

LACM). MEXICO. Sonora: 5 mi E San Luis, 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 micro-punctate 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).

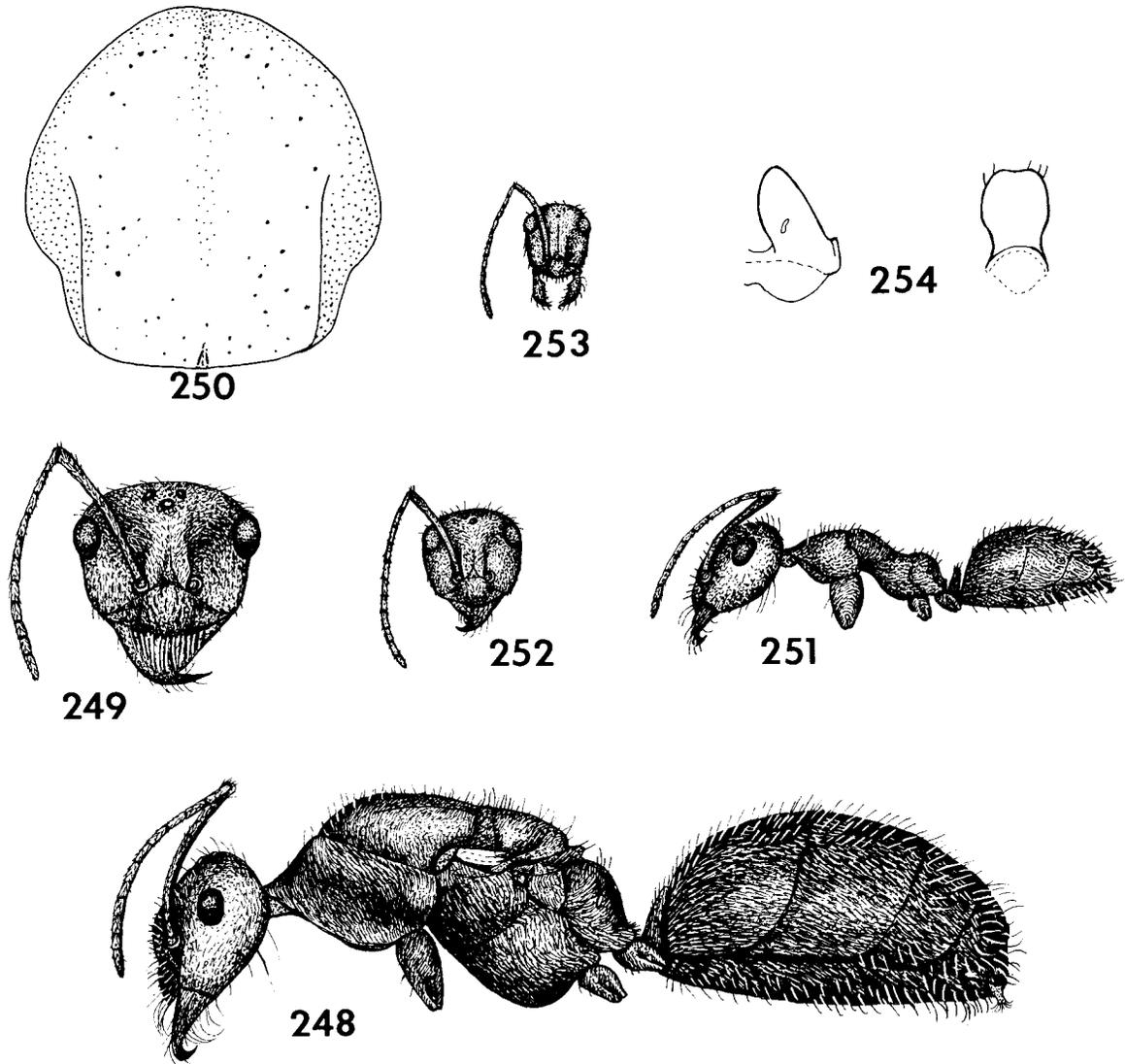
Head: Little broader than long or as broad as long, CI 92–100 (100); a little shorter than scape, SI 103–120; in frontal view, sides slightly convex and a little narrowed toward mandibular insertions; occiput, in frontal view, evenly and gently convex from side to side, without lateral angulations. Eye 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 $1.5 \times$ first flagellomere; OMD $1.33 \times$ EL. Lateral ocelli slightly larger than anterior ocellus; IOD $4.5 \times$ OD; OOD $6.0 \times$ OD. Mandible septentate. 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 $0.57 \times$ 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 $0.5 \times$ MOD. Scutum with scattered erect hairs, longest equal to about $0.5 \times$ 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 Felipe, 200', 15 June 1952 (W. S. Creighton; LACM); 5 mi N San Felipe, 0', 16 June 1952 (W. S. Creighton; AMNH, LACM); San Felipe, 0', 14 June 1952 (W. S. Creighton; LACM).

