

# THE UNIVERSITY OF KANSAS SCIENCE BULLETIN

Vol. 53, No. 2, pp. 65-119

March 24, 1986

## A REVISION OF THE NATIVE NEW WORLD SPECIES OF THE ANT GENUS *MONOMORIUM* (MINIMUM GROUP) (HYMENOPTERA: FORMICIDAE)<sup>1</sup>

MARK B. DUBOIS<sup>2</sup>

### CONTENTS

ABSTRACT . . . . .	66
INTRODUCTION . . . . .	66
GENERAL METHODS . . . . .	69
KEYS . . . . .	74
SYSTEMATIC TREATMENT . . . . .	75
<i>MONOMORIUM</i> ( <i>MONOMORIUM</i> ) <i>MINIMUM</i> SPECIES GROUP . . . . .	75
<i>M. MINIMUM</i> (BUCKLEY) . . . . .	75
<i>M. CYANEUM</i> WHEELER . . . . .	82
<i>M. ERGATOGYNA</i> WHEELER . . . . .	86
<i>M. WHEELERORUM</i> NEW SPECIES . . . . .	91
<i>M. COMPRESSUM</i> WHEELER . . . . .	93
<i>M. VIRIDUM</i> BROWN . . . . .	96
<i>M. EMARGINATUM</i> NEW SPECIES . . . . .	101
<i>M. EBENINUM</i> FOREL . . . . .	103
<i>M. TRAGERI</i> NEW SPECIES . . . . .	109
<i>M. MARJORIAE</i> NEW SPECIES . . . . .	111
<i>M. TALBOTAE</i> DUBOIS . . . . .	112
<i>M. PERGANDEI</i> (EMERY) . . . . .	113
<i>M. INQUILINUM</i> DUBOIS . . . . .	116
ACKNOWLEDGMENTS . . . . .	116
LITERATURE CITED . . . . .	116

<sup>1</sup> CONTRIBUTION NUMBER 1939 FROM THE DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF KANSAS, LAWRENCE, KANSAS 66045, U.S.A.

<sup>2</sup> PRESENT ADDRESS: 208 OAKWOOD CIRCLE, WASHINGTON, ILLINOIS 61571.

## ABSTRACT

Thirteen species (4 new) of native North and Central American ants closely related to *Monomorium minimum*, "minimum group," are included in this revision: *M. compressum* Wheeler, *M. cyaneum* Wheeler (= *M. emersoni* Gregg, NEW SYNONYMY), *M. ebeninum* Forel, *M. emarginatum* sp. n., *M. ergatogyna* Wheeler, *M. inquilinum* DuBois, *M. marjoriae* sp. n., *M. minimum* (Buckley), *M. pergandei* (Emery), *M. talbotae* DuBois, *M. trageri* sp. n., *M. viridum* Brown (= *M. peninsulatum* Gregg, NEW SYNONYMY), and *M. wheelerorum* sp. n. Lectotypes are designated for *M. compressum*, *M. cyaneum*, *M. ebeninum*, and *M. ergatogyna*. All species are described, illustrated, and their distributions are mapped. Keys are provided for identification of queens, known males, and known workers.

This species group inhabits the New World from southern Canada to Panama. Two species, *M. minutum brasiliense* Forel (known only from Brazil) and *M. subcoecum* Emery (known only from Antilles), which may belong to this group were not included due to lack of queens for comparisons.

## INTRODUCTION

The ant genus *Monomorium* contains 326 currently recognized, recent species; most of these occur in the Old World (Emery, 1921; Santschi, 1927, 1936; Ettershank, 1966). Three Old World species are widely distributed "tramps" in the New World (predominantly in tropical and subtropical regions): *Monomorium (Monomorium) floricola* (Jerdon), *M. (M.) pharaonis* (Linnaeus), and *M. (Parholcomymex) destructor* (Jerdon) (Creighton, 1950; Brown, 1964; Kempf, 1972; Smith, 1979).

In addition to these species, Kempf (1972) lists the tropical species occurring in the New World. Two of them, *M. minutum brasiliense* Forel (1908) and *M. subcoecum* Emery (1894), may belong to the group herein revised. Lack of queens for comparisons prevented me from including them. All remaining New World species belong to different species groups.

Emery (1921) considered the *minimum* group closely related to *M. minutum* Mayr (which occurs in southern Europe). Based on published descriptions of *M. minutum* and comparison of 2 queens and 12 workers of this species (from France, Italy and Yugoslavia) with members of the *minimum* group, it appears unlikely that this species is closely related to any of the native New World *Monomorium*.

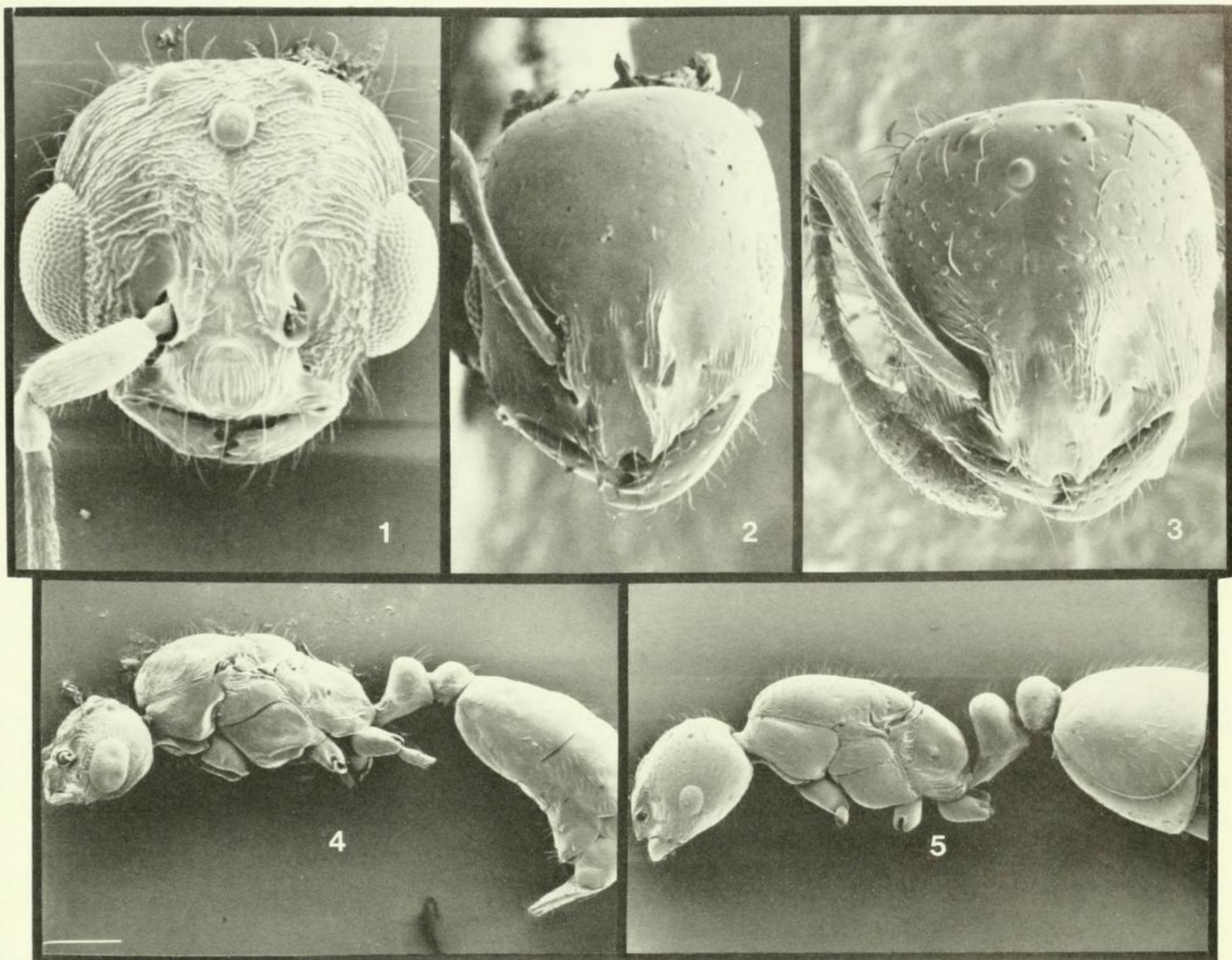
Other evidence which indirectly supports the above contention lies with plate tectonics of North America and Europe. Since Pangea probably fragmented before

the Formicidae evolved, it is unlikely that *Monomorium* could have dispersed directly to North America from Europe (Wilson et al., 1967a, 1967b; Dietz and Holden, 1970; Burnham, 1978). It seems more likely that *Monomorium* arrived in North America via the Bering land bridge since a number of other species are thought to have arrived via this route (Buren, 1958). Furthermore, comparisons between workers of North American *Monomorium* and Asiatic *Monomorium* (*M. chinensis* Santschi, 1925) reveal many similarities (they are difficult to differentiate). However, no queens of Asiatic species were available for study.

Most studies on native New World members of the *minimum* group have been isolated descriptions of taxa with little effort made to synthesize this information. Confusion has resulted from descriptions which compare taxa being described with that author's concept of *M. minimum*. Thus, Wheeler (1904) described *M. minimum ergatogyna* and compared it with "*M. minimum*" from New England (now known as *M. emarginatum*). Later, Wheeler (1914b) described *M. minimum compressum* and *M. minimum cyaneum* and compared them with *M. minimum* from Texas (which may have been *M. minimum* or *M. cyaneum*).

## GENERAL BIOLOGY

Little biological information has been recorded for most species of *Monomorium*



FIGS. 1-5. *Monomorium ergatogyna*. Scanning electron microscope photographs. Some photographs enlarged more than others; for actual dimensions, refer to text. 1—Head of male, frontal view. 2—Head of worker, frontal view. 3—Head of queen, frontal view. 4—Male, lateral view (legs and wings removed). 5—Queen, lateral view (legs removed).

(Ettershank, 1966). One notable exception is the detailed study of *M. pharaonis* (Peacock and Baxter, 1949, 1950; Peacock, 1950a, 1950b, 1951; Hall and Smith 1951, 1952, 1953; Smith and Peacock, 1957).

Most studies of biology of the *minimum* group emphasized information useful in constructing higher classifications of ants. Recent studies dealt with larvae (Wheeler and Wheeler, 1955, 1960a, 1960b, 1973, 1976), chromosomes (Crozier, 1970, 1975), sting morphology (Kugler, 1978), and venom components (Jones et al., 1980, 1982).

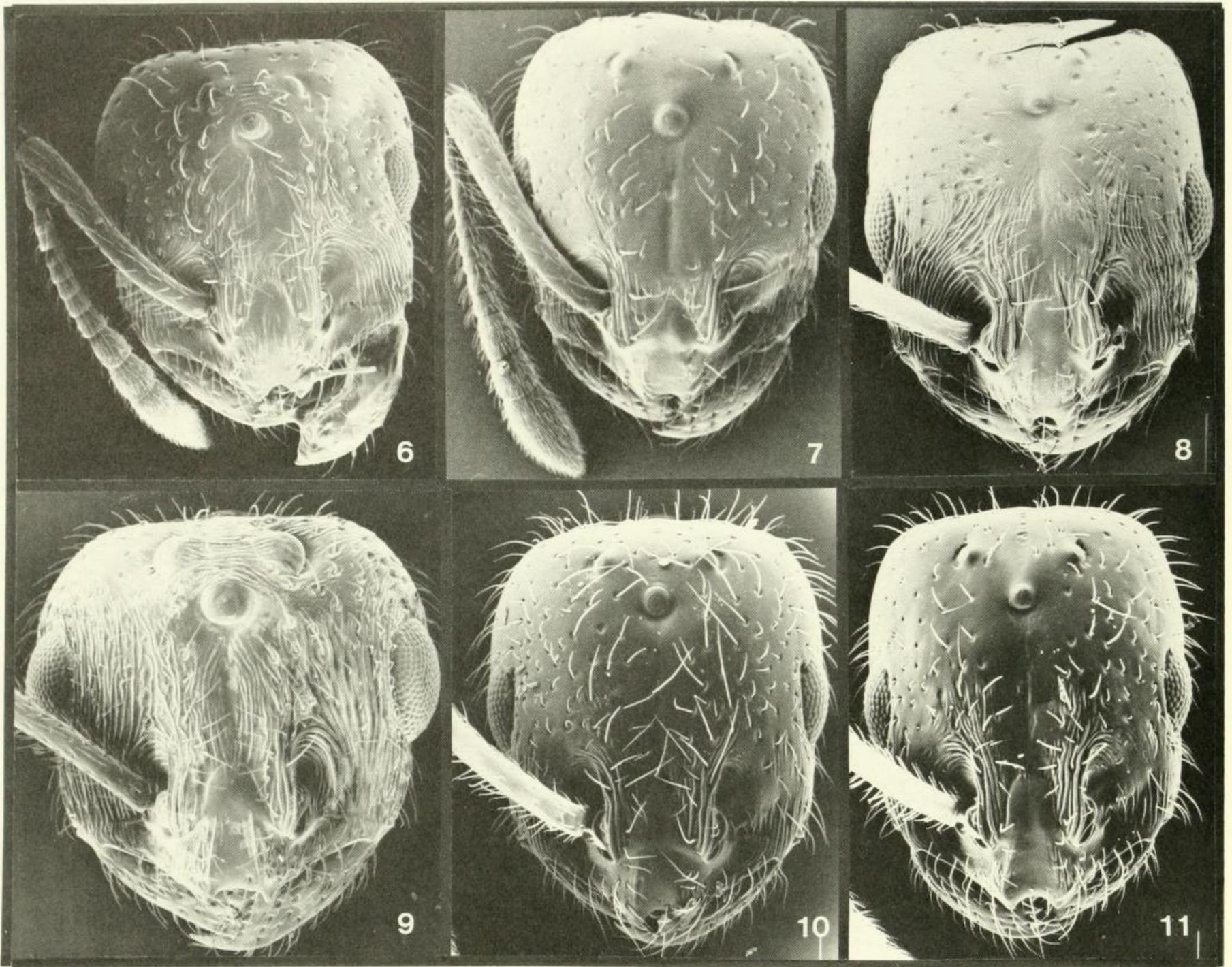
#### INQUILINISM

Inquilinous relationships between two species are those in which a socially parasitic species spends its entire life cycle in nests of its host species (Wilson, 1971).

