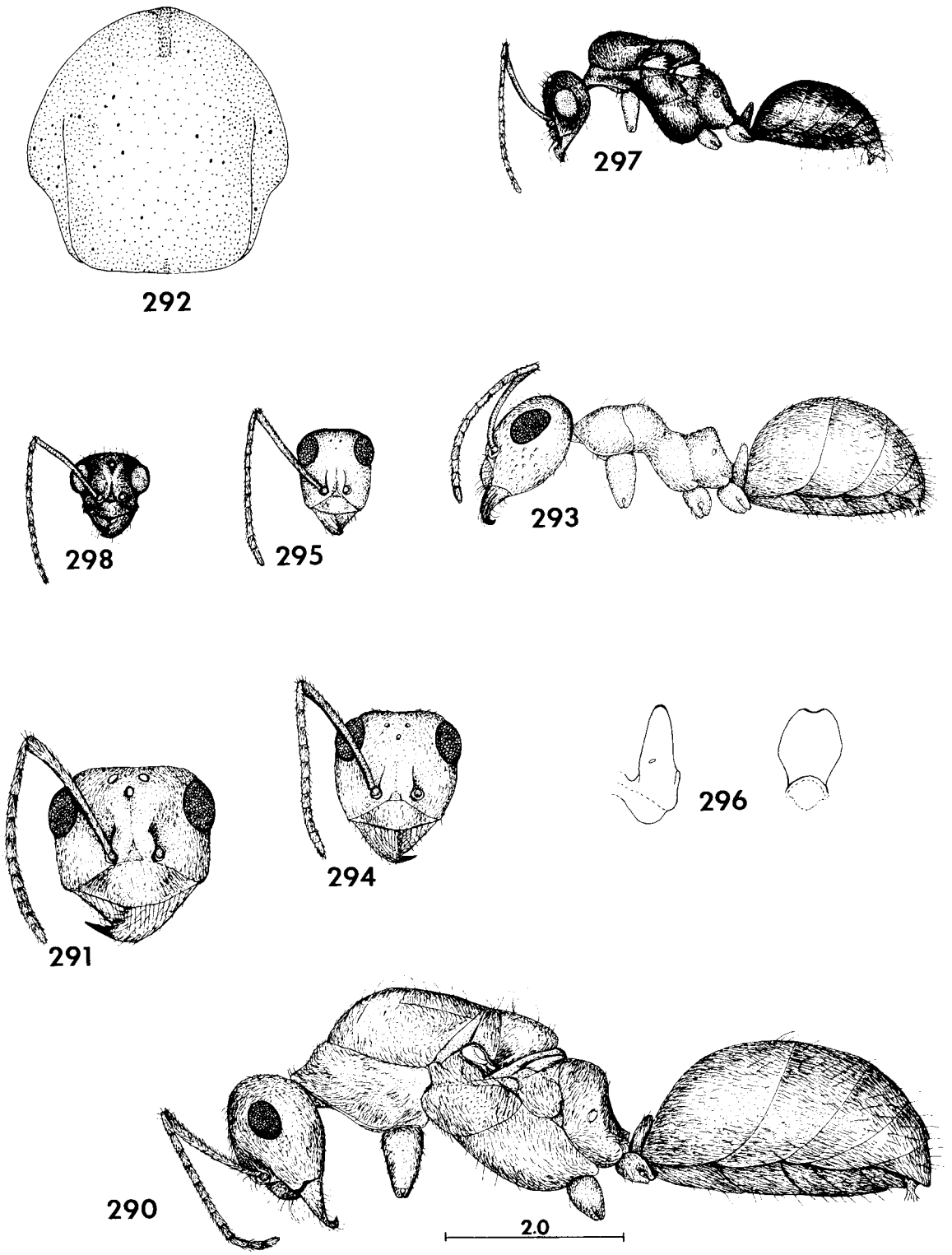
Integument: Moderately shiny, with piligerous micropunctures, a few scattered coarse punctures on scutum and mesopleura.

Color: Uniformly brownish, appendages yellow to yellowish brown. Wings whitish hyaline, stigma and veins pale yellowish.

Terminalia: Figures 327, 338, 339.

Type Material. 3 mi W Shaver's Well, Riverside Co., CALIF., 1 & 8 March 1964 (R. R. Snelling). Holotype, allotype and most paratypes in LACM; additional paratypes in AMNH, GCW, MCZ, MNHG, USNM.

Distribution. Mojave and Colorado Deserts of southern California, probably also in adjacent south-



FIGURES 290–298. *M. ewarti*. 290, female, lateral view; 291, head of female, frontal view; 292, mesoscutum of female, distribution of punctures; 293, major worker, lateral view; 294, head of major worker, frontal view; 295, head of minor worker, frontal view; 296, petiole of major worker, lateral (left) and posterior (right) views; 297, male, lateral view; 298, head of male, frontal view.

western Arizona, northwestern Sonora and northern Baja California (Fig. 372).

Localities. UNITED STATES. California: Imperial Co.: 6 mi E Glamis, 925′, 30 Mar. 1967 (R. R. Snelling; LACM). *Riverside Co.,* Deep Canyon, 800′–975′, various dates (G. C. & J. Wheeler; GCW); 1.5 mi N Thousand Palms, 190′, 5 Feb. 1967 (R. R. Snelling, LACM); Deception Cyn. and Fan Hill, Joshua Tree Natl. Mon., 26 Jan. 1967 (R. J. Hamton; RJH); Carrizo Creek Cyn., San Jacinto Mts., 1100′, 27 Feb. 1963 (M. Ewart; LACM). *San Bernardino Co.:* 23 mi S Needles, 475′, 31 Jan. 1967 (R. R. Snelling; LACM); 44 mi E Twentynine Palms, 2 Oct. 1963 (R. R. Snelling; LACM).

Ecology. The type series was found nesting in a sandy stream bed in Creosote Bush-Bur Sage Desert. The entrance was surrounded by a large crateriform tumulus of fine sand particles. Known habitats range from Creosote Bush and Palo Verde-Cactus Shrub Deserts to Piñon-Juniper Woodland, with most records from Creosote Bush and Creosote Bush-Bur Sage Deserts. The elevational range is from 190′ near Thousand Palms to 1100′ at Carrizo Creek Canyon, both in Riverside County.

Foraging activity is nocturnal; workers gather nectar from plants and solicit aphids. They have also been observed to bring in remnants of dead arthropods. Repletes were found in the type series nest.

The activities of the sexual forms are unknown. Presumably the mating flight takes place at night, most likely following a rain. The sexual forms have been found in the nests during the early spring months (Table 8).

Discussion. Present data indicate that this species replaces the similar *pyramicus* in southern California on the Mojave and Colorado Deserts. It is probably to be found also in adjacent portions of Arizona, Sonora and Baja California.

The workers of *ewarti* may be separated from those of *pyramicus* by the presence of a number of erect hairs on the pronotum and first tergum. A pair of pronotal hairs, which seems always to be present in *ewarti,* is as long as or longer than the apical breadth of the scape. Although occasional specimens of *pyramicus* may have one or two erect pronotal hairs, they are always much shorter. Erect hairs are present on the hind tibia of *pyramicus* but absent in *ewarti.* The median area of the clypeus of *ewarti* has four or more long, erect hairs; in *pyramicus* clypeal hairs are confined to the margins.

The single female available of *ewarti* is very similar to those of *pyramicus* but has a number of erect hairs on the clypeal disc, the antennal scape possesses numerous fine suberect hairs, long erect hairs are abundant on the outer face of the fore femur and there are erect hairs on the hind tibia. The malar area of *ewarti* is less sharply shagreened, the punctures below the eyes are larger and are round (clearly elongate in *pyramicus*). The best character to separate the females of these species seems to be that of mesoscutal punctation. The discal area in *ewarti* is rather uniformly finely, sparsely piligerously punctate. There are, in addition, a number of much coarser, setigerous punctures scattered over the disc. The piligerous punctures of the parapsis are little coarser than those of the median area, and are mostly separated by two or more times a puncture diameter. In *pyramicus,* the center of the mesoscutum is virtually impunctate, the setigerous punctures are fewer and less conspicuous, and the punctures of the parapsis are much coarser than those of the median area, and are mostly separated by a puncture diameter or less.

The males are very similar and, until more specimens of *pyramicus* are available, the differences noted here must be considered provisional. In size, *pyramicus* males are conspicuously longer; head length of males of this species exceeds 0.90 mm, while that of *ewarti* is less than 0.80 mm. However, *Myrmecocystus* males vary greatly in size within a single colony, so the size difference must be considered with this variability in mind. The lower margin of the fore femur of *ewarti* has a number of long, erect hairs as well as many extremely fine, short ones. The few males seen of *pyramicus* possess, in addition, about as many long hairs and an equal, or greater, number of hairs about half as long as the longer. The most conspicuous difference is the presence of a discoidal cell in *ewarti* males and its lack of those of *pyramicus.* Finally, *ewarti* males have a well developed fringe of hairs on the apical margin of the fore wing and apical and posterior margins of the hind wing. There is no fringe on the forewing of *pyramicus* and on the hind wing it is extremely sparse, most of the hairs separated by much more than their own lengths.

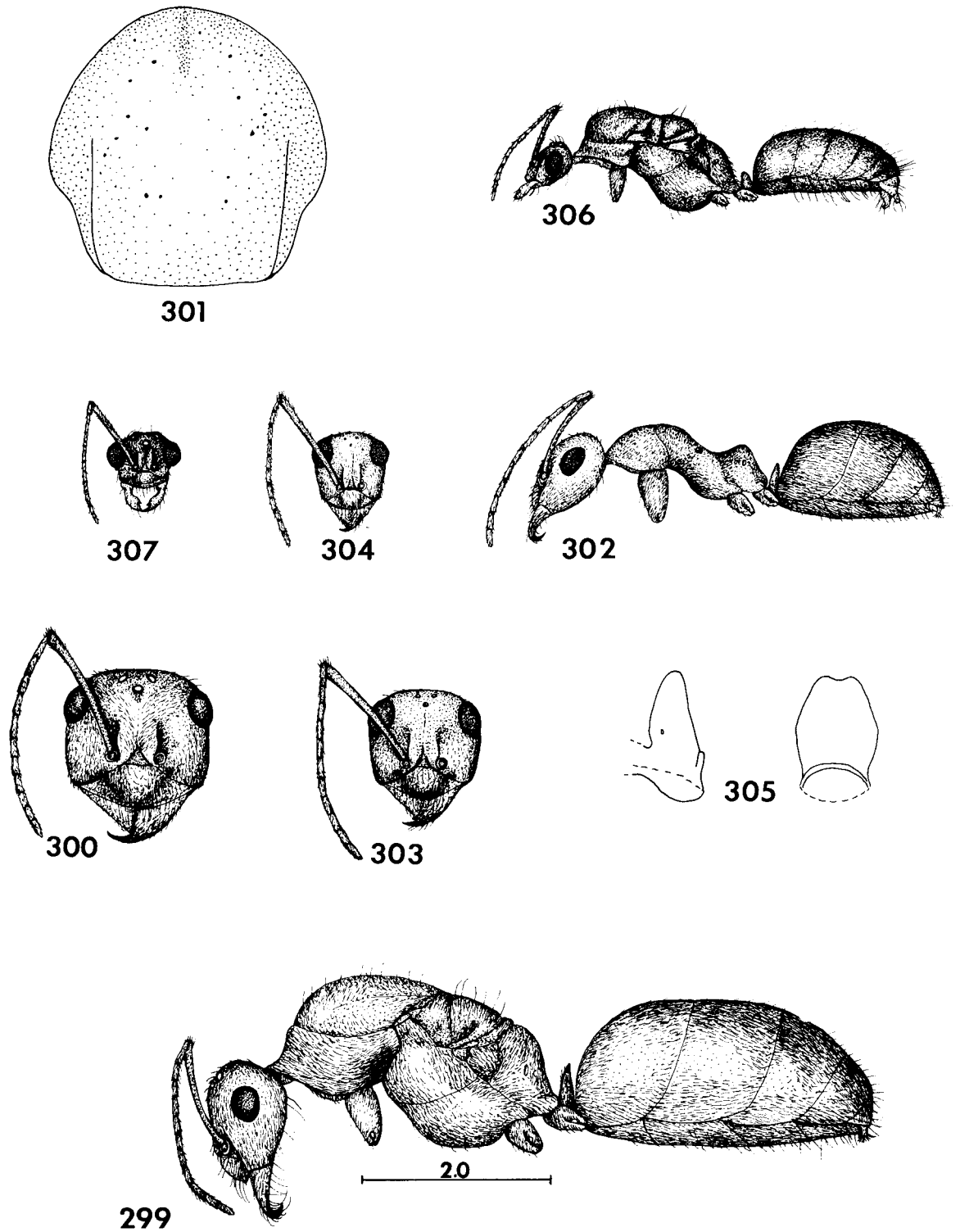
Myrmecocystus (Myrmecocystus) pyramicus M. Smith

Figures 299–307, 324, 325, 336, 337

Myrmecocystus mexicanus subsp. *navajo,* Cole 1934. Ann. Entomol. Soc. Amer. 27:402. *(misidentification)*

Myrmecocystus pyramicus M. Smith 1951. Great Basin Nat. 11:91–94. ♀. Cole 1957. Jour. N.Y. Entomol. Soc. 65:129–130. ♀♂.

