

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), *Campnotus mina* Forel and *C. festinatus* (Buckley).

Workers were observed also near La Berrera 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 ambient 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 $0.5 \times \text{MOD}$. The sexual forms are unknown and, until they become available, the relationships of this species will remain obscure.

Myrmecocystus (Endiodyctes) 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, $0.92\text{--}1.00 \times$ first flagellomere; OMD $1.54\text{--}2.14 \times$ EL. Mandible with seven teeth.

Thorax: Slender to moderately robust, PW $0.38\text{--}0.48 \times$ 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 $0.5 \times \text{MOD}$. 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 $0.5\text{--}1.0 \times$ puncture diameter; face with abundant micropunctures, separated by $1.5\text{--}2.5 \times$ 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 $1.15\text{--}1.19 \times$ first flagellomere; OMD $1.48\text{--}1.53 \times$ EL. OOD $4.3\text{--}5.7 \times$ OD; IOD $2.8\text{--}4.0 \times$ 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 $0.62\text{--}0.65 \times$ 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 $0.5 \times$ 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 $0.5 \times$ MOD. Propodeum with sparse, suberect and erect hairs, about $0.5 \times$ MOD, across basal face; laterally, hairs longer, $0.75\text{--}1.0 \times$ MOD. Crest and side of petiole with erect hairs about $0.5 \times$ MOD. Terga with sparse, erect hairs, longest on disc of second tergum about $0.8 \times$ 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 $0.7\text{--}1.5 \times$ puncture diameter, and with sparse coarse punctures. Mesopleura dull, densely shagreened; micropunctures of anepisternum largely obscured by shagreening; micropunctures of katapisternum 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 $0.75 \times$ EL; OOD $2.7 \times$ OD; IOD $3.0 \times$ OD. Apical margin of mandible without preapical cleft or tooth.

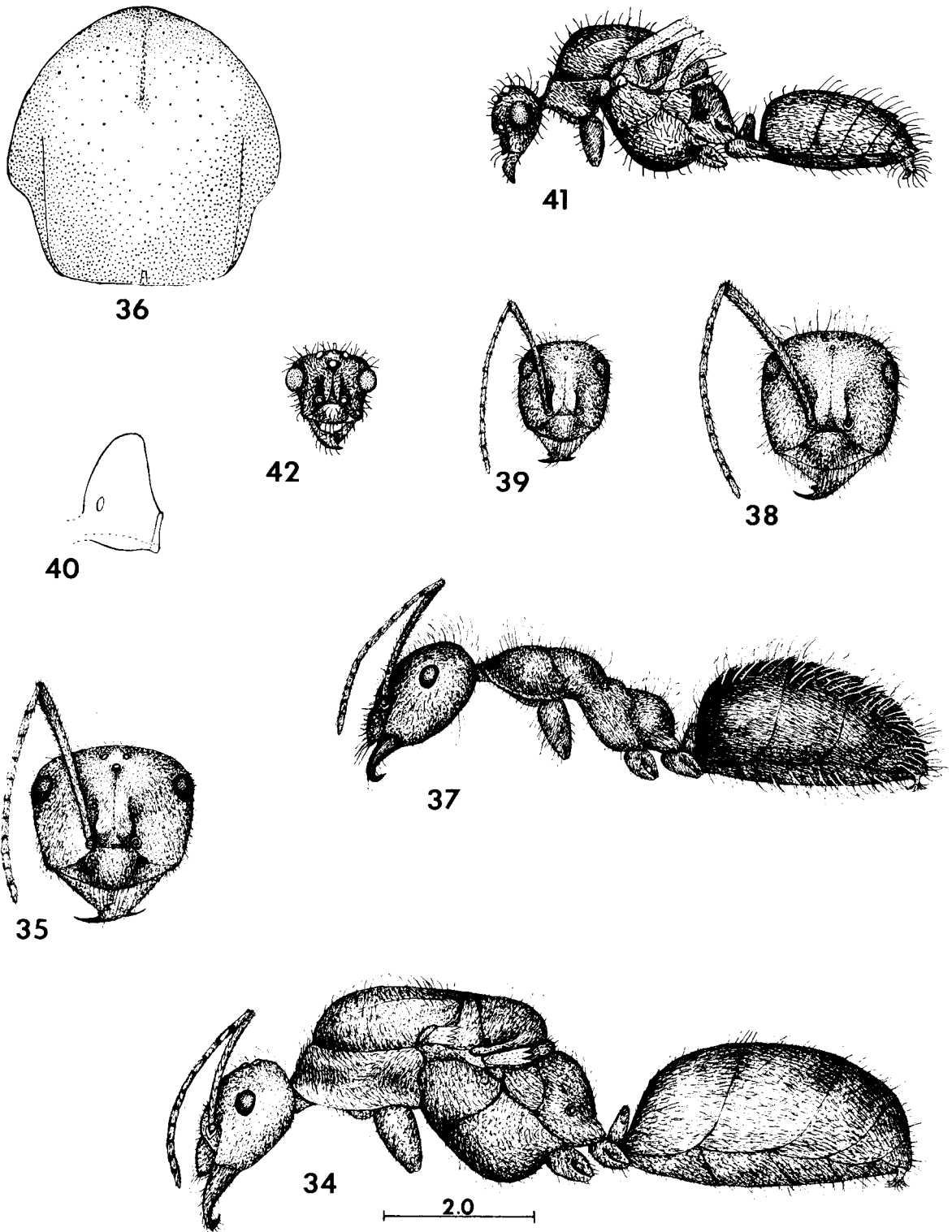
Thorax: Robust, PW $0.57 \times$ WL. Propodeum, in profile, without horizontal basal face.

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 $0.5 \times$ 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 $1.2 \times$ 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 $0.5 \times$ 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 $0.4 \times$ 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 Parral, 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 Cuauhtémoc, 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 I.

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 I
Activity of Reproductives of:

Locality	Date	Activity
<i>M. melliger</i> 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
<i>M. mendax</i> 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, punctuation, 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-