Since the inquilines rely on their hosts for food and care of their brood, the worker caste is often lacking (no workers have ever been discovered in the North American inquilinous *Monomorium*). This relationship is sometimes called “permanent parasitism.”

Three species of inquilinous *Monomorium* have been discovered in North America: *M. inquilinum* (known only from one locality in central Mexico), *M. pergandei* (known only from Washington, D.C.), and *M. talbotae* (known only from one locality in central Michigan). These species follow the distributional pattern of most inquilinous ants, being known only from isolated, limited areas.

These inquilines are remarkably similar in general morphology, presumably because of convergence. In *M. pergandei* and



FIGS. 6-11. *Monomorium* queens, heads, frontal views. Scanning electron microscope photographs. Some photographs enlarged more than others to aid in comparison; for actual dimensions, refer to text. 6—*M. minimum*. 7—*M. trageri*. 8—*M. ebenium*. 9—*M. viridum*. 10—*M. cyaneum*. 11—*M. wheelerorum*.

*M. talbotae*, males and females are quite similar to one another in overall morphology. In fact, the only method of determining gender is to examine their genitalia. This phenomenon has yet to be explained since non-inquilinous *Monomorium* have marked morphological differences between sexes.

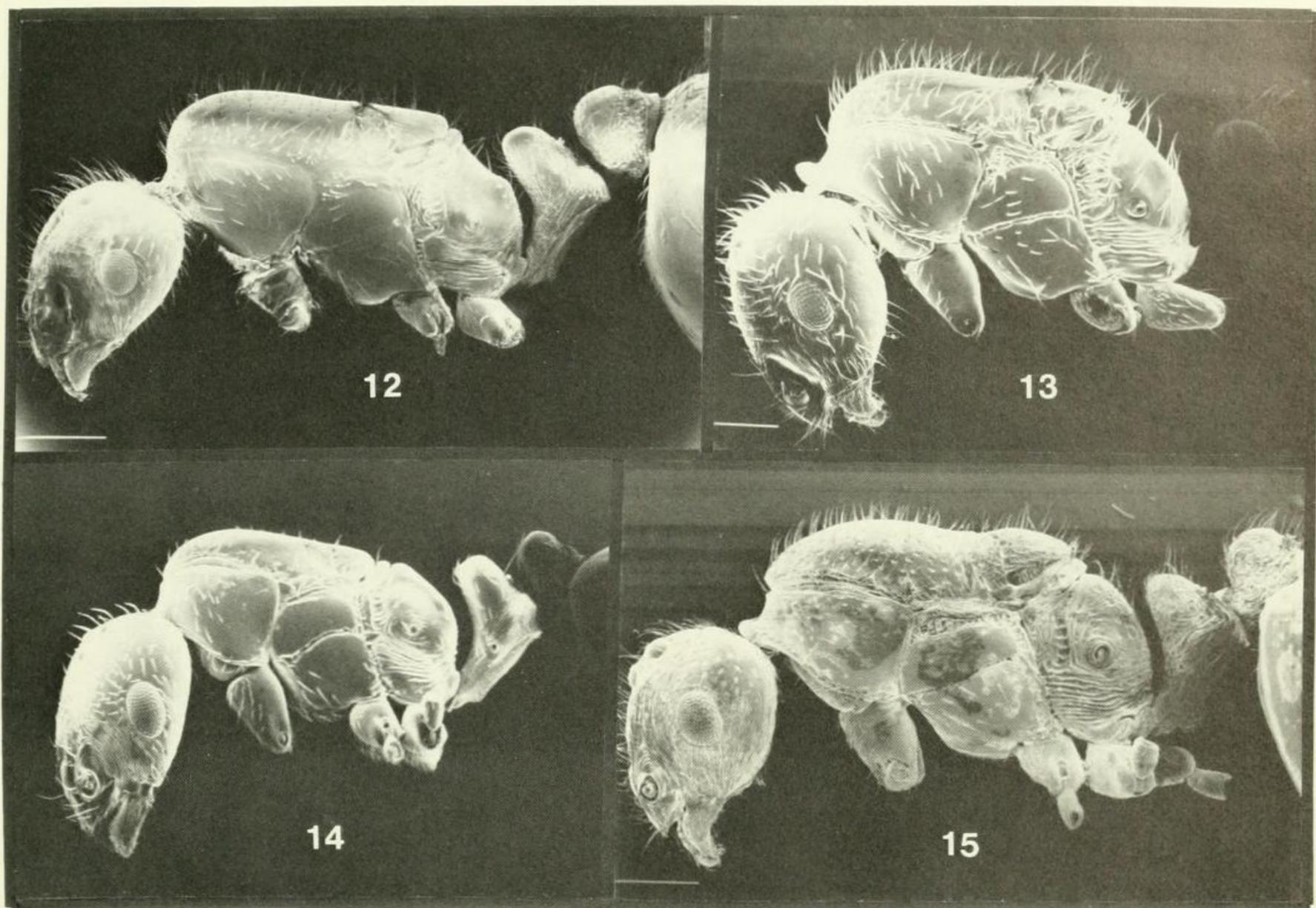
DuBois (1981a) recognized the following common traits of inquiline *Monomorium* (numbers of traits correspond to those of Wilson, 1971: 374-375): (1) the worker caste is absent, (4) both male and female are reduced in size, (8) venation in both forewing and hindwing is diluted — most 'veins' in forewing are represented as absence of microtrichia; hindwing venation is equally diminished, (9) mouthparts are reduced, (13) petiole and postpetiole are thickened, (14) ventral surface of

postpetiole becomes armed with a spine, and (16) cuticular sculpturing is reduced. One additional character, probably associated with diminished size, is reduction in size and complexity of male genitalia (DuBois, 1981a).

#### FOSSIL HISTORY

Although genus *Monomorium* is represented in the fossil record by two species, *M. mayrianum* Wheeler and *M. pilipes* Mayr, both species are known only as workers in Baltic Amber (Wheeler, 1914a; Burnham, 1978). No fossil *Monomorium* have been discovered in North America (see, for example, Carpenter, 1930; Brown, 1973; Burnham, 1978).

Neither fossil species appears to be closely related to native North American *Monomorium*. *Monomorium mayrianum* has 5



FIGS. 12-15. *Monomorium* queens, lateral views (gasters and legs excluded). Scanning electron microscope photographs. Some photographs enlarged more than others to aid in comparison; for actual dimensions, refer to text. 12—*M. minimum*. 13—*M. cyaneum*. 14—*M. ebenium*. 15—*M. viridum*.

mandibular teeth, 12-jointed (segmented?) antenna, and a deep metanotal sulcus (Wheeler, 1914). *Monomorium pilipes* has 11-jointed (segmented?) antenna, and (probably) 5 mandibular teeth based on Wheeler's (1914a) description and accompanying figure.

#### GENERAL METHODS

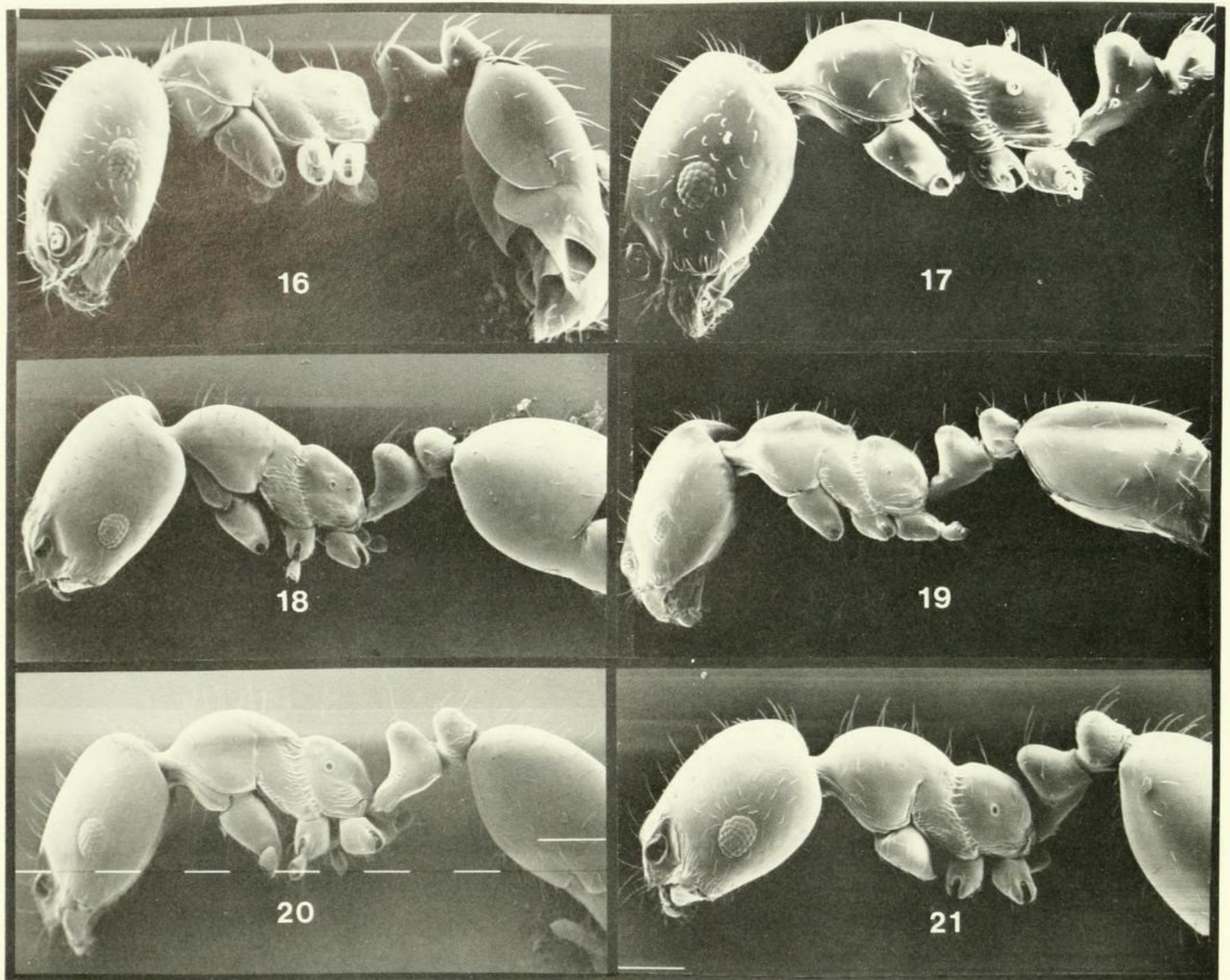
As specimens were received, they were sorted into morphologically distinct groups; each group was compared with specimens previously received. These "morphospecies" were segregated with no effort to name each taxon due to prevailing confusion in the systematics of this group. When the majority of specimens was assembled, collection localities were plotted on a map to ascertain which geographic areas lacked representatives. Efforts were then made (by contacting individuals or institutions in those regions) to cover deficient areas. Finally, names were assigned to taxa after comparison with type material

or with descriptions when types were not readily available.