Diagnosis. Worker: Few or no erect hairs on malar area, antennal scape and tibiae (except beneath); propodeum, at juncture of dorsal and posterior faces, angularly produced upward; petiolar scale compressed; erect pronotal hairs, when present, shorter than apical breadth of scape. *Female.* Penultimate maxillary palpal segment narrowed basally and apically; tibiae without erect hairs; OOD 3 × OD; first tergum without erect discal hairs; mesoscutum, between parapsides, with scattered coarse and fine punctures. *Male.* Forewing



FIGURES 299–307. *M. pyramicus*. 299, female, lateral view; 300, head of female, frontal view; 301, mesoscutum of female distribution of punctures; 302, major worker, lateral view; 303, head of major worker, frontal view; 304, head of minor worker, frontal view; 305, petiole of major worker, lateral (left) and posterior (right) views; 306, male, lateral view; 307, head of male, frontal view.

without fringe hairs on apical margin; scape and tibiae without erect hairs.

WORKER. *Measurements.* HL 0.83–1.26; HW 0.73–1.23; SL 1.06–1.50; WL 1.2–1.9; PW 0.50–0.76.

Head: Longer than broad in all sizes, CI 85–97; distinctly shorter than scape, SI 117–132. In frontal view head broadest about midway between eyes and mandibular bases, sides thus convex but only slightly so; sides slightly narrowed toward mandibular insertions. Occiput, in frontal view, flattened, sides convex, not angulate. Eye large, 1.5–2.0 × first flagellomere; OMD 0.90–1.15 × EL. Mandible seven-toothed, occasionally with an intercalary denticle between subbasal and basal teeth.

Thorax: Slender, PW 0.38–0.46 × WL. Basal face of propodeum pyramidally produced upward at juncture with posterior face, about half as long as posterior face.

Petiole: Compressed when viewed in profile; from behind, crest narrow, angularly excised in middle; from above, about twice wider than long.

Vestiture: Erect cephalic hairs sparse, confined to clypeus, frontal lobes and occiput, those of clypeus much shorter on disc than at sides; longest occipital hairs less than 0.5 × MOD. Pronotal hairs sparse, sometimes absent, longest hairs always shorter than apical breadth of scape; mesonotum with 2–6 short erect hairs; propodeum without erect hairs. Petiolar scale with a few inconspicuous fine hairs on crest. First tergum with hairs on apical margin only; second tergum usually without erect discal hairs, occasionally a few fine hairs present laterad; following terga with scattered short discal hairs and usual longer marginal hairs. Scape, femora (except beneath) and tibiae (except beneath) without erect hairs (rarely 2 or 3 short suberect hairs on basal one-fourth of hind tibia).

Pubescence dilute, very short, but producing evident sheen on cephalic and thoracic dorsa and first three terga.

Integument: Front of head shiny, polished between punctures; clypeal punctures sparse, coarse; frontal punctures dense, fine; malar area shagreened, duller than frons, with scattered elongate fine punctures; integument otherwise moderately shiny, finely shagreened.

Color: Light brownish yellow, legs and antennae more yellowish; mandibular teeth ferruginous to blackish ferruginous.

FEMALE. *Measurements.* HL 1.43–1.50 mm; HW 1.56–1.60; SL 1.46–1.53; EL 0.50–0.53; OMD 0.50–0.53; WL 3.3–3.4; PW 1.9–2.0.

Head: Broader than long, CI 107–109; a little shorter than to a little longer than, scape, SI 93–102. In frontal view, head broadest immediately above mandibular insertions, sides straight. In frontal view, occiput flat in middle, sides broadly rounded, without lateral angles. Eye large, about 1.5 × first flagellomere; EL 0.93–1.06 × OMD. OOD 3 × OD; IOD 3 × OD. Penultimate segment of maxillary palp broadest in middle, narrowed basally and apically.

Thorax: Robust, PW 0.55–0.60 × WL. In profile, posterior half of mesoscutum, scutellum and metanotum forming a continuous, flattened curve.

Petiole: In profile, compressed, crest sharp; distinctly angularly notched; from above, about twice wider than long.

Vestiture: Cephalic pilosity about as described for worker; pronotum with erect hairs on anterior margin; mesoscutum and scutellum with scattered long, erect yellowish hairs arising from coarse punctures; pleura with scattered erect long yellow hairs; propodeum without conspicuous erect hairs; first tergum with erect hairs on apical margin only; second tergum without erect discal hairs, or with a few scattered short hairs, third and fourth terga with scattered short erect hairs; scape without erect hairs except cluster near apex; femora with erect hairs on ventral margin only; hind tibia with sparse short subdecumbent hairs; very short fringe hairs present on apical margin of fore wing and apical and posterior margins of hind wing.

Pubescence long, yellowish, appressed to decumbent on head, thorax and appendages; fully appressed and abundant on first three terga, both shorter and sparser on fourth.

Integument: Clypeus coarsely punctate, interspaces shagreened and dull along midline, subpolished and shiny on lateral lobes; front of head otherwise shiny between punctures, frontal lobes finely and densely punctate, frons more finely and sparsely punctate, area between eyes and frontal lobes very sparsely and more coarsely punctate; occiput duller, very finely punctate and with finely shagreened interspaces; malar area dull, shagreened, coarsely punctate, punctures denser near mandible, those near eye elongate.

Pronotum moderately shiny between sparse, fine punctures, interspaces delicately shagreened. Parapsis densely, finely punctate, moderately shiny; disc of mesoscutum shinier, with sparse, very fine punctures laterad and scattered coarse punctures and broad central portion largely impunctate. Scutellum shiny, with sparse fine punctures, a little coarser and closer laterad. Pleura moderately shiny, closely and finely punctate. Propodeum slightly shiny, strongly shagreened, sparsely, finely and obscurely punctate.

First three terga moderately shiny, finely and sparsely punctate.

Color: Yellowish, cephalic, thoracic and gastric dorsa more brownish; legs and scapes paler. Fore wings transparent whitish, cells on costal margin with yellowish tint; veins and stigma ferruginous or brownish.

MALE. *Measurements.* HL 0.70–0.86; HW 0.66–0.76; SL 0.83–0.96; EL 0.33–0.40; WL 1.7–2.1; PW 0.95–1.13.

Head: Sides slightly convergent toward mandibular insertions; head a little longer than broad, CI 88–95; distinctly shorter than scape; OMD 0.50 × EL; ante-

rior ocellus a little smaller than lateral ocelli; IOD 2.6–3.7 × OD; OOD 1.6–2.0 × OD. Mandible with preapical notch and/or preapical tooth.

Petiole: In profile, distinctly higher than long, sharply cuneate; in frontal view, sides somewhat convergent toward broadly emarginate crest; from above, about twice wider than long.

Vestiture: Erect hairs yellowish, sparse on head and thorax, longest on scutellum, but these distinctly shorter than MOD; propodeum without conspicuous erect hairs; scape and tibiae without erect hairs, or tibiae with scattered fine reclinate hairs; first two terga without erect hairs except on apical margins; remaining terga with numerous long yellowish hairs. Fore wing without fringe hairs; hind wing with fringe on posterior margin and scattered short hairs on apical margin.

Pubescence sparse and inconspicuous on head and thorax, denser on propodeum above and first two terga.

Integument: Moderately shiny, with piligerous micropunctures, a few scattered coarse punctures on scutum and pleura.

Color: Uniformly light brownish, appendages yellowish to yellowish brown. Wings whitish hyaline, stigma and veins pale yellowish.

Terminalia: Figures 325, 336, 337.

Type Material. Nevada Dominion Mine, Pyramid Mining District, 5 mi W Mullen Gap, Washoe Co., NEVADA, 7 April 1951 (I. La Rivers). Holotype and paratypes in USNM; additional paratypes in collections of AMNH, LACM, MCZ and of Ira La Rivers.

Distribution. Southern Oregon and Idaho, south to Nevada. May occur in western Utah and Sagebrush Desert of California (Mono and Inyo Counties) (Fig. 372).

Specimens Studied. UNITED STATES. Oregon: Lake Co.: Alkali Lake, Hwy. 395, 9 June 1967 (R. R. Snelling, No. 67–123; LACM). *Malheur Co.:* 39 mi W Jordan Valley, 4500′, 20 June 1967 (R. R. Snelling, No. 67–176, 177; LACM). *Idaho: Owyhee Co.:* 3.3 mi S Given's Hot Spgs., 2350′, 20 June 1967 (R. R. Snelling, No. 67–171; LACM); 4 mi S Walters Ferry Bridge, 13 May 1967 (N. Yensen; LACM). *Butte Co.:* 5 mi E Arco, 5400′, 15 June 1967 (R. R. Snelling, No. 67–155, 156; LACM). *Nevada: Humboldt Co.:* Soldier Meadows, 4400′, 1 July 1965 (R. C. Bechtel; NDA); same locality, 15 July 1966 (R. C. Bechtel & P. C. Martinelli; NDA). *Washoe Co.:* Mullen Gap, 5 mi W Pyramid Lake, 18 May 1952 (I. La Rivers, No. 1551; USNM); Nevada Dominion Mine, Mullen Gap, 5 mi W Pyramid Lake, 7 April 1951 and 8 May 1951 (I. La Rivers; USNM). *Nye Co.:* Potts, 6700′, 27 Sept. 1966 (R. C. Bechtel & P. C. Martinelli; NDA). *White Pine Co.:* 2 mi N McGill, 6000′, 15 July 1970 (G. C. & J. Wheeler, No. Nev. 1333; GCW); 19 mi SW Ely, 6000′, 14 July 1970 (G. C. & J. Wheeler, No. Nev. 1304; GCW).

Ecology. This Great Basin species has been collected in areas of Great Basin Sagebrush, Sagebrush Steppe and Saltbush-Greasewood Desert. In the Sagebrush Steppe of Idaho the elevational range is from 2350′ to 5400′. In Nevada, where most records are from Great Basin Sagebrush areas, the elevation range is from about 4000′ to 6700′. All records of this species are from Upper Sonoran or Transition Zone localities.

Although foraging is mostly nocturnal, I have found *pyramicus* workers active outside the nest at midday in Oregon and Idaho. In both instances, though, rain was imminent and the sky was completely overcast. As expected, workers gather nectar from flowers and extrafloral nectaries, as well as from aphids and pseudococcids. They are also general scavengers. Repletes have been recovered from nests in Idaho.

The type series was collected by Ira La Rivers, with the notation "swarming nr. sundown." These specimens were collected on 7 April 1951. The reproductives have been taken in the nests in April, June and September (Table 8). Mating flights evidently occur during spring and late summer rainy periods.

The type series was collected from a ". . . small, open mound nest in a sand clearing of *Artemisia tridentata* . . ." Nests which I have observed were all marked by a low crateriform tumulus of fine to coarse sand grains. Since all these were seen during the summer rainy season, the tumuli were likely worn down. Most of the nests have been located in deep, sandy soil. An exception was that discovered in Owyhee County, Idaho. This nest was in deep alkali pan. This soil was very dense and excavation was not complete, but the nest probably continued down into an underlying layer of sand, as the tumulus consisted wholly of coarse sand particles.

Discussion. This species has been adequately described by Smith (1951) and by Cole (1957). The strongly, angularly projecting propodeum is characteristic of this species and the closely related *ewarti* of California. The lack of erect hairs on the pronotum, disc of the first tergum and the extensor surface of the hind tibia will separate workers of *pyramicus* from those of *ewarti*. For a fuller treatment, see *Discussion* under *ewarti*.

Testaceus Group

Myrmecocystus (Myrmecocystus) testaceus Emery

Figures 308–315, 320, 321, 332, 333

Myrmecocystus melliger semirufa var. *testacea* Emery 1893. Zool. Jahrb. f. Syst. 7:667. ♀.

Myrmecocystus mexicanus subsp. *mojave* Wheeler 1908. Bull. Amer. Mus. Nat. Hist. 24:360–361. ♀; Leonard 1911. Trans. San Diego Soc. Nat. Hist. 1:87–92 *(biology);* Wheeler 1912. Psyche 19:173, 179, Fig. 1. ♀♀♂; Cole 1934. Ann. Entomol. Soc. Amer. 24:403. Mallis 1941. Bull. So. Calif. Acad. Sci. 40:81.