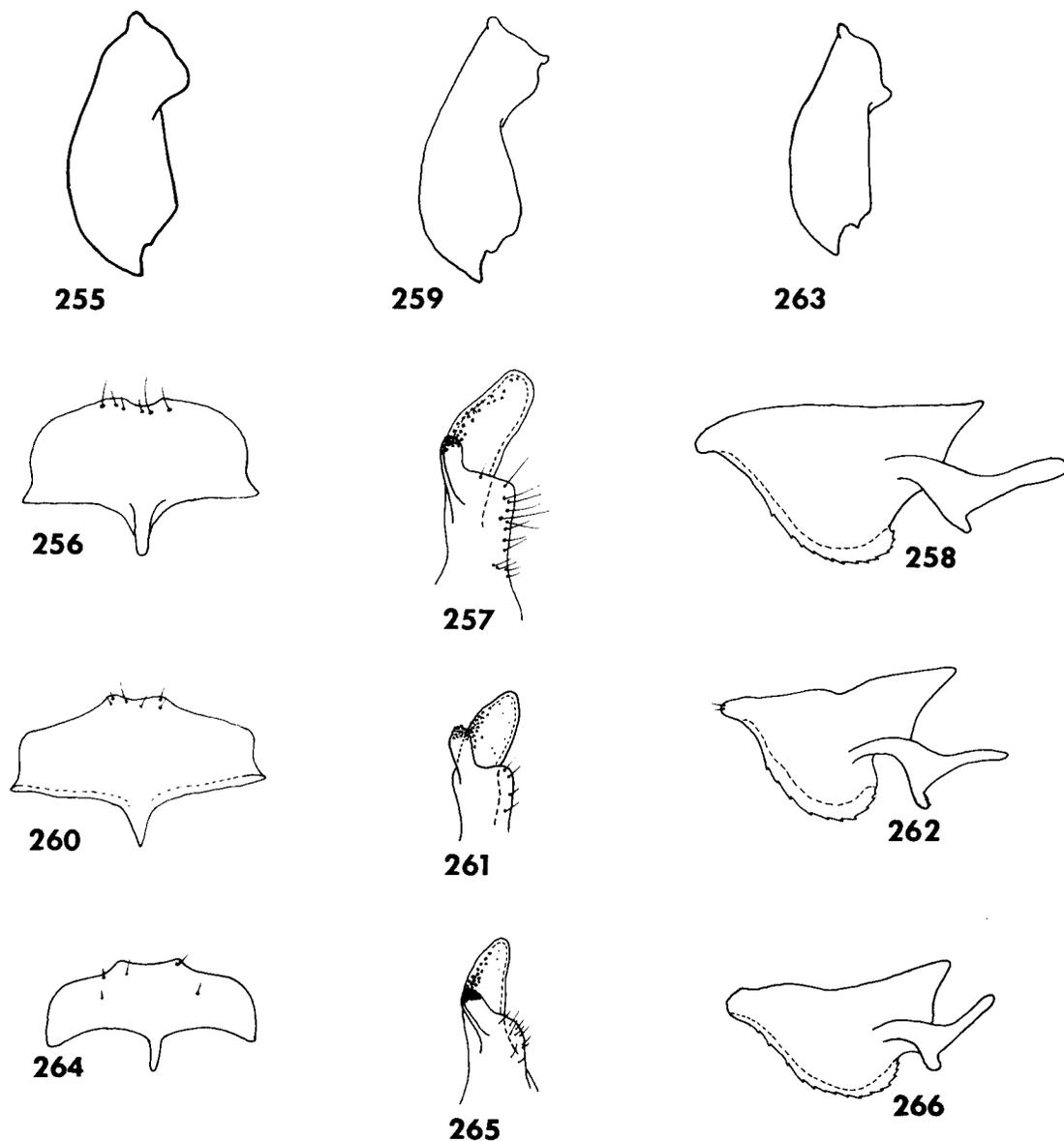
Ecology. Wheeler (1912) observed that nests at the type locality were surmounted by craters three to four inches in diameter and that remains of dead insects were abundant around the edges of the craters. From the latter he surmised the ant to be predatory.

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 *Endiiodictes* 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 $1.5 \times$ the first flagellomere. In these same two species the OMD is shorter than in species of the other groups, not exceeding $1.15 \times$ 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 decedentate 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 septedentate, 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 $1.5 \times$ 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 $1.25 \times$ 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-