When possible, an effort was made to assign previously recorded information to one species or another. A reference is listed in synonymy if either one of two criteria is met: (1) a specimen from that study was examined and identified by me, or (2) the literature reference in question referred to an area where only one species of *Monomorium* probably occurs naturally. Obviously, this latter criterion is the weaker of the two.

#### TERMINOLOGY

Most terms used are conventional to hymenopteran systematics and were defined by Snodgrass (1935, 1941). Some special terms, although known to myrmecologists, may cause difficulty; these have been listed below to clarify their use within this publication. Most of these terms have been used previously in revisions of other ant taxa (see, for example, Snelling,



FIGS. 16-21. *Monomorium* workers, lateral views (gasters and legs excluded). Scanning electron microscope photographs. Some photographs enlarged more than others to aid in comparison; for actual dimensions, refer to text. 16—*M. ebenium*. 17—*M. wheelerorum*. 18—*M. ergatogyna*. 19—*M. minimum*. 20—*M. trageri*. 21—*M. viridum*.

1976; Ettershank, 1966). Terms are listed in the order they appear within descriptions.

1. *Head length* (HL). Maximum length of head (in full face view), measured from midpoint of occipital margin to midpoint of anterior clypeal margin (Fig. 22, no. 1).

2. *Head width* (HW). Maximum width of head (excluding compound eyes) (Fig. 22, no. 2).

3. *Scape length* (SL). Maximum length of scape (excluding basal radicle) (Fig. 22, no. 3).

4. *Interocellar distance* (IOD). Queen and male only; minimum distance between inner margins of posterior ocelli, measured from dorsal view (Fig. 22, no. 4).

5. *Ocellar diameter* (OD). Queen and male only; maximum diameter of anterior ocellus (Fig. 22, no. 5).

6. *Eye length* (EL). Maximum length of compound eye, measured from lateral view (Fig. 22, no. 6).

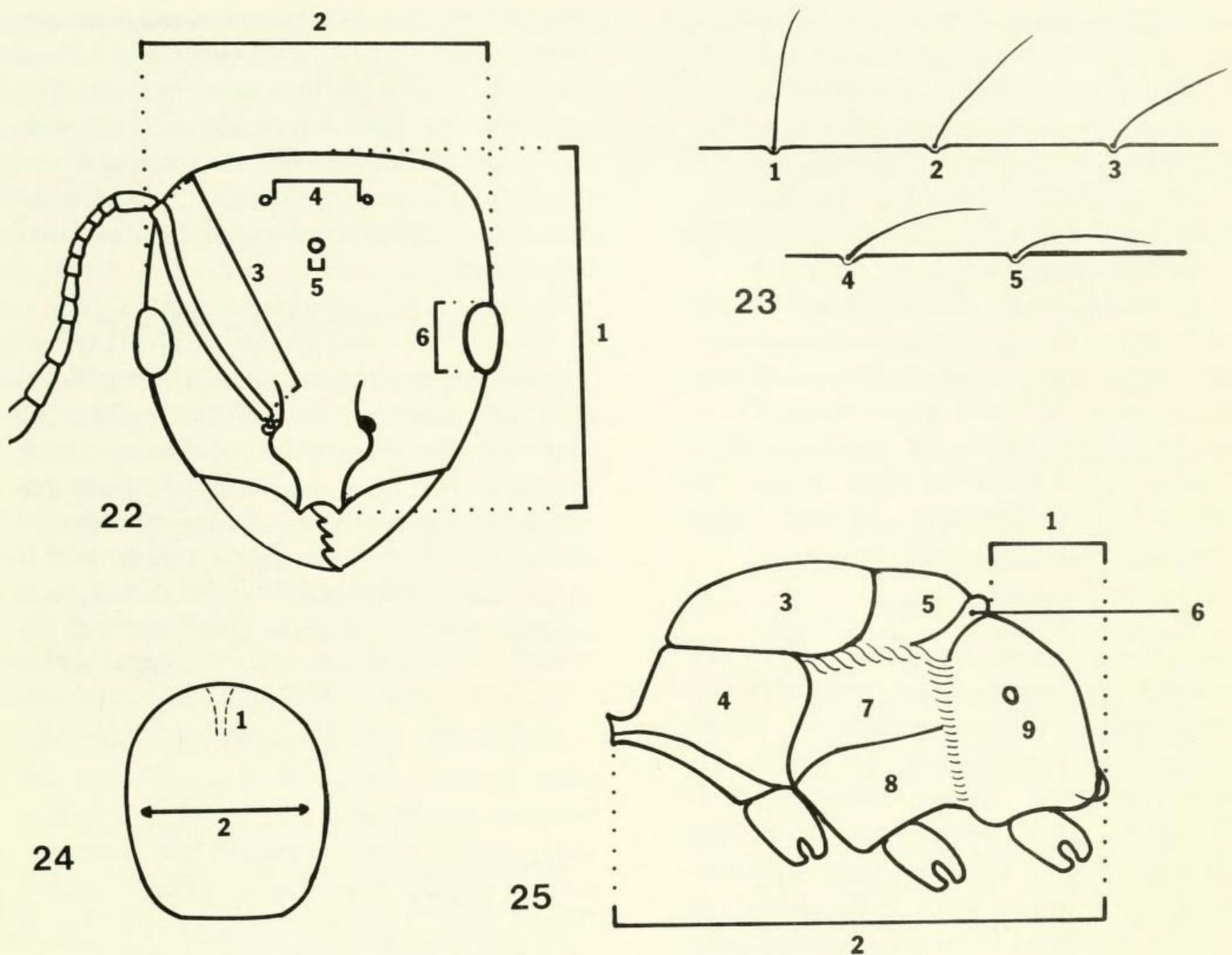
7. *Maximum ocular diameter* (MOD). Maximum width of compound eye, measured from lateral view.

8. *Cephalic index* (CI). Head width X 100 / head length.

9. *Scape index length comparison* (SIL). Scape length X 100 / head length.

10. *Scape index width comparison* (SIW). Scape length X 100 / head width.

11. *Pilosity*. Setal terminology used to indicate degrees of inclination following Wilson (1955) including following terms: (1) erect, (2) suberect, (3) subdecumbent, (4) decumbent, and (5) appressed (Fig. 23). Since these terms are discontinuous expressions of a continuous variable, the two extremes are used to delimit variation (for example,



FIGS. 22-25. Terminology. *Fig. 22.* Frontal view of head, generalized to show measurements. Numbers refer to following measurements: 1—head length, 2—head width, 3—scape length, 4—interocellar distance, 5—ocellar diameter, 6—eye length. *Fig. 23.* Schematic representation of terminology of angle of declination of vestiture (after Wilson 1955). Numbers represent following declinations: 1—erect, 2—suberect, 3—subdecumbent, 4—decumbent, 5—appressed. *Fig. 24.* Dorsal view of scutum. 1—mesonotal furrow, 2—measurement of pronotal width (pronotum extends laterally along alitrunk and is usually the widest directly underneath this part of the scutum; refer also to Figure 25, number 4). *Fig. 25.* Lateral view of queen alitrunk. 1—propodeal length, 2—Weber's length (actual measurements are taken at a slight diagonal from front to rear instead of in a horizontal line as figure indicates), 3—scutum, 4—pronotum, 5—scutellum, 6—metanotum, 7—anepisternum, 8—katepisternum, 9—propodeum. Further explanations are provided in text.

setae erect to subdecumbent). First term used denotes most common inclination of setae on a given structure.

12. *Sculpture.* Usually reflected in terms of punctation or rugosity (see below). When surfaces are described as smooth and shining, this is their appearance at magnifications of 80X or lower; all cuticular surfaces appear rough at higher magnifications.

13. *Punctation.* Punctures can be piliferous (with setae) or non-piliferous (without setae). Sizes are given in relation to average diameter of one eye ommatidium. Select 5 ommatidia from the central portion of the compound eye and average their

diameters. Small punctures are smaller than the average diameter of an ommatidium, moderate punctures are approximately the same diameter, and large punctures are larger than the average diameter.

14. *Rugosity.* Size as for punctation except size is measured as distance between two consecutive ridge summits (i.e., width of one trough).

15. *Pronotal width (PW).* Maximum width of pronotum, measured dorsally, perpendicular to longitudinal axis of thorax.

16. *Propodeal length (PL).* Maximum length of propodeum measured along longitudinal

axis of body from metanotum to apex of inferior propodeal plates (Fig. 25, no. 1).

17. *Weber's length* (WL). Maximum length of alitrunk, measured diagonally from dorsal margin of pronotal collar to apex of inferior propodeal plate (Fig. 25, no. 2).

18. *Propodeal index* (PI). Propodeal length X 100/Weber's length.

19. *Color*. Although all taxa examined appear piceous black at low magnifications, color refers to coloration observed at magnifications of 30X and above under florescent lighting. Many of the specimens examined have faded with age; hence, the colors in fresh specimens may be darker than indicated in the descriptions.

#### MEASUREMENTS

All measurements were made from dry, mounted specimens; most measurements were made at 80X magnification. Measurements were made with an ocular micrometer (100 units), converted to millimeters, and rounded to the nearest 0.01 mm. Where possible, these measurements were made from individuals (selected at random) from different localities (one individual per locality). All measurements are expressed as range and mean (mean in parentheses) with a maximum sample size of 10 per caste. Initial measurements (including mean, standard deviation, median, minimum value, maximum value, and correlation coefficients) are listed in DuBois (1981c).

Although both indexes involving scape length are listed for each species, it appears that the scape length to head length index is slightly more reliable; these indexes are closely correlated (most species  $r = 0.900$  or greater). Since previous authors have employed either index in various revisions (cf. Francoeur, 1973; Snelling, 1976), both indices are included for comparative purposes.

Several steps were taken to avoid as many errors as possible. First, no measurements were recorded until I was able to obtain like measurements of the same structure on the same specimen on different days. Second, after measurements were taken, a number were selected (at random) and repeated. If the values differed for a

given specimen, additional measurements were taken until an agreement was reached. Third, all measurements used in statistical analyses were checked against the original data sheets in search of typographical errors. Similarly, the final manuscript was checked against original data sheets.

#### SPECIES DESCRIPTION FORMAT

Descriptive features pertaining to holotype only are surrounded by brackets {} (with the exception of *M. inquilinum*, which is only known from the holotype). Features which rarely occur in a species are surrounded by the following symbols }<. If specimens are probably typical, overlook information within these symbols.

#### ORIENTATION

Specimens should be oriented in the same manner I examined them when describing a species. The head (excluding gular region and compound eye measurements) should always be examined in full frontal view. This is particularly true when examining setae, since their degree of inclination sometimes changes when viewpoint is radically changed. The gular region, compound eye measurements, alitrunk, petiole, postpetiole (excluding their dorsa), and gaster should be examined in lateral view. Both petiolar and postpetiolar dorsa should be examined by looking over the posterior end of the gaster, up the gastral dorsum.

#### DISSECTIONS

The following structures must be dissected before features can be observed: wings, male mouthparts, and male genitalia.

*Wings* — Most wings curl around their longitudinal axes in pinned specimens. Furthermore, wing venation is difficult to observe in specimens preserved in alcohol. Therefore, wings were removed, placed on a microscope slide, smoothed out, covered with a cover slip, and affixed to the slide with tiny droplets of mounting medium on corners of the cover slip. Since the mounting medium has nearly the same refractive

index as the wing itself, venation is nearly invisible if the entire wing is immersed in the medium. Venation in all species examined is fairly uniform; therefore, one example is depicted (*M. ergatogyna*, Fig. 71).

*Male mouthparts* — Mouthparts of males were selected for detailed study, since they are used less than queen and worker mouthparts. Additionally, female mouthparts are less variable among species. Mouthparts (labial palp, maxillary palp, and mandible) were examined in glycerine at 400X; illustrations were made using an ocular grid.

*Male genitalia* — The male genital capsule was removed entirely (after being drawn *in situ*) and dissected so that individual parts could be examined (examinations and illustrations same as for mouthparts). The eighth and ninth sterna were examined (in glycerine) after being flattened by a cover slip.

#### PRESERVATION OF SPECIMENS

Due to their small size, most specimens should be preserved in alcohol. If necessary (for detailed examination) a subset can be pinned on points. Although the legs of the right side should be pushed into the glue, the entire body should never contact glue as the glue may spread by capillary action between setae and obscure details on the body.

#### COMPUTER TECHNIQUES

Preliminary data analysis was conducted using MINITAB statistics programs which were run on the University of Kansas Academic Computer Center's Honeywell 66/60 computer.

#### REFERENCE COLLECTIONS

Specimens examined during this revision were borrowed from the following individuals and institutions (abbreviations are those used in listing localities). I am extremely grateful to those who cooperated by sending specimens.