Myrmecocystus mexicanus, undescr. var., Cole 1934. Psyche 41:225.

Myrmecocystus mexicanus subsp. *idahoensis* Cole 1936. Entomol. News 47:118. ♀♀♂.

Myrmecocystus mojave, Creighton 1950. Bull. Mus. Comp. Zool. 104:448–449; Cook 1953. The Ants of Calif.; Palo Alto, p. 350–351; Cole 1966. B. Young Univ. Sci. Bull. 7:22; Wheeler and Wheeler 1968. Ann. Entomol. Soc. Amer. 61:213 *(larva)*.

Myrmecocystus testaceus, Snelling 1969. Contr. Sci., L.A. Co. Mus. 170:6; Snelling 1971. Contr. Sci., L.A. Co. Mus. 214:15; Wheeler and Wheeler 1973. Ants of Deep Canyon, 126–127.

Diagnosis. Worker: Numerous fully erect hairs on dorsal surfaces and appendages; HW not exceeding 1.4 mm; dorsal face of propodeum flat, juncture with oblique posterior face angulate; metanotal suture not depressed. *Female*. Penultimate segment of maxillary palp broadest basad of middle; femur and tibia with erect hairs on extensor surfaces; HW less than 2.0 mm. *Male*. Scape and tibia with erect hairs; hind wing without fringe hairs; some occipital hairs exceeding maximum diameter of lateral ocellus.

WORKER. *Measurements*. HL 0.83–1.40 (1.34); HW 0.63–1.33 (1.19); SL 1.03–1.70 (1.53); WL 1.30–2.17 (2.10); PW 0.47–0.90 (0.83).

Head: Longer than broad to as broad as long, CI 72–100 (92); distinctly shorter than scape, SI 116–143 (122). In frontal view, margins straight, subparallel in smallest workers, slightly convex in largest; occipital margin flat, with broadly rounded lateral angles. Eye large, 1.05–1.40 (1.09) × first flagellomere; OMD 1.00–1.45 (1.42) × EL. Mandible with eight, rarely nine, teeth.

Thorax: Moderately stout, PW 0.35–0.46 (0.46) × WL. Mesonotum, in profile, usually abruptly declivitous behind, rarely forming continuous slope to metanotum; metanotal suture not depressed. Propodeum higher than long, dorsal face flat or slightly convex, separated from posterior face by broadly rounded angle.

Petiole: In profile, narrowly cuneate, crest usually rounded, rarely sharp; in frontal view, crest entire or slightly depressed in middle.

Vestiture: Head, thorax and first three terga with abundant fine, appressed pubescence; fourth tergum with sparser, but still conspicuous pubescence.

Head with numerous erect hairs, malar area in frontal view with more than 10 fully erect hairs; occipital hairs rather uniform, longest equal to about 0.5 × MOD; eye with sparse, very short hairs. Erect thoracic hairs longest on pronotum, densest on mesonotum and dorsum of propodeum, sparsest on metanotum; longest pronotal hairs subequal to longest occipital hairs. Petiolar node with ten or more erect hairs on crest. Terga with numerous erect hairs (not exceeding 0.015 mm) on first three segments, longer on remaining segments and on sterna. Erect hairs numerous on appendages, including extensor surfaces of all femora; least numerous on posterior face of scape.

Integument: Front of head moderately shiny, with abundant fine punctures, frontal lobes more densely and coarsely punctate; frontal triangle polished, with a few extremely fine punctures; clypeus polished and impunctate along midline; on each side, less shiny, lightly shagreened and with scattered coarse punctures. Mandible coarsely striate and shiny. Integument otherwise lightly to moderately shagreened, moderately shiny.

Color: Light yellowish to light brownish or reddish yellow, head sometimes darker than thorax; when light brownish, appendages paler.

FEMALE. *Measurements*. HL 1.62–1.87; HW 1.63–1.96; SL 1.57–1.82; EL 0.53–0.96; OMD 0.53–0.72; WL 3.45–4.20; PW 2.05–2.50.

Head: Slightly longer than broad to slightly broader than long, CI 98–107; a little shorter than to a little longer than scape, SI 90–102. Head broadest at level of lower eye margin, sides in frontal view slightly convergent toward mandibular insertion; occiput distinctly convex in frontal view, sometimes slightly angulate in middle, lateral angles well rounded. Eye large, 1.23–1.45 × first flagellomere; OMD 1.00–1.34 × EL; OOD 2.6–4.0 × OD; IOD 2.2–3.7 × OD. Mandible with eight teeth, often with two or three denticles attached to basal and/or penultimate teeth. Penultimate segment of maxillary palp slender, broadest basad of middle.

Thorax: Robust, PW 0.56–0.69 × WL. In profile, scutum flattened behind, continuous with anterior part of scutellum, occasionally depressed below level of anterior margin of scutellum. Propodeum entirely declivitous, without basal, horizontal face.

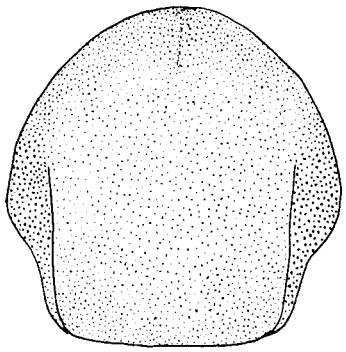
Petiole: In profile, narrowly cuneate, apex sharp; in frontal view, crest deeply, angularly incised.

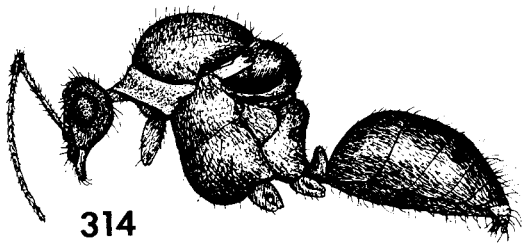
Vestiture: Pubescence about as described for worker, but dense on fourth tergum, longer on head.

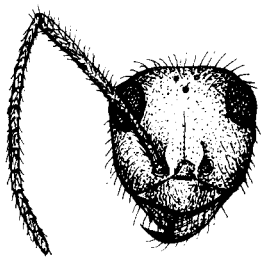
Cephalic hairs about as described for worker, longest occipital hairs distinctly less than 0.5 × MOD. Scutum and scutellum with scattered erect hairs, up to 0.20 mm, arising from coarse punctures; pleura with scattered longer hairs. Propodeum with numerous shorter hairs (less than 0.15 mm) on upper half. Petiolar scale with numerous erect hairs along sides and crest. Discs of terga with sparse subdecumbent to erect hairs, progressively longer on succeeding segments; sterna with hairs sparser, longer. Appendages with numerous erect hairs, including dorsa of all femora; inner face of fore femur with few or no erect hairs, when present they are fine and restricted to apical half or less. Wings without fringe hairs on apical or posterior margins.

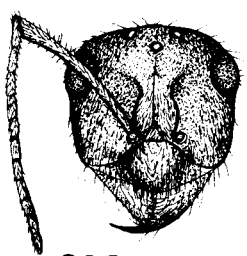
Integument: Front of head shiny between abundant fine punctures; punctures denser on frontal lobes; frontal triangle polished, with numerous micropunctures; clypeus slightly shiny, with impunctate median line, otherwise closely and coarsely punctate with roughened interspaces.

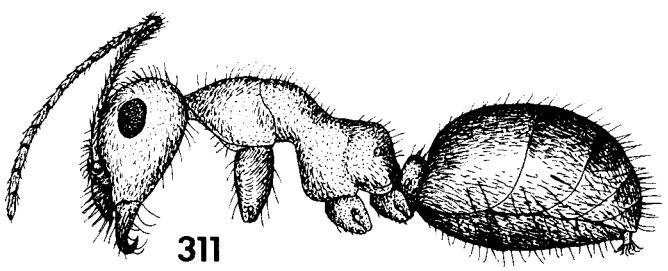
Pronotum closely micropunctate; scutum with abundant fine punctures and scattered coarser punctures,

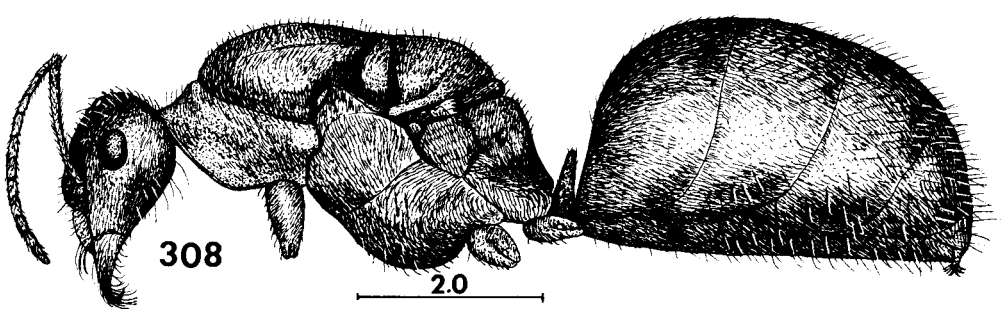












FIGURES 308–315. *M. testaceus*. 308, female, lateral view; 309, head of female, frontal view; 310, mesoscutum of female, distribution of punctures; 311, major worker, lateral view; 312, head of major worker, frontal view; 313, head of minor worker, frontal view; 314, male, lateral view; 315, head of male, frontal view.

parapsis densely punctate, punctures coarser than fine punctures of disc; scutellum with sparse, very fine punctures; pleura closely punctate, punctures about equal to those of parapsis. Propodeum lightly shagreened and with close, fine punctures.

Terga slightly shiny, closely micropunctate.

Color: Medium to dark brown; appendages light brownish yellow. Wings faintly brownish, veins and stigma medium to dark brown.

MALE. *Measurements.* HL 0.80–1.07; HW 0.75–1.07; SL 0.83–1.13; EL 0.32–0.43; OMD 0.15–0.27; WL 1.67–2.43; PW 1.03–1.56.

Head: A little longer than broad to a little broader than long, CI 91–104; slightly to much shorter than scape, SI 104–125; in frontal view, sides straight, slightly convergent toward mandibular insertions; occiput, in frontal view, strongly convex, without distinct lateral angles. Eye large, OMD 0.43–0.69 × EL; OOD 2.2–3.0 × OD; IOD 2.7–4.0 × OD. Mandible with one or more preapical teeth.

Thorax: Stout, PW 0.55–0.68 × WL. Propodeum with distinct horizontal basal face, rarely with sharply sloping basal face which is hardly separable from posterior face.

Petiole: Node, in profile, cuneate, crest angular; in frontal view, crest flat or slightly convex.

Vestiture: Erect hairs sparse on head, those of occiput short (up to 0.10 mm), much less than 0.5 × MOD; hairs of malar area shorter than those of occiput. Longest scutal hairs about equal to those of occiput; scutellar hairs longer, up to 0.16 mm; pleural hairs sparse, about equal to those of scutum. Propodeum with scattered short, erect hairs on basal and lateral faces. Petiolar node with scattered short, erect hairs on sides and crest. Terga with sparse subdecumbent to erect hairs, longer on succeeding segments, those on disc of second segment up to 0.13 mm; sterna with hairs longer. Appendages with abundant erect hairs. Wings without fringe hairs on apical or posterior margins.

Integument: Head moderately shiny, lightly shagreened, with obscure close micropunctures. Scutum slightly shiny, densely shagreened, with scattered fine punctures; scutellum shinier, punctures more obscure. Pleura shinier, with scattered obscure, coarse punctures. Terga moderately shiny, with abundant micropunctures.

Color: Medium to dark brownish (appearing blackish to unaided eye), appendages light brownish. Wings slightly yellowish tinged, veins and stigma light brownish yellow.

Terminalia: Figures 321, 332, 333.

Type Material. M. melliger testacea Emery: Described from an unknown number of cotypes from San Jacinto, Calif. Lectotype, by present designation: cotype worker agreeing with the above general description and parenthetical particulars: San Jacinto, Calif., Nov. 14, collection T. Pergande, in USNM (No. 54070). Lectoparatypes in AMNH and MCSN.

M. mexicanus subsp. *mojave* Wheeler: Described from "two dozen" cotypes from Ontario, Calif. Lectotype, by present designation: cotype worker (HL 1.17; HW 1.03; SL 1.50; WL 1.70; PW 0.77; CI 89; SI 129) agreeing with above general description: Ontario, Calif.: coll. J. C. Bradley, in AMNH. Lectoparatypes in AMNH, LACM, MCZ.