AFPC—Andre Francoeur, personal collection

AMNH—American Museum of Natural History, New York (Marjorie Favreau)

BPPC—B. Poldi, personal collection (Mantova, Italy)

CAS—California Academy of Sciences, San Francisco (Paul Arnaud, Jr.)

CGPC—Chris George, personal collection

GCWPC—George C. and Jeanette Wheeler, personal collection

INHS—Illinois Natural History Survey, Urbana (Wallace LaBerge)

JMPC—James Moody, personal collection

JTPC—James Trager, personal collection

KSU—Kansas State University, Manhattan (Jim Johnson)

KU—Snow Entomological Museum, University of Kansas, Lawrence (George Byers)

LACM—Natural History Museum of Los Angeles County (Roy Snelling)

MBDPC—Mark DuBois, personal collection

MCZ—Museum of Comparative Zoology, Cambridge, Massachusetts (Margaret Thayer and Ron McGinley)

MHNG—Museum d'Histoire Naturelle, Geneva, Switzerland (Claude Besuchet)

MTPC—Mary Talbot, personal collection

NCSU—North Carolina State University, Raleigh (C. Parron)

NMNH—National Museum of Natural History, Washington, D.C. (David Smith)

OHSU—Ohio State University, Columbus (R. Triplehorn)

ORSU—Oregon State University, Corvallis (Gary Stonedahl)

OSU—Oklahoma State University, Stillwater (W. Drew)

PWPC—Petr Werner, personal collection (Prague, Czechoslovakia)

RHPC—Robert Hamton, personal collection

SBMNH—Santa Barbara Museum of Natural History, California (Scott Miller)

SBSK—State Biological Survey of Kansas, Lawrence (Mark DuBois)

UA—University of Arkansas, Fayetteville (Sheila Hoelscher)

UM—University of Missouri, Columbia (Edward Riley)

UN—University of Nebraska, Lincoln (Brett Ratcliffe)

UO—University of Oklahoma, Norman (Bill Shepard)

#### KEY TO QUEENS

1. Head broadest at occiput; surface sculpturing greatly reduced; masticatory margin of mandible with fewer than 4 teeth . . . . . 11  
Head broadest near compound eyes; at least some surface sculpturing near mandibular insertion; masticatory margin of mandible with 4 teeth . . . . . 2
2. (1). Lateral profile of scutum and scutellum convex (Figure 43). . . . . 5  
Lateral profile of scutum and scutellum flat or concave (Fig. 87) . . . . . 3
3. (2). Scape with lateral fringe of erect setae (Fig. 82); occurs in California, Nevada, and Utah . . . *M. wheelerorum*  
Scape lacking lateral fringe of erect setae . . . . . 4
4. (3). Petiole emarginate; postpetiole not emarginate; head sculpturing reduced (Fig. 120); occurs in Caribbean region . . . . . *M. ebenium*  
Petiole not emarginate; postpetiole emarginate; head sculpturing as in Fig. 88; occurs in central Mexico . . . . . *M. compressum*
5. (2). Mesonotum with notal furrow (Fig. 24, no. 1) . . . . . 6  
Mesonotum lacking notal furrow . . . . . 7
6. (5). Metanotum not projecting to level of propodeum and scutellum; petiole and postpetiole not emarginate; occurs in central and north-central Atlantic coastal states . . . . . *M. emarginatum*  
Metanotum projecting to level of propodeum and scutellum; petiole and postpetiole emarginate; occurs along coastal regions from New Jersey to Florida . . . . . *M. viridum*
7. (5). Scape with lateral fringe of erect

setae (Fig. 59); occurs in coastal and southern California. . . . . *M. ergatogyna*

Scape lacking lateral fringe of erect setae . . . . . 8

8. (7). Basal face of propodeum 2X length of declivity; known only from type locality (Nayarit, Mexico) *M. marjoriae*

Basal face of propodeum never 2X length of declivity . . . . . 9

9. (8). Head sculpturing greatly reduced, rugae only on lateral margin of clypeus; occurs in northern Florida. . . . . *M. trageri*

Head with rugae in addition to those on lateral margin of clypeus. . . . . 10

10. (9). Gyne winged (sclerites near wing base not fused); postpetiole emarginate; common in central U.S. . . . . *M. minimum*

Gyne wingless (sclerites fused); postpetiole not emarginate; occurs throughout central Mexico, Arizona, New Mexico, and parts of Texas . . . . . *M. cyaneum*

11. (1). Metanotum reaching level of propodeum and scutellum; postpetiole emarginate . . . . . 12

Metanotum not reaching level of propodeum and scutellum; postpetiole not emarginate; known only from type locality (Livingston Co., Michigan) . . . . . *M. talbotae*

12. (11). Mesonotum with notal furrow; petiole not emarginate; masticatory margin of mandible with 3 teeth; known only from type locality (Washington, D.C.) . . . . . *M. pergandei*

Mesonotum lacking notal furrow; petiole emarginate; masticatory margin of mandible with 2 teeth; known only from type locality (Estado de Mexico, Mexico) . . . . . *M. inquilinum*

#### KEY TO KNOWN MALES

The following species are not included in this key: *M. compressum*, *M. emarginatum*, *M. inquilinum*, *M. marjoriae*, *M. pergandei*, and *M. wheelerorum*.

1. Eighth sternite emargination lacking

- projecting setae . . . . . 2  
 Eighth sternite emargination with projecting setae; common along Atlantic coast from New Jersey to Florida . . . . .  
 . . . . . *M. viridum*
2. (1). Aedeagus with toothed margin straight . . . . . 3  
 Aedeagus with toothed margin curved . . . . . 4
3. (2). Cuspis of volsella present; known only from type locality (Livingston Co., Michigan). . . . . *M. talbotae*  
 Cuspis of volsella absent; occurs throughout Caribbean region . . . . .  
 . . . . . *M. ebeninum*
4. (2). Cuspis of volsella with 3 setae . 5  
 Cuspis of volsella with 5 setae; occurs throughout central Mexico, Arizona, New Mexico, and parts of Texas . . . . .  
 . . . . . *M. cyaneum*
5. (4). Aedeagus quadrate; occurs throughout central U.S. . *M. minimum*  
 Aedeagus longer than broad . . . . . 6
6. (5). Eighth sternite emargination 1/2 as deep as wide (Fig. 74); occurs along California coast . . . . . *M. ergatogyna*  
 Eighth sternite emargination as deep as wide (Fig. 146); occurs in northern Florida. . . . . *M. trageri*

## KEY TO KNOWN WORKERS

The following species are not included in this key and apparently lack a worker caste: *M. inquilinum*, *M. pergandei*, and *M. talbotae*.

1. Propodeum rounded (Fig. 63); occurs along California coast . . *M. ergatogyna*  
 Propodeum angular (Fig. 31). . . . . 2
2. (1). Basal and declivitous faces of propodeum of equal length . . . . . 3  
 Basal and declivitous faces of propodeum of unequal length (either face may be longer). . . . . 5
3. (2). Mesopleuron punctate; fewer than 8 setae projecting above dorsum of alitrunk; occurs throughout central Mexico, Arizona, New Mexico, and parts of Texas . . . . . *M. cyaneum*  
 Mesopleuron not punctate; more than

- 10 (rarely 8 or 9) setae projecting above dorsum of alitrunk . . . . . 4
4. (3). Petiole and postpetiole convex to flat; occurs in central Mexico . . . . .  
 . . . . . *M. compressum*  
 Petiole and postpetiole flat to slightly emarginate; occurs throughout Caribbean region . . . . . *M. ebeninum*
5. (3). Basal face of propodeum length less than declivity . . . . . 6  
 Basal face of propodeum length greater than declivity. . . . . 7
6. (5). Fewer than 6 setae projecting above dorsum of alitrunk; occurs in northeastern U.S. . . . *M. emarginatum*  
 More than 8 setae projecting above dorsum of alitrunk; occurs in northern Florida. . . . . *M. trageri*
7. (5). Mesopleuron punctate; occurs along Atlantic coastline from New Jersey to Florida. . . . . *M. viridum*  
 Mesopleuron not punctate (for further separation of these species refer to their distributions) . . . . . *M. minimum*,  
*M. wheelerorum*, *M. marjoriae*

## SYSTEMATIC TREATMENT

Genus *Monomorium* Mayr

A complete synonymy is provided by Ettershank (1966). The following synonymy contains only names pertaining to this revision. Similarly, complete synonymies are not provided for each species; only references of taxonomic or biological importance are listed.

*Monomorium* Mayr, 1855: 452. Type species: *Monomorium minutum* Mayr (Monobasic).

*Epoecus* Emery, 1892: cclxxvi-cclxxvii. Type species: *Epoecus pergandei* Emery (Monobasic).

**DIAGNOSIS:** QUEEN: Antenna 12- or 11-segmented, rarely 10-segmented, with more or less distinct club of greater than 2 segments; median clypeal setae always present; clypeus usually distinctly bicarinate, carinae sharp or rounded; propodeum never with distinct teeth, rarely angulate, usually rounded; petiole distinctly pedunculate; wing venation similar to that of *Solenopsis* but radial cell always open; metapleural gland well developed; four Malpighian tubules with tips attached to rectum

(cryptonephritic); diploid chromosome number usually 22. **WORKER:** Usually smaller than queen, remaining diagnosis same as queen, except wings lacking. **MALE:** Usually smaller than queen but larger than worker; Mayrian furrows lacking; mandible with teeth; antenna with 13 segments.

### Subgenus *Monomorium* Mayr

*Monomorium* (*Monomorium*); Emery, 1921: 170.

**DIAGNOSIS:** **QUEEN:** Antenna 12-segmented with distinct 3-segmented club (lengths of club segments increasing distally); propodeum unarmed (small bump may be present); clypeus with carinae usually extended anteriorly into teeth; masticatory border of mandible with 2-5 teeth, usually 4. **WORKER:** As in queen; pronotal suture reduced or absent; metanotal sulcus present as pronounced constriction. **MALE:** Antennal scape cylindrical, never surpassing occiput.

#### *Monomorium* (*Monomorium*) *minimum* species group

*Monomorium* species related to *M. minutum* Mayr, Emery, 1921: 171 (in part).

*Monomorium minutum* group, Ettershank, 1966: 83 (in part).

**DIAGNOSIS:** **ALL CASTES:** Anepisternum and katepisternum always smooth and shining; propodeum with distinct parallel longitudinal rugae on side.

This species group as here understood includes only those species which are native to North and Central America. Further revisionary work within this genus may reveal this to be a paraphyletic group and may show that certain South American and Asiatic species are members of this group. However, it is a group of species (somewhat isolated geographically) well suited for revisionary study.

#### *Monomorium minimum* (Buckley)

Figures 6, 12, 19, and 26-42

*Myrmica* (*Monomarium*) [*sic*] *minima* Buckley, 1867: 338.

*Monomorium minutum* var. *minimum*: Emery, 1895: 274-275 (in part); Wheeler, 1902: 27; Wheeler, 1908: 423 (in part).

*Monomorium carbonarium*: Mitchell and Pierce, 1912: 70 (misidentification).

*Monomorium minimum*: Wheeler, 1917a: 464-465, 501 (in part); Talbot, 1934: 420; Smith,

1935: 237; Smith, 1936a: 163; Cole, 1937: 99 (in part); Smith, 1943: 300; Buren, 1944: 289; Gregg, 1944: 456, 466; Smith, 1947: 565; Creighton, 1950: 219-222 (in part); Smith, 1952: 810 (in part); Cole, 1953: 299 (in part); Talbot, 1953: 4; Wheeler and Wheeler, 1955: 122; Kanno, 1956: 177; Hess, 1958: 26-27; Smith, 1958: 128 (in part); Wheeler and Wheeler, 1960a: 15; Gregg, 1963: 367-368; Wheeler and Wheeler, 1963: 133-135 (in part); Smith, 1965: 33-34 (in part); Ettershank, 1966: 90 (in part); Smith, 1967: 356 (in part); Kempf, 1972: 144; Talbot, 1975: 245; Kugler, 1978: 451-452; Smith, 1979: 1382-1383 (in part); Talbot, 1979: 88; DuBois, 1981a: 33-34; DuBois, 1981b: 35; Jones *et al.*, 1982: 287.

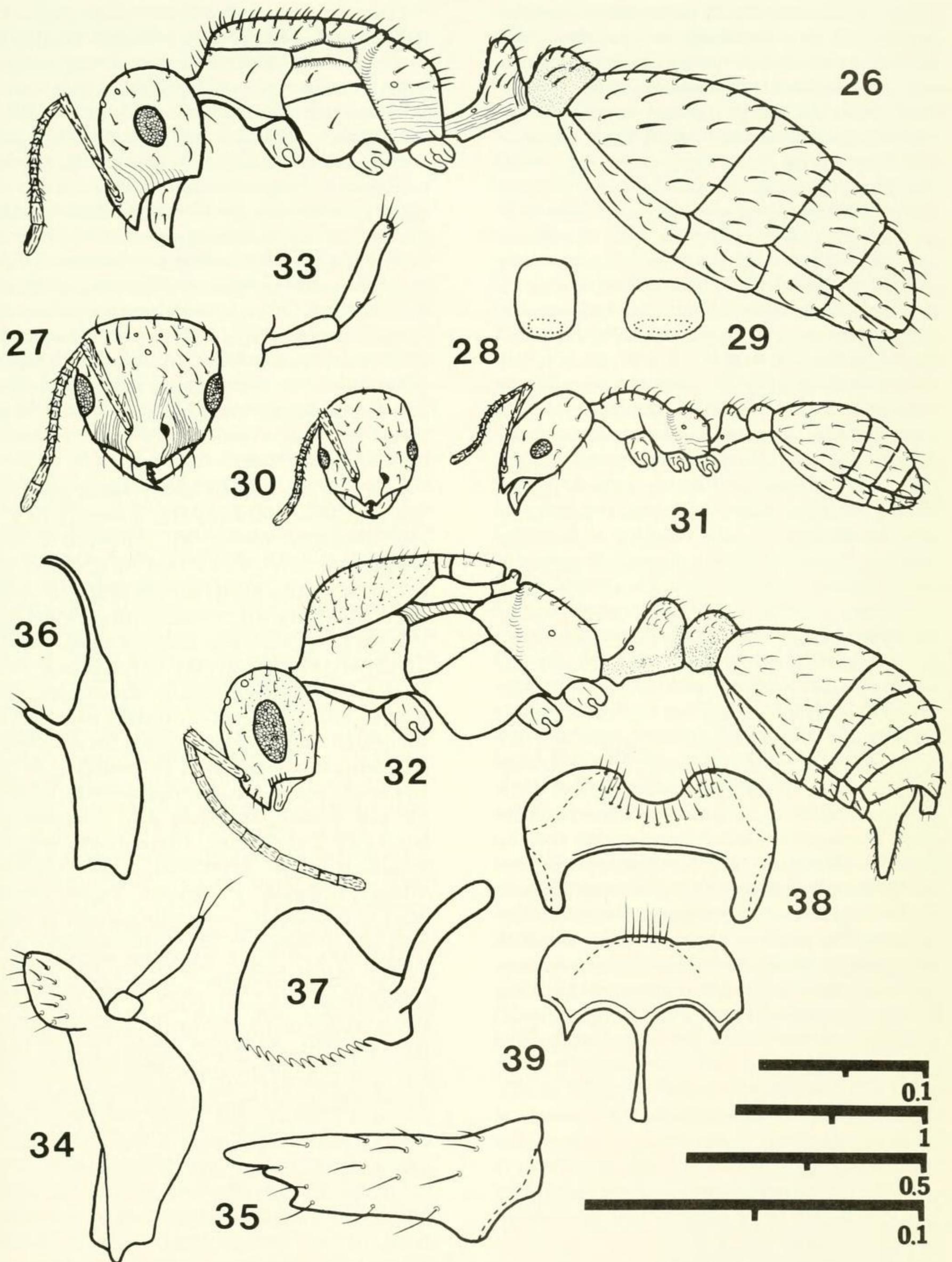
*Monomorium minutum* subsp. *minima*: Emery, 1921: 172 (in part).

*Monomorium viridum peninsulatum*: Creighton, 1950: 223-224 (in part), Gregg, 1963: 368-370 (misidentification); Smith, 1967: 356 (in part); Smith, 1979: 1384 (in part).

*Monomorium metoecus* Brown and Wilson, 1957: 239-244 (in part); Wilson and Brown, 1958: 33-38 (in part); Jones *et al.*, 1982: 287 (syn. by Brown in Ettershank, 1966: 90).

**DIAGNOSIS.** **QUEEN:** Winged; petiole as in Figures 26 and 28; scutum and scutellum not depressed; metanotum (in side view) projecting to level of propodeum and scutellum; propodeum angular. **MALE:** Genitalia and sterna as in Figures 32 and 36-39. **WORKER:** Propodeum angular; mesopleuron not punctate; petiole as in Figure 31; PI 33-40 (37).

**DESCRIPTION.** **QUEEN: HEAD:** Measurements (representing different localities;  $N=10$ ) {Neotype measurements in brackets} HL 0.69-0.86 (0.77) {0.79}, HW 0.65-0.81 (0.74) {0.66}, SL 0.40-0.60 (0.50) {0.58}, IOD 0.12-0.20 (0.17) {0.17}, OD 0.04-0.06 (0.05) {0.06}, EL 0.15-0.20 (0.17) {0.20}, MOD 0.11-0.18 (0.13) {0.15}. **Structure**—Head slightly longer than broad or slightly broader than long, CI 84-106 (95) {84}, distinctly longer than scape, SIL 56-79 (65) {73}; SIW 53-88 (68) {88}. In full frontal view, head broadest slightly above eyes; side convex; occiput rounded laterally, summit flat. Eye moderate in size. Scape reaching but never surpassing occiput. Mandible with 4 teeth; maxillary palp 2-segmented; labial palp 2-segmented. Clypeal teeth sharp, moderate in length. Frontal carinae diverging slightly posteriorly. **Pilosity**—Setae erect to suberect on clypeus, frons, gular region, mandible, and occiput, decumbent to appressed elsewhere.



FIGS. 26-39. *Monomorium minimum*. 26—Queen, lateral view. 27—Head of queen, frontal view. 28—Petiole of queen, posterior view. 29—Postpetiole of queen, posterior view. 30—Head of worker, frontal view. 31—Worker, lateral view. 32—Male, lateral view. 33—Labial palp of male. 34—Maxilla and maxillary palp of male. 35—Mandible of male. 36—Volsella of male. 37—Aedeagus of male. 38—Eighth sternite of male. 39—Ninth sternite of male. Scales: Top scale (0.1 mm) for Figure 35. Second scale (1 mm) for Figures 26-32. Third scale (0.5 mm) for Figures 36 and 37. Bottom scale (0.1 mm) for Figures 33 and 34.

Setae of scape suberect to decumbent, of pedicel and flagellum decumbent to appressed with percentage of latter increasing distally. *Sculpture*—Head smooth and shining with small to moderate piliferous punctures evenly distributed except as follows: small, parallel, longitudinal rugosities beginning all along lateral margin of clypeus, extending past antennal insertion, converging with rugosities from frontal carinae and extending to level of anterior ocellus. Other small, parallel, longitudinal rugosities beginning between frontal carinae, sometimes extending to level of anterior ocellus (Fig 27). *ALITRUNK: Measurements* PW 0.50-0.72 (0.61) {0.62}, PL 0.31-0.42 (0.38) {0.40}, WL 1.34-1.81 (1.61) {1.37}. *Structure*—Mesonotum usually lacks notal furrow >rarely, with small emargination<. Pronotal-scutal suture on dorsal 1/3 of alitrunk. Scutum and scutellum not depressed. Mesopleural suture straight or deflected ventrally on posterior end and deflected dorsally on anterior end (resulting in S-shaped suture). Small pit usually present on posterior end of suture. Metanotum (in lateral view) reaching or exceeding level of propodeum and scutellum. Propodeum angular, basal face approximately 2/3 length of declivitous face. PI 21-29 (24) {29}. Wings present; venation typical (Fig. 71); 6-8 hamuli on hindwing; stigma located directly above vannal emargination {neotype lacks wings but condition of basal sclerites indicate queen once possessed wings}. *Pilosity*—Dorsal outline of alitrunk with more than 30 erect to suberect setae. Setae erect to suberect on coxae and trochanters, erect to suberect on flexor surfaces of femora (decumbent to appressed elsewhere), decumbent to appressed on tibiae and tarsi. *Sculpture*—Smooth and shining except as follows: moderate to large piliferous punctures on dorsum of alitrunk; lower 1/2 of side of propodeum (below spiracle) with several moderate, parallel, longitudinal rugae >rarely, some rugae occur above spiracle<; sculpturing of sutures as in Fig. 26. *PETIOLE:* As in Figures 26 and 28. Dorsum of node convex to flat. Subpetiolar process moderate in size, anterior to node. Setae decumbent to appressed on anterior surface, erect to suberect on dorsum, posterior surface, and side, absent from venter. Dorsum of node smooth and shining with moderate piliferous punctures; side with moderate, parallel, longitudinal rugae becoming transverse near posterior surface of node; posterior surface of node with moderate, semicircular, concentric rugae. *POSTPETIOLE:* As in Figures 26 and 29. Dorsum of node flat to slightly emarginate. Anterior subpostpetiolar process reduced, located medially on venter.

Setae appressed to decumbent on anterior surface of node, suberect to erect on remaining surfaces. Dorsum of node smooth and shining with moderate to small piliferous punctures; remainder of node covered with dense, moderate to small, non-piliferous punctures. *GASTER:* Setae erect to decumbent on all surfaces with percentage of erect to suberect setae increasing towards posterior end of gaster. Setae of first gastral tergite exceeding level of dorsum of postpetiolar node. All surfaces smooth and shining with small to moderate piliferous punctures. *COLOR:* Head brown to dark brown with mandible and lateral margin of clypeus yellow brown to brown; scape brown, pedicel and flagellum yellow brown to yellow. Alitrunk brown to dark brown with legs brown; tibiae and tarsi yellow brown to yellow. Petiole, postpetiole, and gaster brown to dark brown. All setae white.

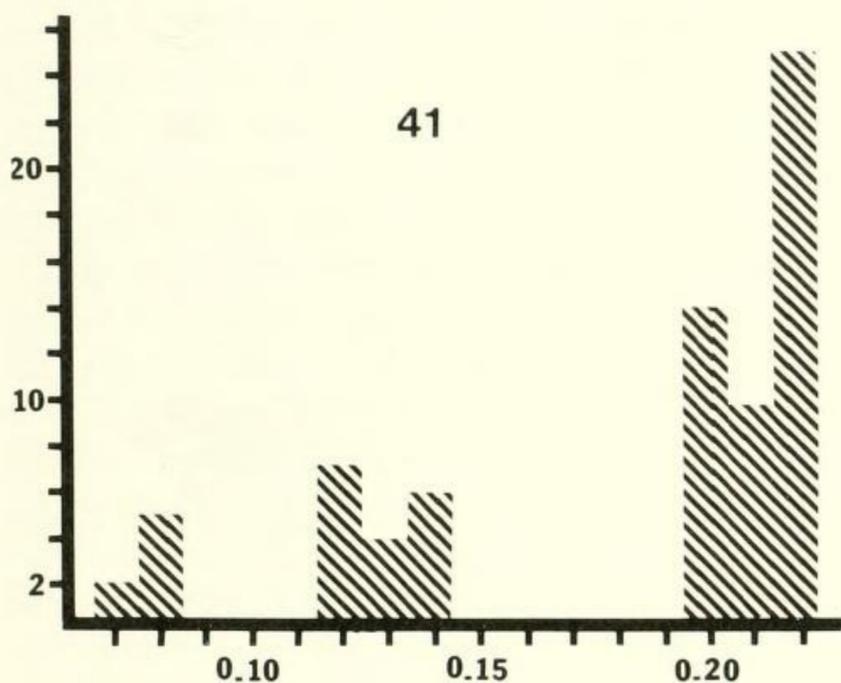
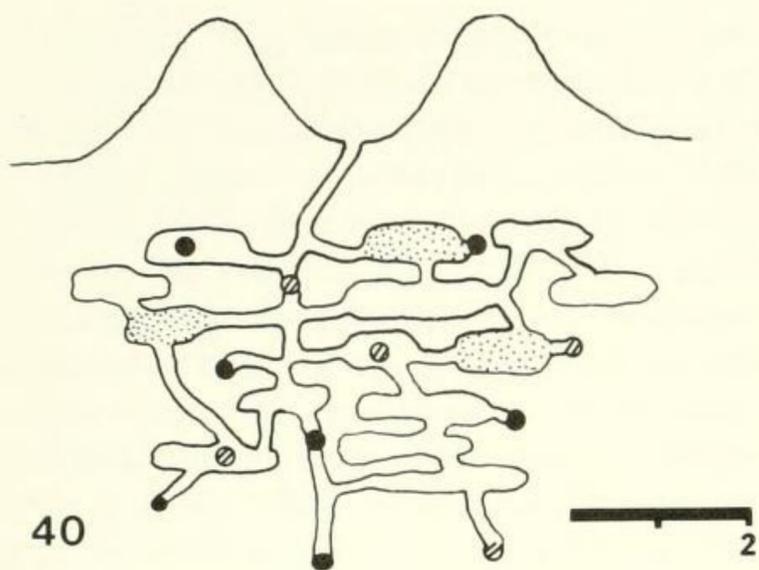
*MALE: HEAD: Measurements* (representing different localities;  $N=10$ ) HL 0.65-0.74 (0.71), HW 0.69-0.78 (0.75), SL 0.22-0.30 (0.26), IOD 0.22-0.26 (0.24), OD 0.05-0.12 (0.09), EL 0.28-0.34 (0.32), MOD 0.15-0.24 (0.19). *Structure*—Head slightly broader than long, CI 105-109 (107), distinctly longer than scape, SIL 31-42 (36); SIW 29-38 (34). In full frontal view, head broadest at or slightly above eyes; side straight to slightly convex (usually obscured by compound eye); occiput rounded laterally, summit flat (usually obscured by posterior ocelli). Eye large. Scape not reaching occiput. Mandible with 3 teeth; maxillary palp 2-segmented; labial palp 2-segmented. Clypeal teeth reduced or absent (blunt if present). Frontal carinae diverging slightly posteriorly. *Pilosity*—Setae erect to decumbent over entire surface of head with erect to suberect setae predominating near clypeus, gular region, mandible, and occiput. Antennal pilosity as in queen. *Sculpture*—Entire head covered with dense, moderate to large, non-piliferous punctures. Small to moderate, parallel, longitudinal rugae beginning all along lateral margin of clypeus, continuing to level of antennal insertion and fusing with large, concentric, semicircular rugae surrounding antennal insertion. *ALITRUNK: Measurements* PW 0.70-0.81 (0.76), PL 0.44-0.62 (0.52), WL 1.66-1.90 (1.75). *Structure*—Mesonotum lacking notal furrow. Pronotal-scutal suture on dorsal 1/3 of alitrunk. Scutum and scutellum not depressed. Mesopleural suture deflected ventrally at posterior end and deflected dorsally at anterior end (resulting in an S-shaped suture) with small pit on posterior end. Metanotum (in lateral view) reaching or exceeding level of propodeum and scutellum. Propodeum angular, basal face 2X as long as declivitous face.