M. mexicanus subsp. *idahoensis:* Described from an undesignated number of specimens from Hollister, Idaho. Holotype worker in LACM; paratypes (all castes) in LACM, USNM.

Distribution. Southern Washington to northern Baja California, Mexico, east to Idaho and Utah (Fig. 373).

Localities. UNITED STATES. Washington: Benton Co.: Rattlesnake Mtn., 2700′, Hanford (AEC) Res., 10 mi NW Richland, 4 May 1972 (USNM). *Oregon: Deschutes Co.:* Redmond, 6 Sept. 1963 (J. R. Willard; LACM). *Lake Co.:* 5 mi S Plush, 4800′, 9 June 1967 (R. R. Snelling, No. 67–122; LACM); Warner Valley, Hart Mtn. Antelope Refuge, 16 Apr. 1954 (O. C. Nelson; OSC, USNM). *Harney Co.:* Indian Cr., 4300′, 5 mi S Alvord Ranch, 11 June 1967 (R. R. Snelling, No. 67–142; LACM). *Idaho: Butte Co.:* 5 mi E Arco, 5400′, 15 June 1967 (R. R. Snelling, No. 67–154; LACM). *Clark Co.:* 1 mi W DuBois, 5050′, 16 June 1967 (R. R. Snelling, No. 67–162; LACM). *Boise Co.:* Boise, 2695′, *Gooding Co.:* Hagerman (A. C. Cole; LACM); Wendell, 2 May 1934 (Fox; LACM). *Twin Falls Co.:* Hollister, 17 July 1932 (A. C. Cole; LACM, USNM; Holotype and paratypes, *M. mexicanus idahoensis*); Twin Falls, 12 June 1931 (A. C. Cole, No. 399; LACM); same locality, 6 Oct. 1932 (A. C. Cole, No. 1016; LACM); same locality, 30 mi S, 3 July 1931 (A. C. Cole, No. 399; LACM, USNM); Rogerson (A. C. Cole; LACM). *Utah: Duchesne Co.:* Hwy. 40, 3 mi E Duchesne, 18 June 1965 (G. & J. Wheeler, No. Utah–5; GCW). *Millard Co.:* Swasey Spring, 16 May 1938 (A. W. Grundmann; LACM). *Nevada: Humboldt Co.:* Winnemucca, 4334′, 27 May 1960 (T. R. Haig; CDA). *Elko Co.:* Hwy. 40, 24 mi E Wells, 18 June 1965 (G. & J. Wheeler; GCW). *Washoe Co.:* Lemmon Valley, 4900–5400′, 16 May to 25 Oct., various years (G. C. & J. Wheeler; GCW); 7 mi N Reno, 22 Oct. 1967 (G. C. & J. Wheeler, Nos. Nev. 245, 251; GCW); Peavine Peak, 6900′, 13 June 1968 (G. & J. Wheeler, No. Nev. 357). *Lyon Co.:* Frog Quarry, 8 mi NE Virginia City, 30 May 1951 (I. La Rivers, No. 1277; USNM); Dayton, 4300′, 20 Oct. 1965 (R. C. Bechtel; NDA). *Douglas Co.:* 25 mi S Carson City, 13 Aug. 1956 (A. C. Cole, No. Nev. 687; LACM); 16 mi SE Minden, 5700′, 7 Sept. 1967 (G. C. & J. Wheeler, No. Nev. 203, 207; GCW); 8 mi SE Minden, 5200′, 15 July and 22 Aug. 1967 (G. C. & J. Wheeler, Nos. Nev. 113, 186; GCW); 12 mi ESE Minden, 6400′, 23 Aug. 1968 (G. C. & J. Wheeler, No. Nev. 468; GCW). *Mineral Co.:* Aurora, 1400′, 15 June 1967 (R. C. Bechtel & P. C. Martinelli; NDA). *Nye Co.:* [Nevada Test Site, Mercury, Cole, 1966]; 2 mi SW Moore's Sta., 7000′, 18 June 1970 (G. C. & J. Wheeler, No. Nev. 1128; GCW). *Esmeralda Co.:* Pigeon Spg., 6500′, 28 May 1970 (G. C. & J. Wheeler, No. Nev. 1020; GCW). *Clark Co.:* Lee Cyn., near Las Vegas, 18 July 1954 (A. C. Cole, No. Nev. 401; LACM); Kyle Cyn., near Las Vegas, 19–23 July 1954 (A. C. Cole, Nos. Nev. 546, 619; LACM, MCZ). *California: Siskiyou Co.:* 15.2 mi NNE Montague, 2500′, 10 June 1969 (R. R. Snelling, No. 69–162; LACM); Weed, 3467′, 9 June 1969 (R. R. Snelling, No. 69–149; LACM); Mt. Shasta (city), 3561′, 10 Aug. 1957 (A. C. Cole, No. Cal. 323; LACM). *Lassen Co.:* 4.6 mi S Doyle, 4300′, 15 June 1969 (R. R. Snelling, No. 69–204; LACM). *Contra Costa Co.:* Antioch, 8 July 1965 (W. Turner;

UCB). *San Joaquin Co.:* Lathrop, 11 Apr. 1968 (J. Hegden; CDA). *Merced Co.:* 3.5 mi S Delhi, 50′, 29 Apr. 1960 (R. R. Snelling; LACM). *Fresno Co.:* Fresno, 295′, 6 Apr. 1960 (R. P. Allen; LACM); Parkfield Grade, 3500′, 30 Oct. 1969 (R. R. Snelling, No. 69–321; LACM). *Mono Co.:* Huntoon Forest Camp, 6800′, Toiyabe Natl. For., 18 June 1952 (W. S. Creighton; LACM). *Inyo Co.:* 16 mi E Big Pine, 1 Nov. 1968 (G. C. & J. Wheeler, No. Calif. 216; GCW). *Los Angeles Co.:* 2 mi S Pearblossom, 3500′, 17 Dec. 1963 (C. Henne & N. McFarland; LACM); 4 mi SE Pearblossom, 4300′, 20 Mar. 1966 (R. R. Snelling; LACM); Charlton Flat, 18 June 1944 (USNM); Tanbark Flat, 2700′, 13 July 1962 (T. C. Lawrence; UCB); same locality, 6, 7 July 1963 (R. R. Snelling; LACM); Millard Cyn., 3 Feb. 1963 (R. R. Snelling; LACM); Eaton Cyn., 6, 7 Feb., 18 May 1963 (R. H. Crandall, R. R. Snelling; LACM); nr. Sunland, 7 May 1938 (J. Schwartz; USNM); Altadena, 1 July 1945, 8 Aug. 1946 (C. A. Hamsher; USNM); same locality, 2 Feb. 1963 (R. R. Snelling; LACM); Irwindale, 17 Feb. 1963 (R. H. Crandall & R. R. Snelling; LACM); same locality, 19 Feb. 1967 (R. R. Snelling; LACM); Claremont, no date (C. Metz; AMNH); same locality, no date (Chamberlin; AMNH); same locality, 8 Dec. 1910 (W. M. Wheeler; GCW, MCZ). *San Bernardino Co.:* Ontario, no date (J. C. Bradley; MCZ, AMNH, cotypes of *M. mexicanus mojave*); same locality, no date (L. S. Jones & L. D. Christensen; USNM); Cajon Cyn., 4000′, 7 mi NW Cajon, 21 Apr. 1969 (R. R. Snelling, Nos. 67–116, 117; LACM); Piñon Wells, Joshua Tree Natl. Mon., 28 Mar. 1965 (S. L. Jenkins; LBSC). *Riverside Co.:* San Jacinto, 14 Nov. (Colln. T. Pergande; USNM, AMNH, MCSN; cotypes of *M. melliger testacea*); Perris, Aug. 1915 (CU); Railroad Cyn., 4 mi E Elsinore, 14 Apr. 1965 (J. Powell; UCB); Herkey Creek, 4400′, 11 May 1952 (W. S. Creighton; LACM). *San Diego Co.:* Point Loma, no date (P. Leonard; AMNH, MCZ); Boulder Oaks, 3100′, 11 June 1952 (W. S. Creighton; LACM); Descanso, no date (Colln. T. Pergande; USNM); 5 mi N Descanso, 3000′, 18 Feb. 1962 (J. H. Hunt, No. 512; LACM); Campo, 2500′, 10, 19 June 1952 (W. S. Creighton; LACM). *MEXICO. Baja California:* 11 mi E Tecate, 3 May 1964 (R. R. Snelling; LACM); Descanso Bay, 1 Apr. 1931 (A. H. Sturtevant; USNM).

Ecology. Leonard (1911) observed this species (reported as *mexicanus mojave*) at Pt. Loma, California. According to his report the species is nocturnal, tends aphids and obtains nectar directly from several plants. Aestivation for a period of several days during exceptionally hot weather was reported. Leonard also obtained repletes from nests at Pt. Loma. Wheeler (1912) noted that nests were found near Claremont, Calif., in hard, dry soil, along roads and paths, that entrances ¼″×¾″ in diameter were surmounted by craters from 4″–8″ in diameter.

In Washington, Oregon, Idaho and Nevada this species is found in Sagebrush Steppe; in Nevada it also enters Piñon-Juniper Woodland. Habitats in California range from Coastal Sagebrush to Sagebrush Steppe, with the preponderance of the records from chaparral areas. In elevation *testaceus* ranges from 1400′ to 6900′; in southern California the range is from sea level to 4300′. The bulk of the southern California records are from stations below 4000′.

Rather than nocturnal, as reported by Leonard, this ant is probably better characterized as crepuscular. Workers begin to assemble at the nest entrance about 15–20 minutes prior to sunset and may completely block the entrance with their heads. Foraging begins within a few minutes of sundown and immediately before the onset of active foraging the interior of the crateriform tumulus may become completely blanketed with ants. At the proper moment, the mass of ants departs from the crater, as nearly simultaneously as possible, each ant proceeding individually. Within a few minutes after the exodus begins, the area around the nest, for up to a meter, is virtually covered with ants. Dispersal into surrounding areas and vegetation, however, is rapid and at a distance of four meters the ants are widely scattered.

For about an hour after this initial exodus of foragers, individual ants continue to leave the nest at irregular intervals. The total number of ants departing during this hour is much less than that of the initial group. Within about 15 min. of the onset of foraging activities, workers begin to return and thus continue for about two, rarely as many as four, hours. Apparently all individuals who will be foraging depart within the first hour following onset of activities, and all return within four hours.

During the period of foraging activity, non-foraging workers may be engaged in excavation. Soil particles are carried to the surface. Since this species often nests in areas of clayey soil nearly devoid of small pebbles, it follows that the crateriform tumuli do not always consist of such material. In the chaparral of southern California the tumuli are built up of soil particles which are aggregated into small pellets. Such pellets are carried to the top of the crater and dropped over the side. These pellets disintegrate fairly rapidly through weathering and must constantly be replaced. In areas in which the soil includes coarse sand and small pebbles, the tumuli are constructed of these materials and are less subject to wind and rain damage.

The sexual forms are present in the nests in southern California in early spring and mid autumn, and fly following rains during these seasons. The flights take place in late afternoon. Shortly before the flight, workers emerge from the nest in large numbers and run out over an area up to one meter from the nest. Up to fifteen minutes before the flight, males emerge sporadically; some run about on the surface near the nest, a few take flight and alight on vegetation up to ten meters from the nest. The exit of the females is preceded by another outpouring of workers and more males. Females emerge and take flight, usually from the rim of the crater. Mating takes place in the air or on vegetation near the nest.

In more northern areas the males and females are present during late spring and early summer, less commonly during the fall months (Table 9). According to Cole (1934b) alates are present throughout June and July near Twin Falls, Idaho.

TABLE 9

Activity of Reproductives of:

Locality	Date	Activity
M. testaceus Emery		
IDA., Hammett	10 Apr. 1932	♂♂, ♀♀ in nest
IDA., Wendell	2 May 1934	♀♀ in nest
IDA., Twin Falls	4 Oct. 1932	♂♂, ♀♀ in nest
ORE., Hart Mt. Antelope Ref.	16 Apr. 1954	♀♀ in nest
ORE., Indian Creek	11 June 1967	♀♀ larvae in nest
ORE., Redmond	6 Sept. 1963	♂♂, ♀♀ in nest
NEV., Lemmon Valley	15 May 1968	♂♂ in nest
NEV., Hot Creek Valley	18 June 1970	♂♂ in nest.
NEV., 25 mi S Carson City	13 Aug. 1956	♀♀ in nest
NEV., Dayton	20 Oct. 1965	♂♂, ♀♀ in nest
NEV., Lemmon Valley	25 Oct. 1967	♂♂, ♀♀ in nest
CALIF., Millard Cyn.	3 Feb. 1963	♂♂ in nest
CALIF., Eaton Cyn.	7 Feb. 1963	♂♂, ♀♀ in nest
CALIF., Irwindale	17 Feb. 1963	♂♂ in nest
CALIF., 5 mi N Descanso	18 Feb. 1972	♀ on ground
CALIF., Cajon Cyn.	21 Apr. 1969	♀♀ in nest
CALIF., Parkfield Grade	30 Oct. 1969	♂♂, ♀♀ in nest

Discussion. This species has had an unfortunate taxonomic history. Emery described *testaceus* as a variety of *melliger,* rather than of *mexicanus,* to which it is closely related and which it greatly resembles. A few lines before this description he had enumerated the characteristic differences in mandibular dentition, eye size and color which separate the two species, so it may not be argued that he was ignorant of these differences. Emery's original error is, however, no excuse for what followed.

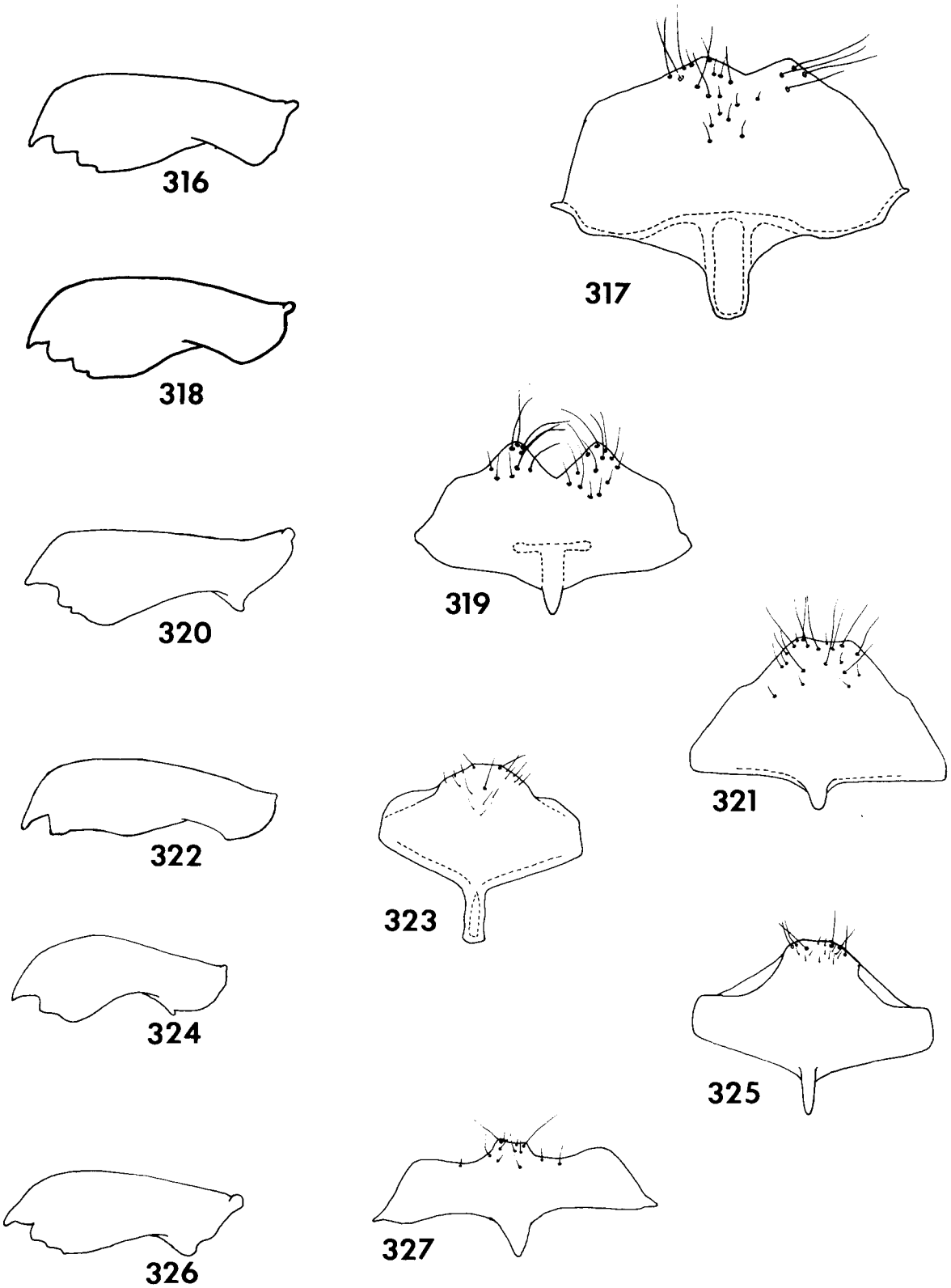
When he treated *Myrmecocystus* in 1908, Wheeler had a cotype of *testaceus,* now in the AMNH; the specimen is well preserved and clearly exhibits the essential characteristics of *testaceus.* He assigned to this name a few specimens from Claremont. The Claremont specimens are uniformly reddish, not at all yellowish as in the type, the eyes are small and the mandibles possess seven teeth. His reasons for assuming these Claremont specimens to be conspecific with the cotype of *testaceus* were never stated. Even more remarkably, he regarded *testaceus* as a variety of *semirufus,* also described by Emery from San Jacinto, on the basis of supposed intermediate specimens taken at Phoenix, Arizona and Needles, California. That specimens taken several hundred miles from the only known, at that time, area of sympatry could be intermediates is difficult to accept.

The difficulties were compounded, for in the same paper Wheeler described *mojave* as a subspecies of *mexicanus.* The type locality of *mojave* is Ontario, California. While correctly recognizing that this ant was related to *mexicanus,* Wheeler did not recognize that it was, in fact, conspecific with the *testaceus* cotype.

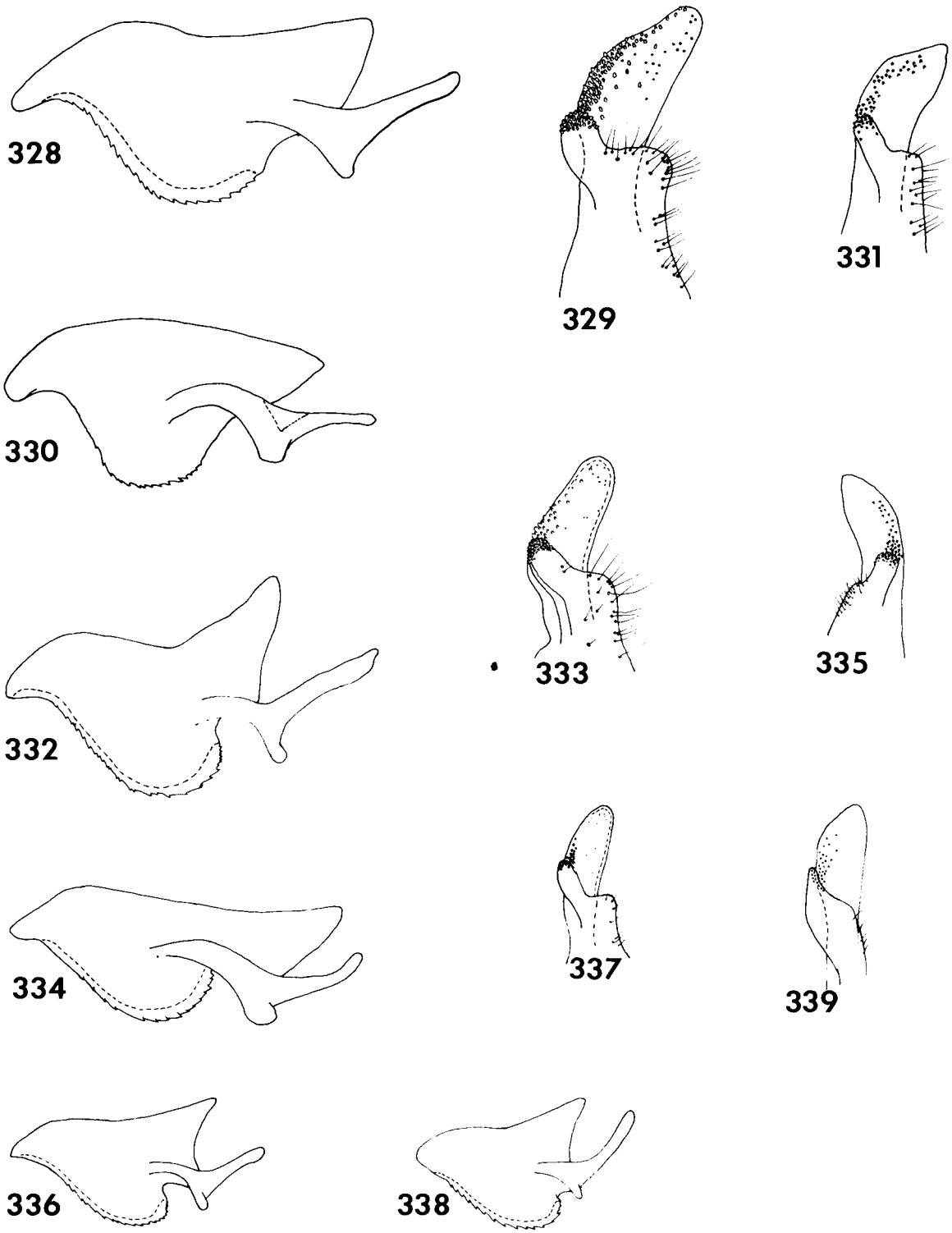
Material identified by Wheeler during subsequent years in various collections indicate that he apparently never realized the error. Cole (1936) described *idahoensis* as a variety of *mexicanus* from Idaho. This name was recognized by Creighton (1950) to be the same as *mojave* and was correctly synonymized. Creighton seems not to have studied the *testaceus* cotype; on the basis of the supposed intermediates between *semirufus* and *testaceus,* he placed *testaceus* in synonymy.

I have seen the cotype of *testaceus;* it is certainly conspecific with Wheeler's *mojave,* and not at all related to *semirufus.* At the same time, the uniformly reddish ant established by Wheeler as *testaceus* was found not to be conspecific with true *testaceus.* This species I described (1971) as *wheeleri.*

This ant most closely resembles *mexicanus* but is smaller (HW>1.5 mm in largest specimens) and more robust. In *testaceus* the pronotal width is 0.35–0.46 times Weber's Length, which barely overlaps the range of *mexicanus* (PW 0.30–0.37 × WL). The metanotum is distinctly impressed in *mexicanus* (Fig. 277), not at all in *testaceus* (Fig. 311). The juncture of the basal and posterior faces of the propodeum is sharply rounded or subangulate in *testaceus* and the propodeum is higher than long.



FIGURES 316–327. Male mandible and seventh sternum, respectively of: 316, 317, *M. mexicanus;* 318, 319, *M. melanoticus;* 320, 321, *M. testaceus;* 322, 323, *M. navajo;* 324, 325, *M. pyramicus;* 326, 327, *M. ewarti.*



FIGURES 328–339. Male aedeagus and volsella, respectively, of: 328, 329, *M. mexicanus; 330, 331, M. melanoticus;* 332, 333, *M. testaceus;* 334, 335, *M. navajo;* 336, 337, *M. pyramicus;* 338, 339, *M. ewarti.*

FIGURES 340–343. Habitats. 340, Alkali Lake, Ore. *(testaceus* and *kennedyi)*; 341, 37 mi SW Alpine, Tex. *(depilis)*; 342, nr. Shaver's Well, Calif. *(ewarti, flaviceps, semirufus)*; 343, Texas Cyn., Ariz. *(mexicanus, navajo, mimicus, mendax)*.

FIGURES 344–347. Habitats. 344, nr. Colorado Spgs., Colo. *(mendax)*; 345, 12 mi S Merced, Calif. *(mimicus)*; 346, Arroyo Calamajué, Baja Calif. *(flaviceps)*; 347, 8 mi WSW El Arco, Baja Calif. *(flaviceps)*.

FIGURES 348–351. Nest tumuli. 348, *pyramicus*, Alkali Lake, Ore.; 349, *mexicanus*, Texas Pass, Ariz., 350, *mexicanus*, nr. Portal, Ariz.; 351, *testaceus*, Tanbark Flat, Calif. (photo by G. I. Stage). Cards are 3" × 5".

FIGURES 352–355. Nest tumuli. 2, *depilis*, 37 mi SW Alpine, Tex.; 353, *depilis*, 6.1 mi NE Apache, Ariz.; 354, *minicus*, 12 mi S Merced, Calif.; 355, *wheeleri*, nr. Delhi, Calif. Cards are 3" × 5".