Wings present; venation typical; 5-7 hamuli on hindwing; stigma located directly above vannal emargination. *Pilosity*—Dorsal outline of alitrunk with more than 30 erect to suberect setae; setae absent from side (except near sutures). Leg pilosity as in queen. *Sculpture*—Entire surface smooth and shining except as follows: small to moderate piliferous punctures on dorsum of alitrunk; small to moderate non-piliferous punctures loosely distributed on side; lower 1/2 of side of propodeum (below spiracle) with small, parallel, longitudinal rugae; entire surface of propodeum often covered with small, non-piliferous punctures (Fig. 32). *PETIOLE*: As in Figure 32. Dorsum of node flat to emarginate. Subpetiolar process reduced, anterior to node. Setae erect to decumbent on anterior surface of node, erect to suberect on side and posterior surface of node, absent elsewhere (including dorsum of node). All surfaces smooth and shining except as follows: small to moderate piliferous punctures on anterior and posterior surfaces of node; side with small to moderate non-piliferous punctures. *POSTPETIOLE*: As in Figure 32. Dorsum of node flat to slightly emarginate. Anterior subpostpetiolar process absent. Setae erect to decumbent on anterior surface, side, and posterior surface, absent elsewhere. Dorsum of node smooth and shining; remainder of node covered with moderately dense, non-piliferous punctures. *GASTER*: Pilosity as in queen. All surfaces smooth and shining with small to moderate piliferous punctures. *GENITALIA*: As in Figures 32 and 36-39. Eighth sternite with emargination lacking setae, approximately as deep as wide (Fig. 38). Ninth sternite with 6-8 erect setae (Fig. 39). Aedeagus with 12-15 teeth; toothed margin rounded (Fig. 37). Volsella with curved digitus and reduced cuspis; cuspis with 3 setae (Fig. 36). *COLOR*: Head brown to dark brown, mandible and lateral margin of clypeus yellow brown to yellow. Alitrunk brown to yellow brown; leg coloration as in queen. Petiole, postpetiole, and gaster brown to dark brown. Genitalia brown to yellow brown. All setae white.

*WORKER*. *HEAD*: *Measurements* (representing different localities;  $N=10$ ) HL 0.46-0.56 (0.52), HW 0.38-0.48 (0.42), SL 0.28-0.40 (0.33), EL 0.06-0.10 (0.09), MOD 0.05-0.08 (0.06). *Structure*—Head a little longer than broad, CI 76-86 (81), distinctly longer than scape SIL 56-71 (64); SIW 71-90 (79). In full frontal view, head broadest at or slightly above eyes; side convex; occiput rounded laterally, summit flat. Eye small in size. Scape never reaching occiput. Mandible with 4 teeth; maxillary palp 2-seg-

mented; labial palp 2-segmented. Clypeal teeth sharp, of moderate length. Frontal carinae diverging slightly posteriorly >rarely, parallel<. *Pilosity*—Setae suberect to subdecumbent on clypeus, frons, gular region, mandible, and occiput, decumbent to appressed elsewhere. Setae of scape subdecumbent to decumbent, of pedicel and flagellum decumbent to appressed. *Sculpture*—All surfaces smooth and shining with small to moderate piliferous punctures. *ALITRUNK*: *Measurements* PW 0.22-0.32 (0.28), PL 0.18-0.25 (0.21), WL 0.50-0.65 (0.57). *Structure*—Mesonotum lacking notal furrow. Anterior propodeal suture of moderate depth. Propodeum angular, basal face 1.5-2X as long as declivitous face. PI 33-40 (37). *Pilosity*—Dorsal outline of alitrunk with more than 10 erect to suberect setae. Leg pilosity as in queen. *Sculpture*—Entire surface smooth and shining except as follows: small to moderate piliferous punctures on dorsum; lower 1/2 of side of propodeum (below spiracle) with 1-3 small, parallel, longitudinal rugae. *PETIOLE*: As in Figure 31. Dorsum of node convex. Subpetiolar process of moderate to reduced size, anterior to node. Setae erect to suberect on dorsum, absent elsewhere. All surfaces smooth and shining with small piliferous punctures on dorsum. *POSTPETIOLE*: As in Figure 31. Dorsum of node convex. Anterior subpostpetiolar process reduced, located medially on venter. Setae suberect to erect on dorsum, absent elsewhere. All surfaces smooth and shining with small piliferous punctures on dorsum. *GASTER*: Setae erect to suberect with percentage of erect setae increasing towards posterior end of gaster. Setae of first gastral tergite not exceeding level of dorsum of postpetiolar node. All surfaces smooth and shining with small to moderate piliferous punctures evenly distributed. *COLOR*: Head brown to dark brown with trace of bluish reflection, mandible yellow brown to yellow. Alitrunk brown to dark brown with trace of bluish reflection, legs yellow brown with tibiae and tarsi yellow. Petiole, postpetiole, and gaster brown. All setae white.

*TYPE MATERIAL*. None known to exist (Creighton, 1950). Wheeler (1902) stated the probable type locality as Austin, Texas (or vicinity) since Buckley (1867) failed to mention a specific locality. Although a few of Buckley's specimens remain (Academy of Natural Sciences, Philadelphia and collection of Gustav Mayr, Vienna Museum of Natural History, Vienna, Austria), none could be located that were collected in the



FIGS. 40-41. *Monomorium minimum*. 40—Diagrammatic lateral view of nest. Darkened circles represent tunnels leading away from viewer. Cross-hatched circles represent tunnels leading toward viewer. Stippled chambers represent chambers containing queens and brood. Scale = 2 mm. 41—Histogram of larval head widths in one nest. Interval is 0.10 mm.

1860's or earlier which might have provided the basis for his description.

Since two species of *Monomorium*, *M. cyaneum* and *M. minimum*, could occur in the Austin, Texas, vicinity, I designate the following queen [MCZ] as neotype of *Monomorium minimum* to reduce confusion: TEXAS: Bastrop Co., Bastrop State Park, June 9, 1954, W. Clayd T-119. Since Buckley failed to mention a specific locality in his original description, I followed Wheeler's suggestion in designating a neotype from the Austin, Texas, vicinity. This specimen bears a red, handwritten label: *Monomorium/ minimum/ (Buckley)/ Neotype/ M. DuBois 1983/*.

**DISTRIBUTION.** This species ranges from Pennsylvania and District of Columbia, south to Georgia, west to Texas and New Mexico, and north to Idaho, Montana, and North Dakota (Fig. 42). Although this species has been collected in northern Wisconsin and North Dakota, no collections have been made in southern Canada; this species undoubtedly occurs there. In the eastern United States, this species occurs sporadically and is apparently replaced by *M. emarginatum* in the northeastern states and by *M. viridum* along the Atlantic coast in New Jersey, Georgia, and Florida. In the southern United States, *M. minimum* is known from collections in northern Georgia (Athens), Alabama (northern Alabama south to Mobile), Mississippi (only two collections, Amory and State College), and numerous collections in Louisiana and Texas. This species overlaps the range of *M. cyaneum* in Texas and New Mexico. *Monomorium cyaneum* apparently prefers drier habitats and usually nests under rocks while *M. minimum* prefers moisture habitats usually near the edges of woods. Most of my records of *M. minimum* from Colorado are from the eastern plains. I have only examined one worker which was collected from western Colorado (Mesa Verde National Park). However, Gregg (1963) includes many localities from the mountainous regions of the state (his *M. viridum peninsulatum* records should be included with his records for *M. minimum*). The furthest western records for *M. minimum* are three collections from southern Idaho (Rupert, 6.4 km W of St. Anthony, and Holbrook). These three collections consist of workers only. It is possible these are *M. wheelerorum* although they appear to be *M. minimum* workers. A detailed list of all localities for this and other *Monomorium* species is provided in DuBois (1981c).

**DISCUSSION. BIOLOGY.** Recorded as nesting in soil, under rocks, in logs, man-made structures, and living trees (mesquite, *Prosopis glandulosa*) (Dennis, 1938; Buren, 1944; Kanno, 1956; Hess, 1958; Wheeler and Wheeler, 1963). Talbot (1934) and Gregg (1944) found *M. minimum* most frequently in sandy soil, and

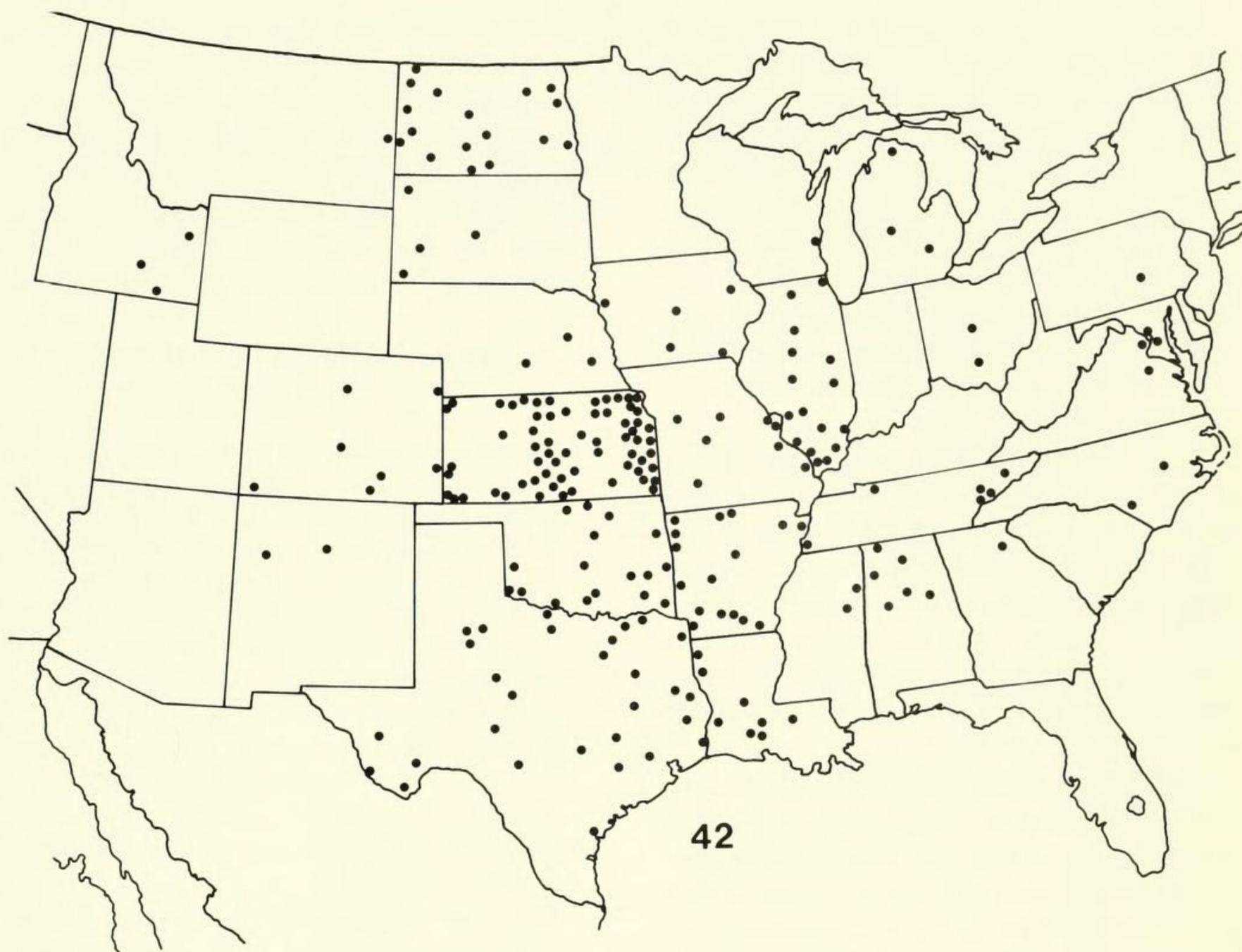


FIG. 42 Distribution of *Monomorium minimum* (closed circles).