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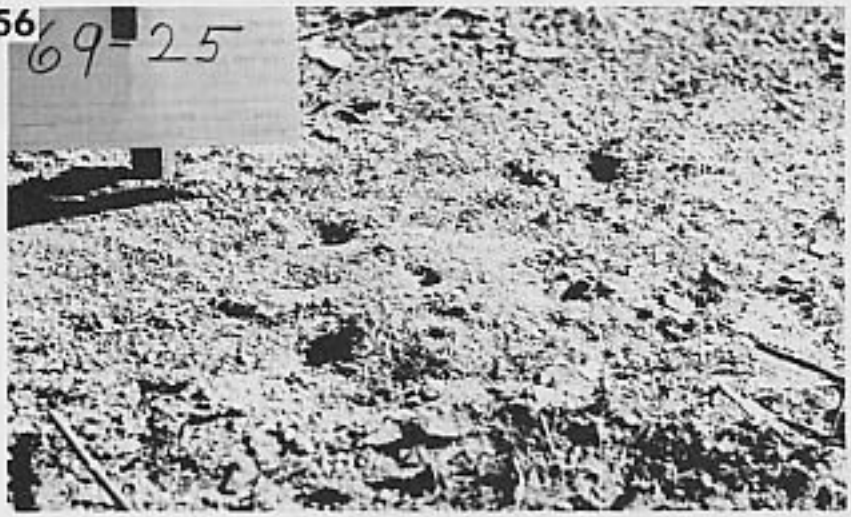

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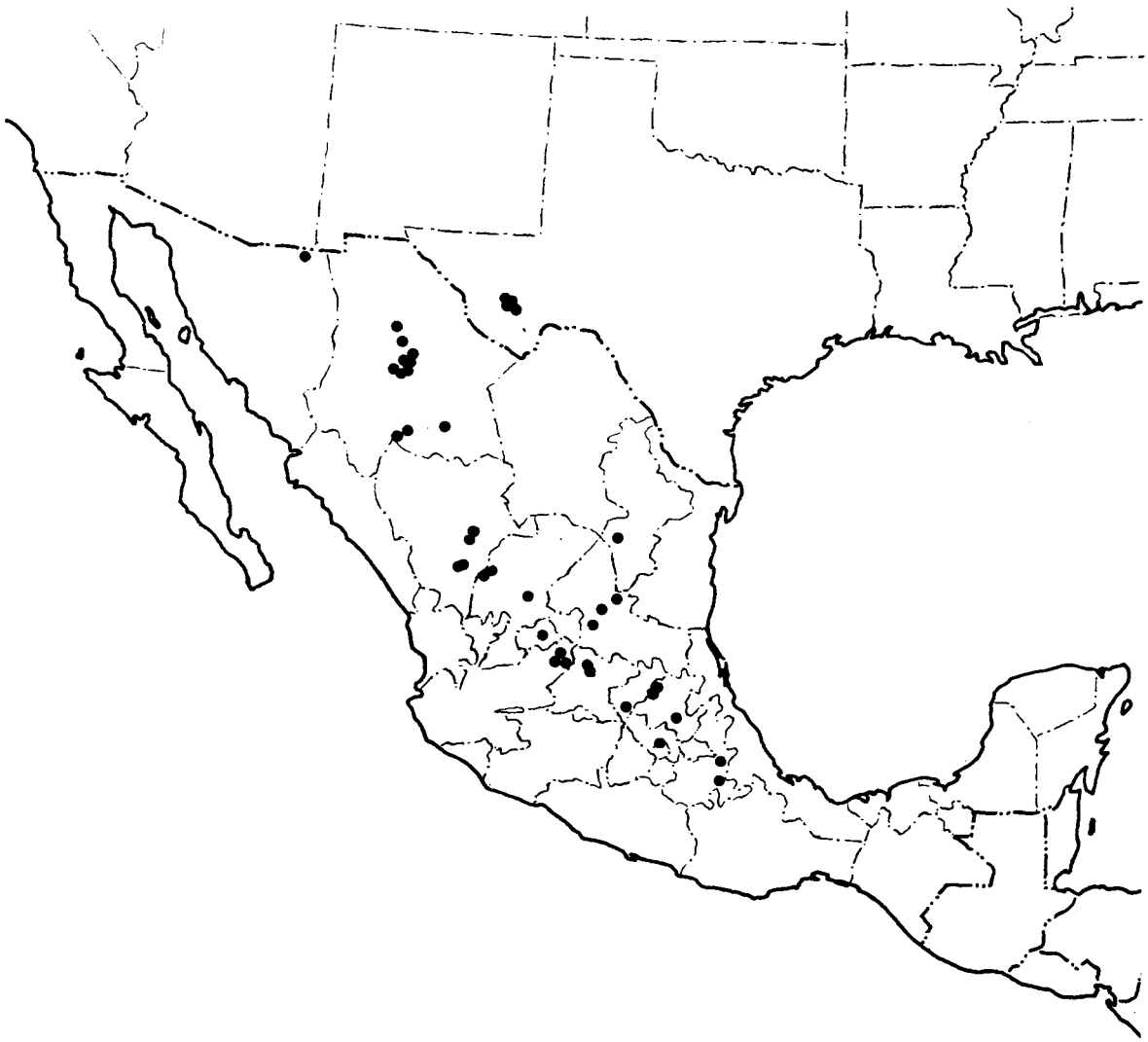
FIGURES 356–358. Nest tumuli. 356, *flavicepsi*, 8 mi WSW El Arco, Baja Calif.; 357, *melliger*, Davis Mts., Tex.; 358, *mendax*, 0.6 mi N Dilia, N. Mex. Cards are 3" × 5".

FIGURE 359. Approximate distribution of genus *Myrmecocystus:* subg. *Endiodioctes*—heavy broken line; subg. *Myrmecocystus*, s. str.—light broken line; subg. *Eremnocystus*—dotted line.

FIGURE 360. Distribution of *Myrmecocystus semirufus* (solid dot) and *M. intonsus* (circled dot).



melliger

FIGURE 361. Distribution of *Myrmecocystus melliger*.

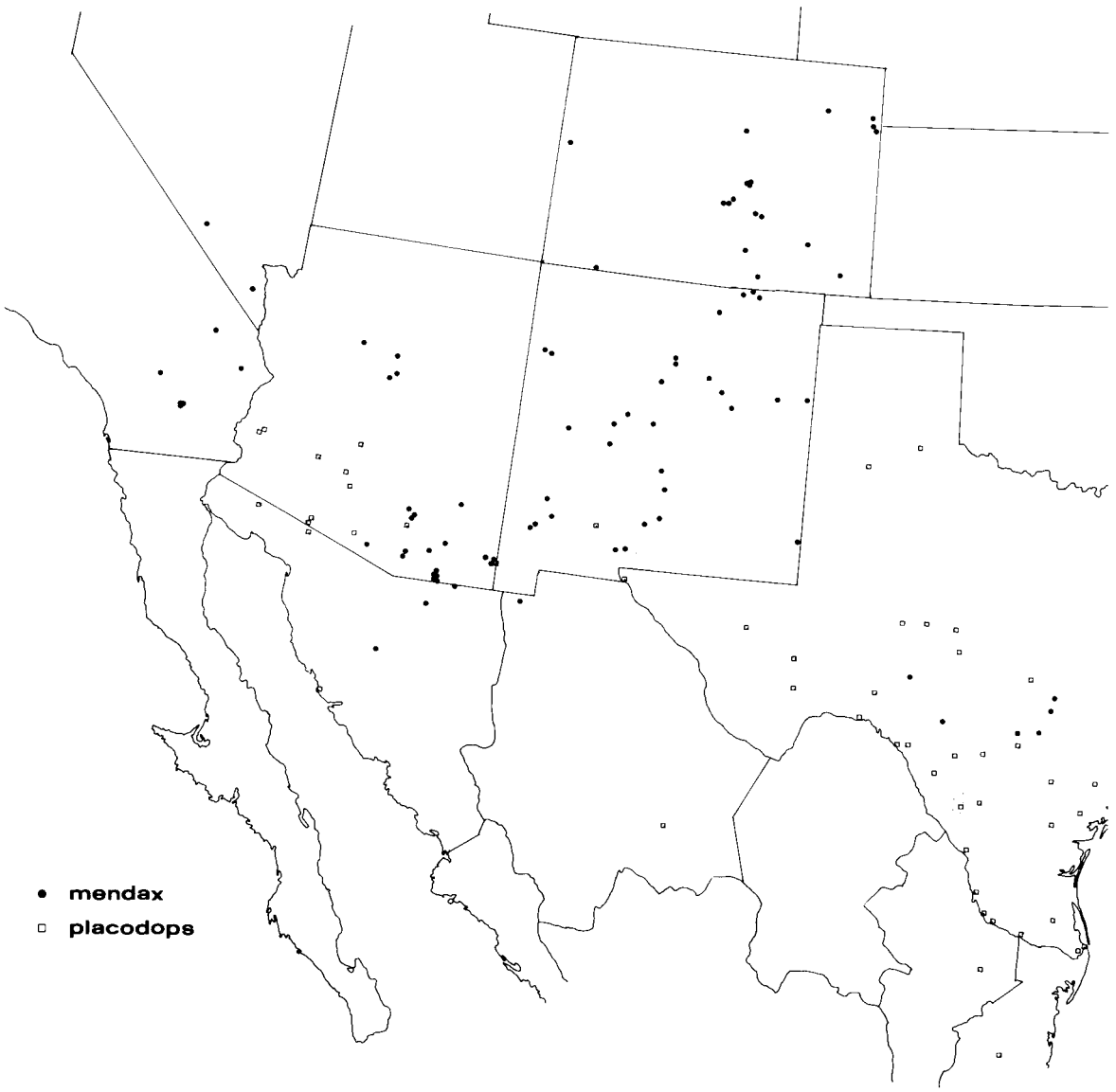


FIGURE 362. Distribution of *Myrmecocystus mendax* (solid dot) and *M. placodops* (square).

FIGURE 363. Distribution of *Myrmecocystus depilis* (solid dot) and *M. nequazcatl* (circled dot).

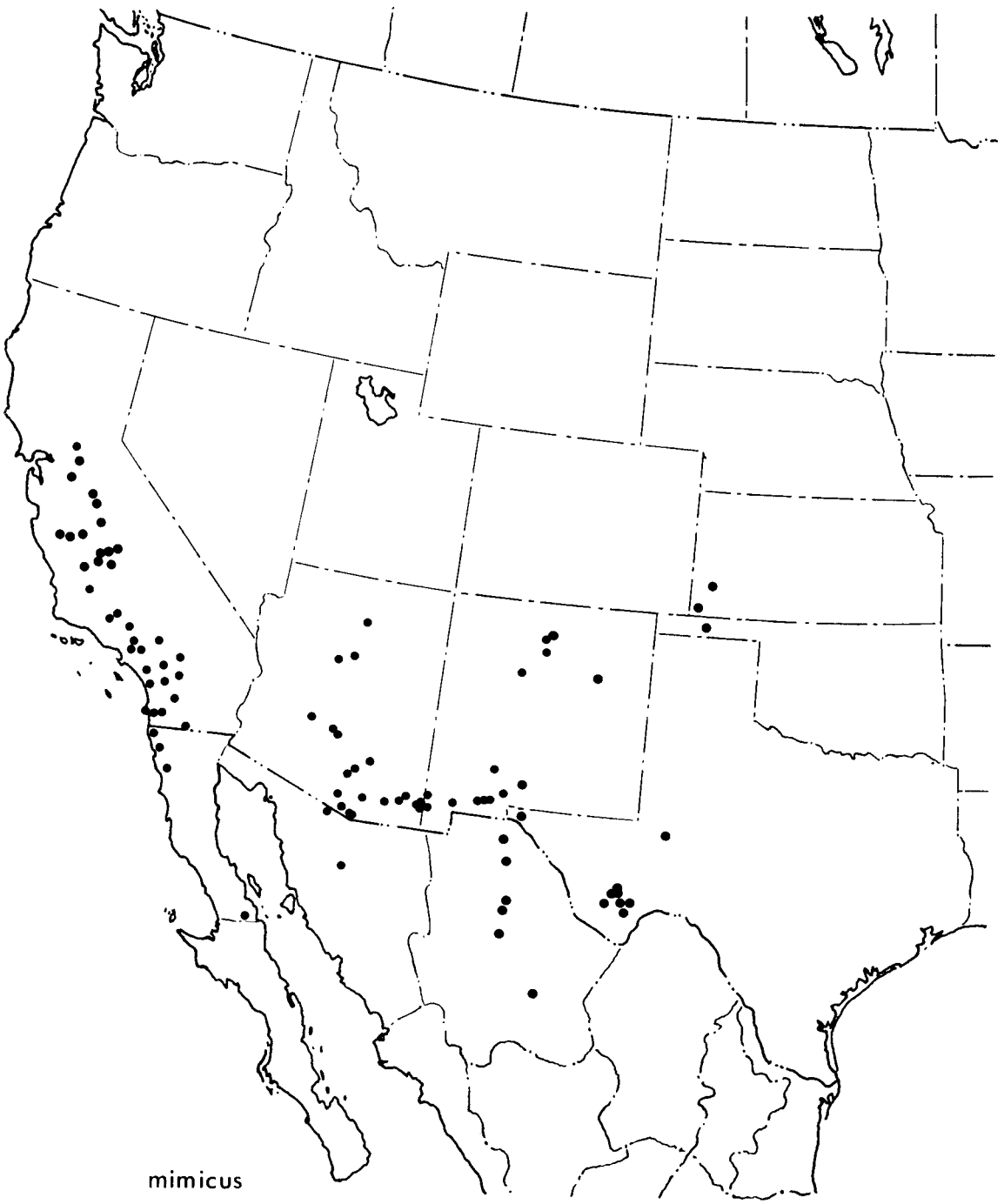


FIGURE 364. Distribution of *Myrmecocystus mimicus*.

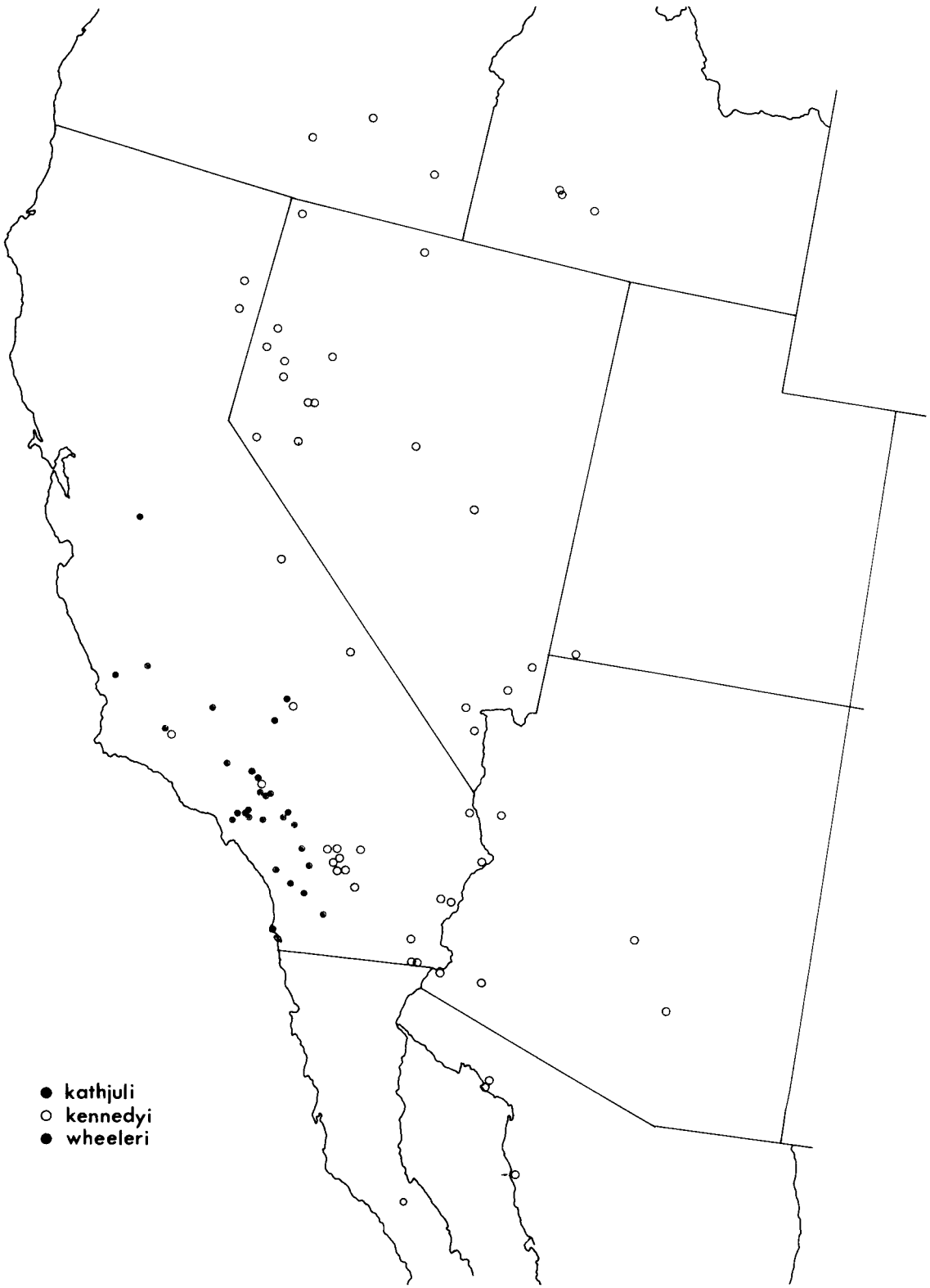


FIGURE 365. Distribution of *Myrmecocystus kathjuli* (solid dot), *M. kennedyi* (circle) and *M. wheeleri* (circled dot).

FIGURE 366. Distribution of *Myrmecocystus flaviceps*.

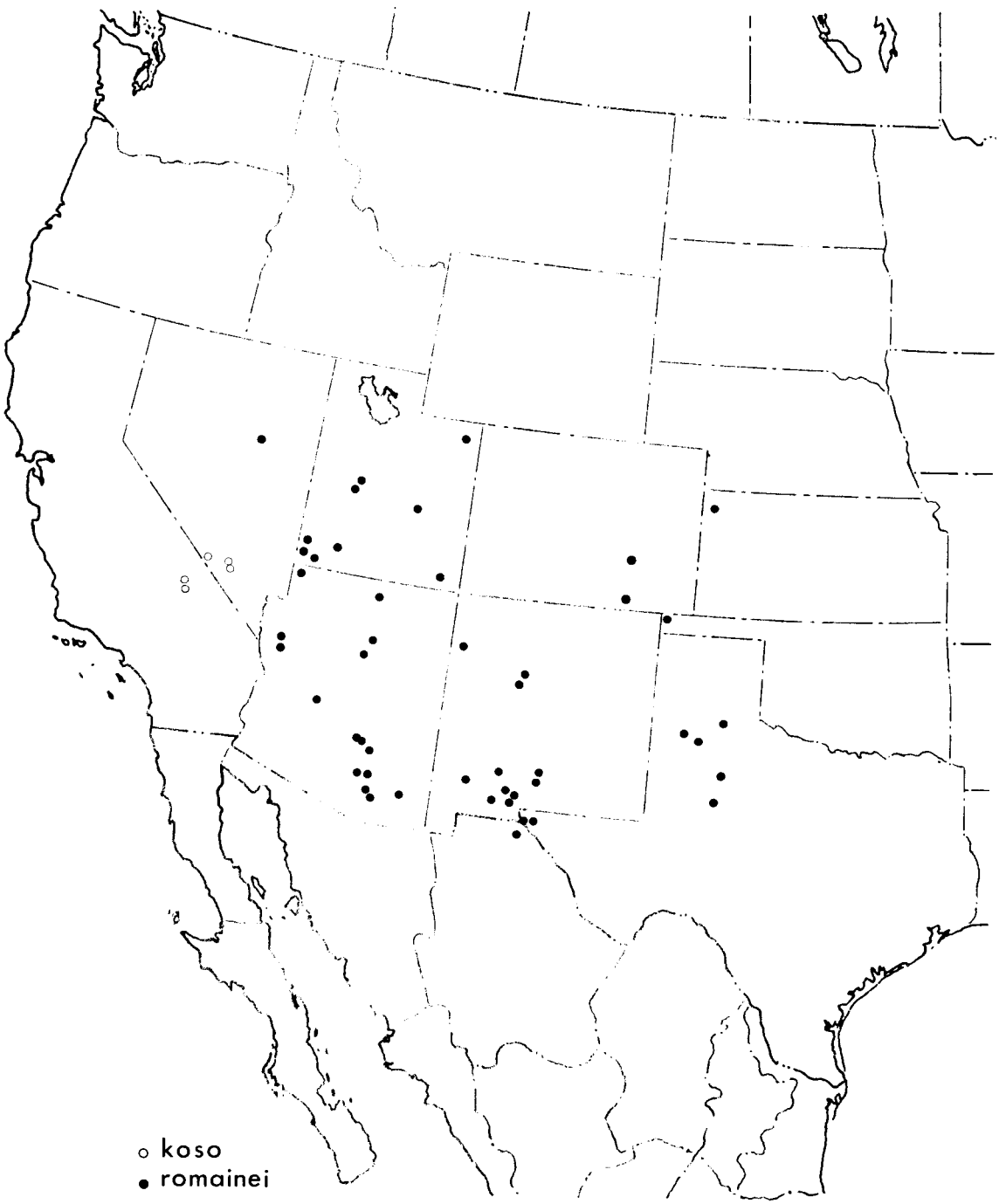


FIGURE 367. Distribution of *Myrmecocystus koso* (circle) and *M. romainei* (solid dot).

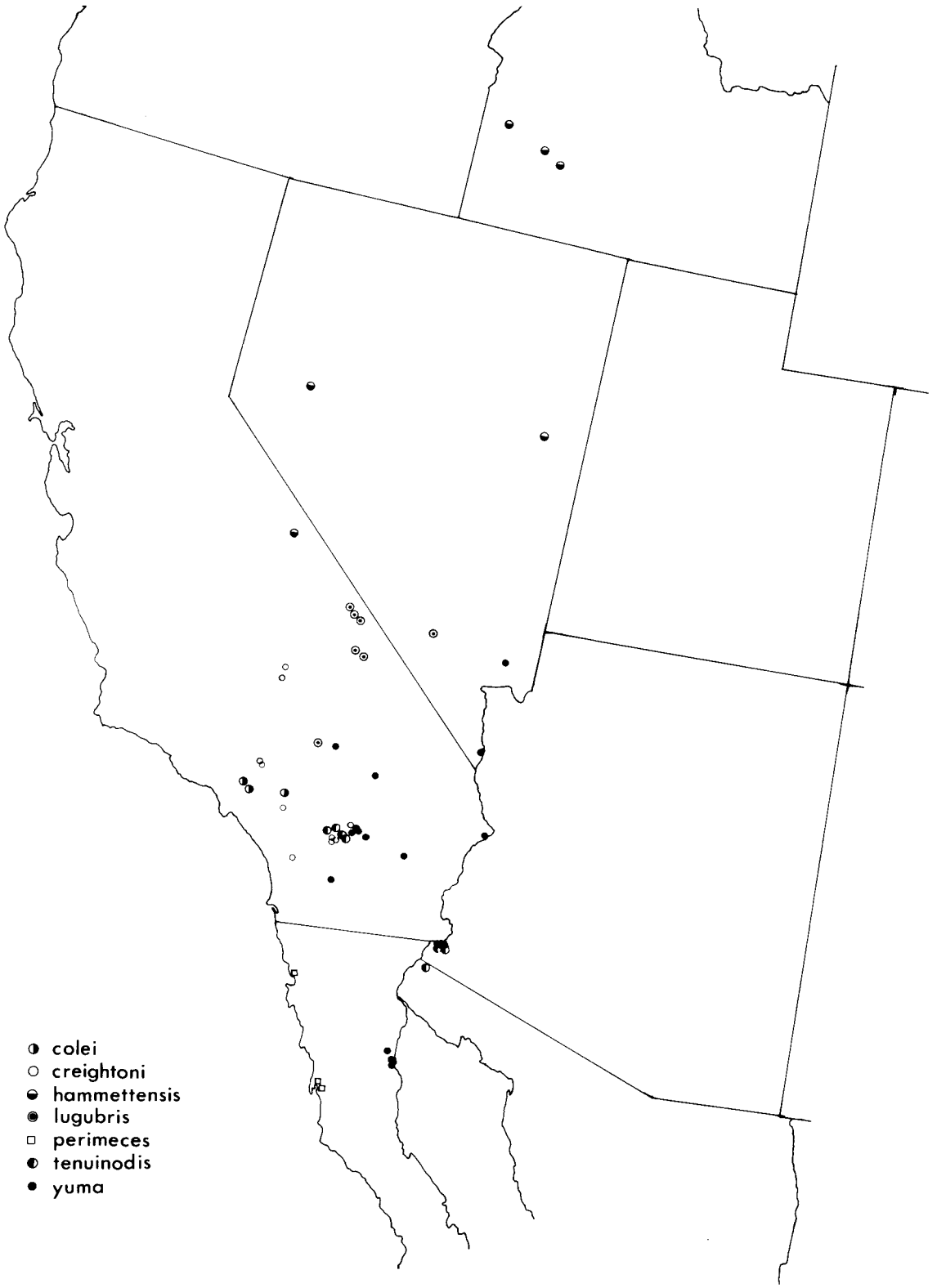


FIGURE 368. Distribution of *Myrmecocystus colei* (circle, right half solid); *M. creightoni* (circle); *M. hammettensis* (circle, lower half solid); *M. lugubris* (circled dot); *M. perimeces* (square); *M. tenuinodis* (circle, left half solid); *M. yuma* (solid dot).