Gregg (1963) discovered it in a number of microhabitats representing both Upper Sonoran and Transition life zones: foothills meadow, deciduous canyon forest, oak woodland, ponderosa pine-oak woodland, pinyon-cedar woodland, pinyon-cedar-oak woodland, mixed grass prairie, short grass prairie, sagebrush desert, sagebrush-greasewood desert, sandhills grassland, roadside, and exposed bedrock.

Nests in soil appear to have a characteristic structure; most are shallow (less than 10 cm deep, Kanno, 1956) with most brood chambers located from just under the soil surface to depths of 5 cm (Wheeler and Wheeler, 1963). Although this description referred to nests in North Dakota, nests in Kansas and Illinois are of a similar internal construction (Fig. 40). However, tumuli vary considerably depending upon environmental conditions. In Kansas, most nests are located near edges of woodlands and have tumuli with a typical crater structure such as that depicted in Figure 40.

Nests in areas of scant vegetation usually lack conspicuous tumuli, since soil particles are presumably blown away as soon as they are deposited on the surface. Nests in sheltered areas, such as at the base of grass clumps, possess mounds with many crenulations causing the structure to resemble a lump of brain coral.

In addition to the wide environmental tolerance of this species, there is a wide altitudinal tolerance. In Kansas, collection elevations range from 244 m to over 1220 m (pers. observ.). In Colorado, Gregg (1963) found collection elevations to range from 1067 m through 2591 m. Similar elevational extremes were found in Tennessee by Dennis (1938). This species also occurs down to sea level.

*Monomorium minimum* queens live approximately 1 year in laboratory colonies while workers live approximately 4 months. There appear to be three larval instars (Fig. 41) (pers. observ.).

Most nests contain multiple queens. For

example, Gregg (1944) found that nests near Chicago, Illinois usually contained 12-14 queens and Dennis (1938) found a similar number of queens per nest in Tennessee. Presumably these are functioning queens since most are associated with small, separate piles of eggs and first instar larvae (pers. observ.). Recent preliminary allozyme studies have demonstrated that several queens produce eggs at the same time in nests near Lawrence, Kansas (pers. observ.). Although it is not known how many queens establish a nest, most nests are probably established by one or two queens since a number of small nests with a small number of offspring and one or two queens are found each autumn in the Lawrence, Kansas, vicinity. Since nuptial flights occur in July in this vicinity, most newly mated queens should have new nests established by autumn.

Production of sexuals occurs in late spring and summer; most nests in Kansas contain larvae which will develop into sexuals by late May. Most sexual adults eclose by mid-July. Nuptial flights have not been observed, although they probably occur, since both males and gynes are winged.

*Monomorium minimum* is one of two species reported to have inquilines (*M. ergatogyna* is the other species). Van Pelt and Van Pelt (1972) reported larvae of *Microdon baliopterus* Loew (Diptera: Syrphidae) from nests of *M. minimum* in Big Bend National Park, Texas.

*Monomorium minimum* nests have been discovered in close association with nests of other ant species. Wheeler and Wheeler (1963) found *M. minimum* associated with nests of the following species: *Acanthomyops claviger* (Roger), *Camponotus vicinus* Mayr, *Formica fusca* Linnaeus, *Lasius crypticus* Wilson, and *Pogonomyrmex occidentalis* (Cresson). I have found nests of *M. minimum* associated with nests of an additional species, *Solenopsis (Diplorhoptrum) molesta* (Say), in Kansas.

COMPARISONS. Since *Monomorium minimum* queens are winged, they can easily be separated from other species occurring in the same area, most of which have wingless queens. Only *M. viridum* queens are

winged. Nests of *M. viridum* appear to be restricted to pure sand while nests of *M. minimum* only occur in soils containing some clay (W. L. Brown pers. observ.). Workers of this species can usually be separated by the combination of characters listed in the diagnosis, particularly the smooth and shining mesopleuron.

### *Monomorium cyaneum* Wheeler

Figures 10, 13, and 43-57

*Monomorium minimum*: Wheeler, 1906: 332, 336 (misidentification); Wheeler, 1908: 423 (in part); Smith, 1936a: 163 (in part); Cole, 1937: 99 (in part); Creighton, 1950: 219 (in part); Cole, 1953: 299 (in part); Smith, 1958: 128 (in part); Ettershank, 1966: 90 (in part); Smith, 1967: 356 (in part); Hunt and Snelling, 1975: 21; Smith, 1979: 1382-1383 (in part).

*Monomorium minimum* subsp. *cyaneum* Wheeler, 1914b: 43; Wheeler, 1917a: 465, 501; Kempf, 1972: 144.

*Monomorium minutum* subsp. *minima* var. *cyanea*: Emery, 1921: 173.

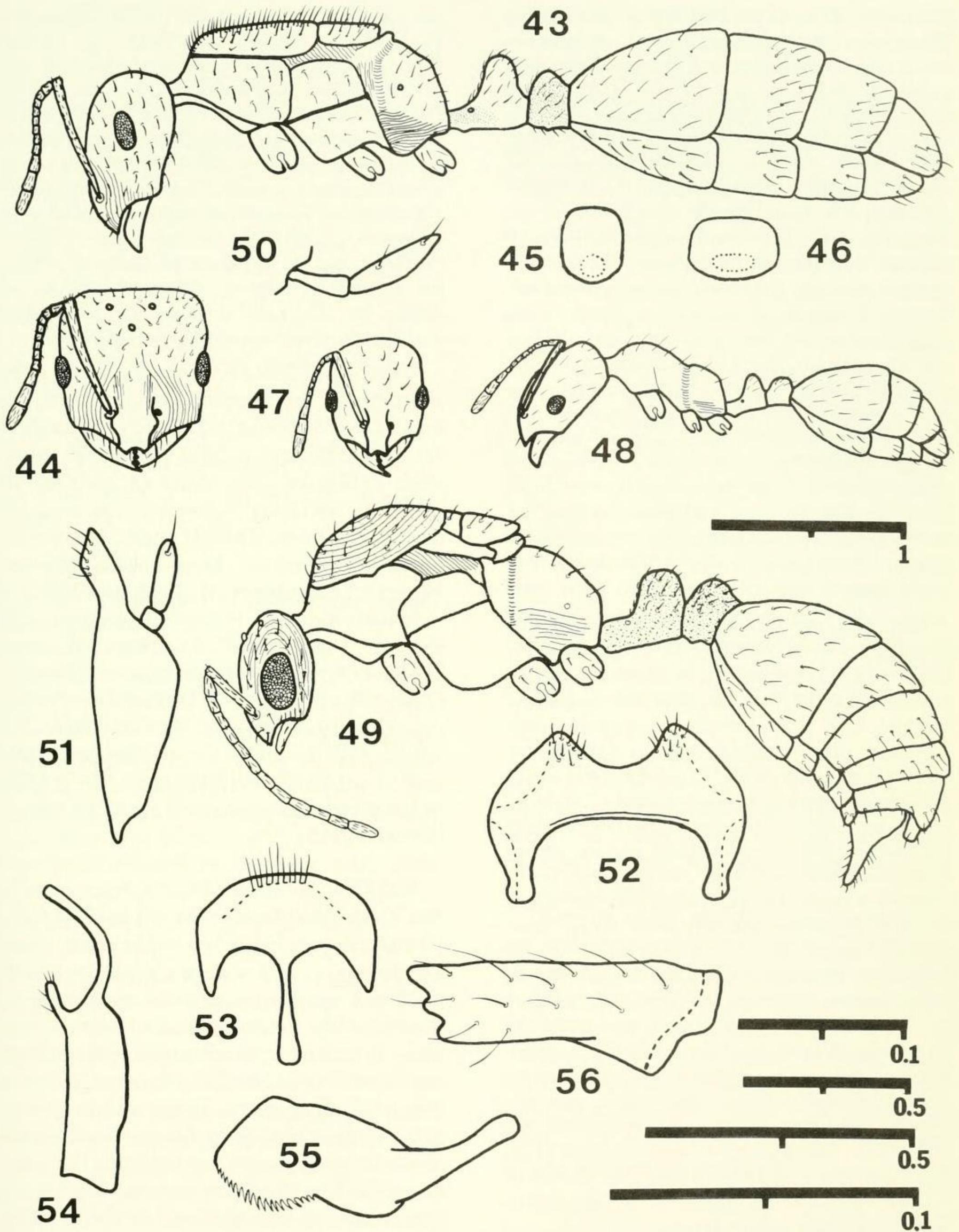
*Monomorium minimum* subsp. *emersoni* Gregg, 1945: 66-67; Smith, 1952: 810 (in part); **NEW SYNONYMY.**

*Monomorium cyaneum*: Ettershank, 1966: 88; DuBois, 1981a: 35-36; Jones et al., 1982: 287.

*Monomorium* near *emersoni*: Jones et al., 1982: 287.

**DIAGNOSIS.** QUEEN: Wingless; scutum and scutellum not depressed; metanotum (in lateral view) projecting to level of propodeum and scutellum; propodeum angular; petiole as in Figures 43 and 45; head sculpturing as in Figure 44. MALE: Genitalia and sterna as in Figures 49, 52-55. WORKER: Propodeum angular; mesopleuron punctate; petiole as in Figure 48; PI 29-38 (34).

**DESCRIPTION.** As described for *M. minimum* except as indicated. QUEEN: **HEAD:** Measurements (representing different localities;  $N=10$ ) HL 0.68-0.88 (0.76), HW 0.62-0.78 (0.68), SL 0.50-0.55 (0.52), IOD 0.15-0.19 (0.18), OD 0.04-0.05 (0.05), EL 0.16-0.20 (0.18), MOD 0.12-0.16 (0.13). **Structure**—CI 83-96 (90), SIL 62-76 (69), SIW 70-84 (77). Scape reaching or barely surpassing occiput. **Pilosity**—Setae suberect to subdecumbent near clypeus, frons, gular region, mandible, and occiput, decumbent to appressed elsewhere. **ALITRUNK:** Measurements PW 0.41-0.48 (0.44), PL 0.28-0.32 (0.30), WL 1.28-1.38 (1.32).



FIGS. 43-56. *Monomorium cyaneum*. 43—Queen, lateral view. 44—Head of queen, frontal view. 45—Petiole of queen, posterior view. 46—Postpetiole of queen, posterior view. 47—Head of worker, frontal view. 48—Worker, lateral view. 49—Male, lateral view. 50—Labial palp of male. 51—Maxilla and maxillary palp of male. 52—Eighth sternite of male. 53—Ninth sternite of male. 54—Volsella of male. 55—Aedeagus of male. 56—Mandible of male. Scales: Top scale (1 mm) for Figures 43-49. Second scale (0.1 mm) for Figure 56. Third scale (0.5 mm) for Figures 52 and 53. Fourth scale (0.5 mm) for Figures 54 and 55. Bottom scale (0.1 mm) for Figures 50 and 51.

*Structure*—Mesonotum lacking notal furrow. Mesopleural suture straight with no pits at either end. Propodeum angular, basal face half as long as declivitous face. PI 22-25 (23). Wings absent (fusion of sclerites and presence of callow queens in some nests indicate queens are wingless). *Pilosity*—Setae suberect to decumbent on side of alitrunk. *Sculpture*—Small to moderate piliferous punctures evenly distributed on alitrunk (moderate punctures predominating dorsally). *PETIOLE*: As in Figures 43 and 45: dorsum of node flat. Subpetiolar process reduced. Peduncle with dense, small, non-piliferous punctures; remainder of petiole smooth and shining with small to moderate piliferous punctures evenly distributed on anterior surface, dorsum, posterior surface, and sides. *POSTPETIOLE*: As in Figures 43 and 46: dorsum of node flat. Entire surface covered with dense, small to moderate, nonpiliferous punctures. *GASTER*: Setae of first gastral tergite not exceeding level of dorsum of postpetiolar node. *COLOR*: Mandible yellow to yellow brown. Alitrunk brown, legs yellow brown.