FIGURE 369. Distribution, in Mexico, of *Myrmecocystus mexicanus* (solid dot) and *M. melanoticus* (circle, lower half solid).

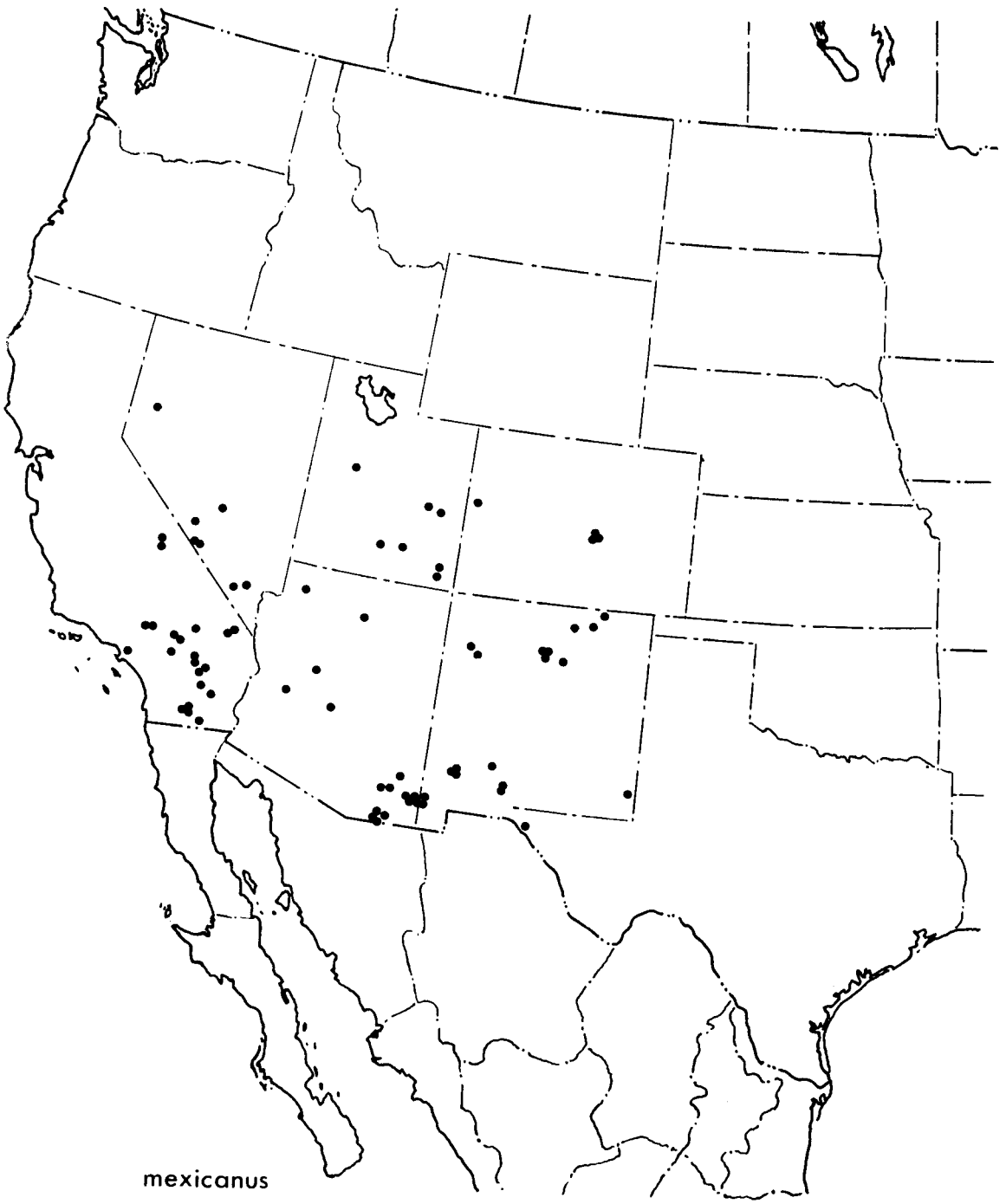


FIGURE 370. Distribution, in United States, of *Myrmecocystus mexicanus*.

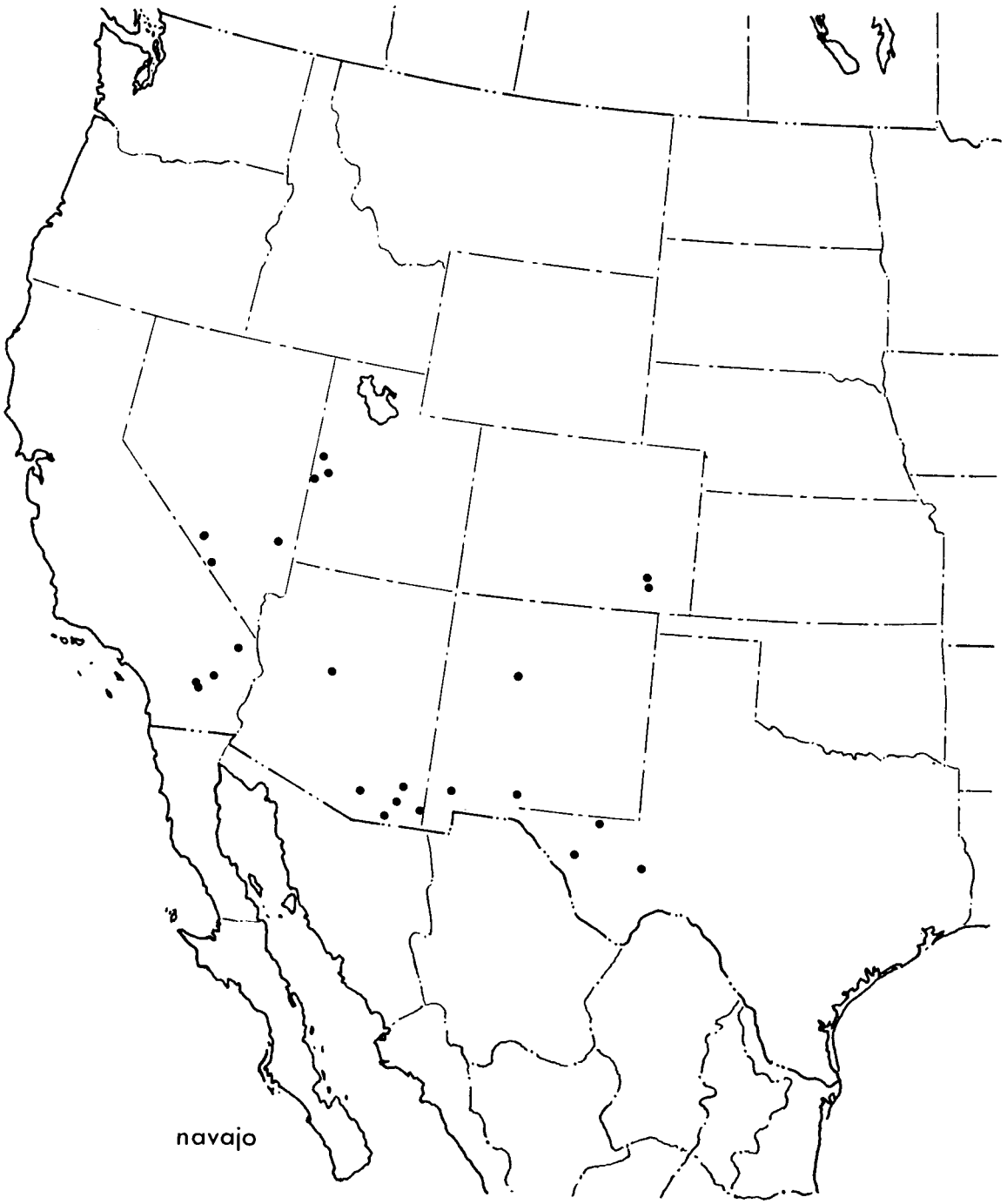


FIGURE 371. Distribution of *Myrmecocystus navajo*.

FIGURE 372. Distribution of *Myrmecocystus ewarti* (circle) and *M. pyramicus* (solid dot).

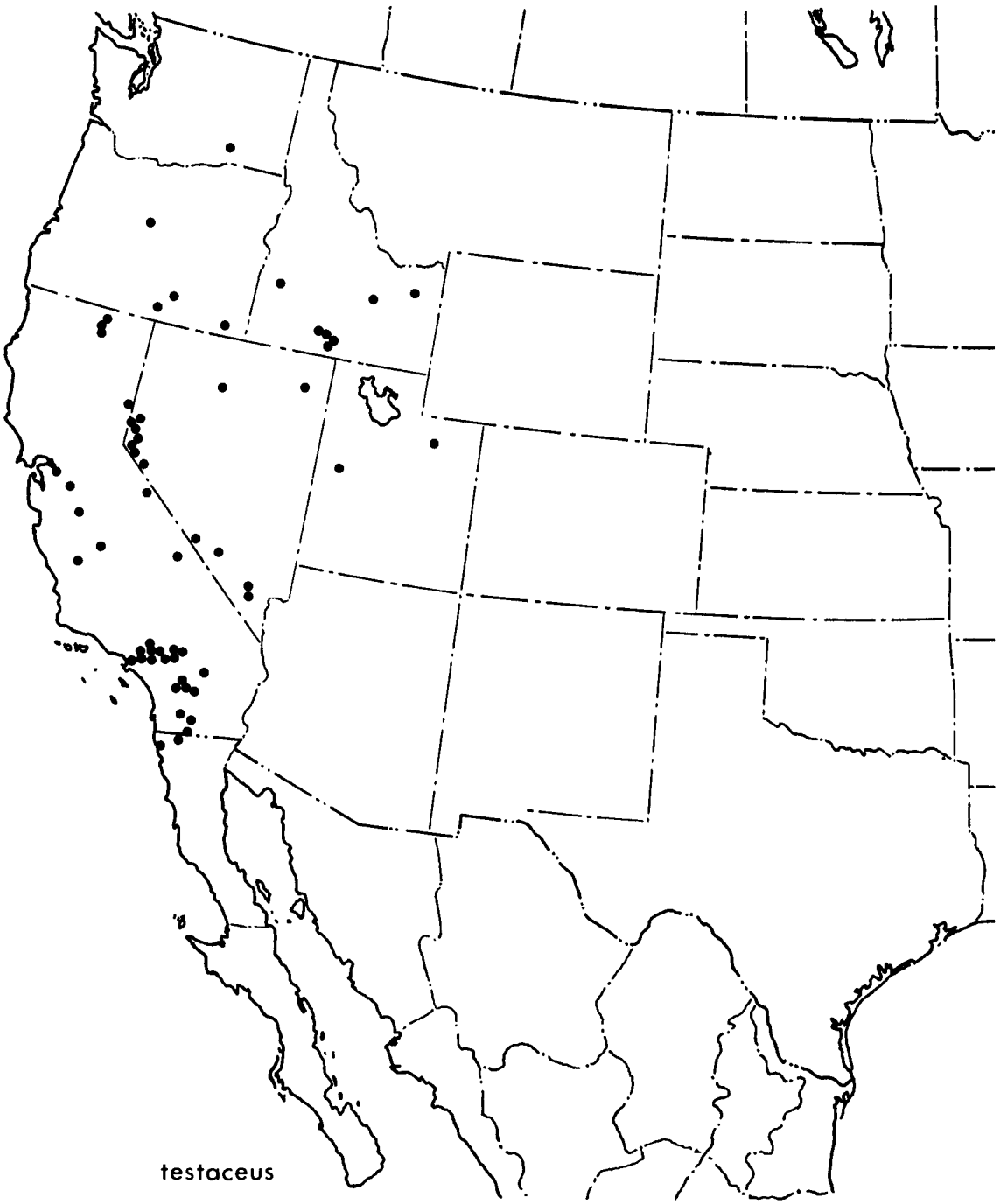


FIGURE 373. Distribution of *Myrmecocystus testaceus*.

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Accepted for publication June 30, 1975

INDEX TO *MYRMECOCYSTUS* SPECIES

The following index cites only primary references within the taxonomic section of this revision. Synonymic names are italicized.

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