**MALE:** *HEAD: Measurements* (representing 1 locality,  $N=1$ ) HL 0.68, HW 0.72, SL 0.26, IOD 0.24, OD 0.08, EL 0.30, MOD 0.17. *Structure*—CI 106, SIL 38, SIW 36. *Sculpture*—Occiput with several moderate to large, concentric, semicircular rugae. *ALITRUNK: Measurements* PW 0.75, PL 0.49, WL 1.72. *Structure*—Mesopleural suture straight (pits lacking on both ends). Metanotum (in lateral view) not reaching level of propodeum and scutellum. *Pilosity*—Dorsal outline of alitrunk with fewer than 30 erect to suberect setae projecting above outline. *Sculpture*—Scutum with large, concentric, semicircular rugae. *PETIOLE*: As in Figure 49. Dorsum of node flat. Setae erect to subdecumbent on dorsum of node. Entire surface of node covered with small, non-piliferous punctures. *POSTPETIOLE*: As in Figure 49. Anterior subpostpetiolar process reduced. Entire surface of node covered with small, non-piliferous punctures. *GASTER*: As in Figures 49, and 52-55. Ninth sternite with 11 setae (Fig. 53). Aedeagus with 18 teeth (Fig. 55). Cuspis of volsella with 5 setae (Fig. 54). *COLOR*: As in queen. Genitalia yellow brown.

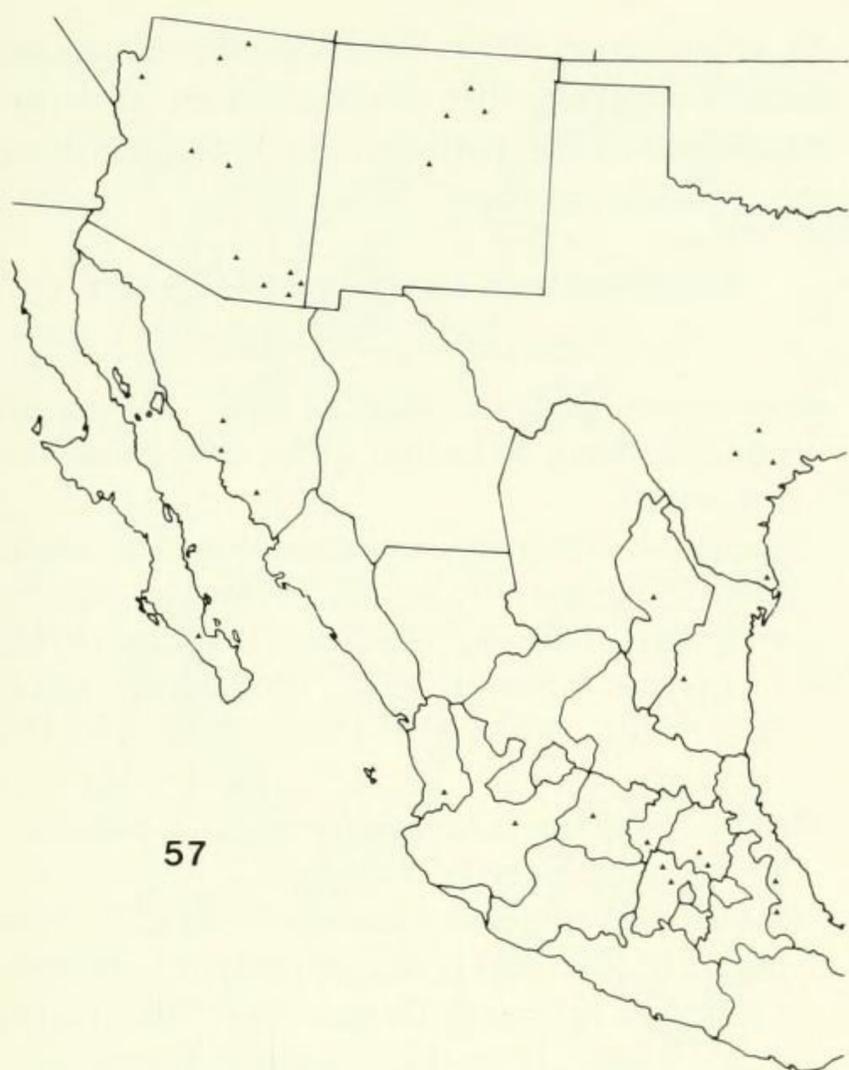
**WORKER.** *HEAD: Measurements* (representing different localities;  $N=10$ ) HL 0.48-0.60 (0.51), HW 0.35-0.42 (0.39), SL 0.30-0.45 (0.35), EL 0.08-0.10 (0.09), MOD 0.05-0.06 (0.05). *Structure*—CI 70-83 (78), SIL 60-80 (70), SIW 77-107 (90). *Pilosity*—Setae erect to suberect on clypeus, frons, gular region, mandible, and occiput, decumbent to appressed on remainder.

*ALITRUNK: Measurements* PW 0.20-0.25 (0.22), PL 0.14-0.22 (0.18), WL 0.45-0.62 (0.54). *Structure*—Propodeum angular, basal and declivitous faces of approximately equal length. *Pilosity*—Dorsal outline of alitrunk with 4-8 erect to suberect setae. *Sculpture*—Mesopleuron covered with small, dense, non-piliferous punctures (leading to a granular appearance); lower 1/3 of side of propodeum (below spiracle) with moderate, parallel, longitudinal rugae. PI 29-38 (34). *PETIOLE*: As in Figure 48. Dorsum of node flat to slightly convex. *POSTPETIOLE*: As in Figure 48. Dorsum of node flat to slightly convex. Anterior subpetiolar process absent.

**TYPE MATERIAL.** Syntypic series consisting of "numerous workers and females" (Wheeler, 1914b): MEXICO: HIDALGO: Guerrero Mill [spring or summer, 1913], W. M. Mann (4 queens, 40 workers; NMNH). Lectotype queen here designated from NMNH series bears red, handwritten label: *Monomorium/cyaneum/Wheeler/* Lectotype/ M. DuBois 1983/.

Synonymous *M. emersoni* type series consists of "1 queen and 79 workers" (Gregg, 1945): UNITED STATES: ARIZONA: Gila Co.; Globe, April, 1937, A. E. Emerson. Paratype queen and workers: TEXAS: Travis Co.; Austin, A. E. Emerson [paratype queen and 51 workers; NMNH, examined]. Holotype presumably in collection of R. Gregg (Gregg, 1945).

**DISTRIBUTION.** This species ranges from central Mexico (Mexican Plateau), particularly Hidalgo, Mexico, and Queretaro, east to western Vera Cruz, and west to Nayarit. These localities appear to represent the southern extent of this species. It occurs sporadically northward to southern Texas, New Mexico, and Arizona (Fig. 57). In eastern Texas this species is apparently replaced by *M. minimum* which seems to prefer moister habitats than *M. cyaneum*. The furthest eastern collections are from the San Antonio vicinity. The northernmost extensions of *M. cyaneum* occur in northern Arizona (numerous collections from Grand Canyon vicinity). This species has been collected as far west as the Hualapai Mountains near Kingman, Arizona. Further west, *M. cyaneum* is replaced by *M. ergatogyna*, while further north, *M. wheelerorum* predominates. It is possible that



57

FIG. 57. Distribution of *Monomorium cyaneum* (closed triangles).

*M. cyaneum* may someday be discovered in southern Utah and Nevada since the habitat is not significantly different from that of northern Arizona. It appears that while part of the sporadic distribution of this species is due to lack of collections, habitat restriction also plays a part. Most of the localities collected in Arizona and New Mexico represent upland areas (usually canyons within mountain ranges). Thus many populations may be rather isolated. At the southern extents of the range of *M. cyaneum*, most collections are from the Mexican Plateau. Although there are two collections from the state of Vera Cruz, both are from upland areas along the Mexican Plateau. Most collections from the plateau were near Mexico City (from such nearby states as Hidalgo and Queretaro). Collections from the western coast of Mexico are spotty. Only one collection has been made on an island (Maria Cleofas Islas, Nayarit). Three collections have been made in the region of Guaymas, Sonora and one collection in the Baja California peninsula (21 km N of La Paz).

**DISCUSSION. BIOLOGY.** Wheeler (1914b) indicated this species nests under

stones in "rather damp places on the sides of canyons." I have observed this to be the case with colonies of this species I have collected in New Mexico and Arizona. For example, one nest of this species (ARIZONA: Gila Co.) was located in such a habitat on the south facing slope of a small canyon.

This nest was concealed under a stone measuring approximately 0.1m<sup>2</sup>. Most of the nest occupied an area about 10 cm in diameter, about 5 cm from the east side of the stone (a populous colony of *Iridomyrmex pruinosus* (Roger) occupied the western portion under this stone). The portion of the *M. cyaneum* nest which was visible after the stone was removed consisted of a series of small chambers (1 cm in diameter) connected by tunnels (3 mm in diameter and 0.5-2 cm in length). The topmost layer of chambers was broken open when the stone was lifted. Most brood was near the surface, with different life stages clustered in separate chambers. Although this nest could only be excavated to a depth of about 7.5-10 cm due to large buried stones, I believe I collected the majority of individuals.

Colonies of *M. cyaneum* have multiple queens, although it is not known whether they are all functional. However, in nests I excavated, each queen was in a separate chamber and surrounded by eggs and first or second instar larvae.

Dates on which sexual forms are released are unknown, although the Gila County (Arizona) colony contained many callow queens and developing male pupae on June 12, 1979.

*Monomorium cyaneum* has a moderately wide altitudinal range (from 1387 m through 2286 m elevation in Arizona and from 1341 m through 2743 m {type locality} elevation in Mexico).

**SYSTEMATICS.** Although Gregg (1945) believed *M. emersoni* to be a separate taxon (subspecies), he failed to compare it with *M. cyaneum*. The most prominent feature used to distinguish *M. emersoni* was the prominent tubercles at the point where basal and declivitous faces of the propodeum meet. Although this seems to be a good character upon superficial examina-

tion, one colony (Santa Fe, New Mexico) contained numerous queens which ranged in morphology from the typical *M. cyaneum* propodeum to one with tubercles nearly developed into teeth. Since all other characters indicated this was a queen of *M. cyaneum*, *M. emersoni* was synonymized; none of the other characters used by Gregg differed from characters found in *M. cyaneum*.

COMPARISON. Since *Monomorium cyaneum* has wingless queens, the following species which occur in or near its range might be confused with it: *M. compressum*, *M. ergatogyna*, and *M. wheelerorum*. *Monomorium cyaneum* queens can easily be distinguished from *M. compressum* since the latter species has a depressed scutum and scutellum, an emarginate postpetiole, and fewer than 30 erect to suberect setae projecting above the dorsal profile of the alitrunk. *Monomorium cyaneum* queens differ from *M. ergatogyna* queens since the latter species has a fringe of erect to suberect setae on the anterior edge of the scape and less facial sculpturing than *M. cyaneum* (Fig. 34). *Monomorium cyaneum* queens are easily distinguished from *M. wheelerorum* queens since the latter species has an antennal fringe similar to that of *M. ergatogyna* queens, a flat to slightly depressed scutum and scutellum, and a notal furrow on the mesonotum.

Since the ranges of many species overlap with *M. cyaneum*, it is best to use the keys to separate workers which are not associated with queens. The following species are most likely to be collected within the range of *M. cyaneum*: *M. compressum*, *M. ebeninum*, *M. ergatogyna*, *M. marjoriae*, *M. minimum*, and *M. wheelerorum*. *Monomorium cyaneum* workers can easily be separated from *M. compressum* and *M. ebeninum* workers since the latter two species have a nonpunctate mesopleuron and more than 10 erect to suberect setae projecting from the dorsum of the alitrunk. *Monomorium cyaneum* workers can be separated from *M. ergatogyna* workers since the latter species has a more rounded propodeum and occurs mainly along the California coast. *Monomorium cyaneum* workers can be separated from workers of *M. marjoriae*, *M. minimum*, and

*M. wheelerorum* since the latter three species have a nonpunctate mesopleuron and the basal face of the propodeum is longer than the declivitous face.

### *Monomorium ergatogyna* Wheeler

Figures 1-5, and 58-80

*Monomorium minutum*: Brues, 1903: 148 (misidentification); Wheeler, 1910: 386 (misidentification).

*Monomorium minimum ergatogyna* Wheeler, 1904: 269; Wheeler, 1905a: 88; Wheeler, 1917b: 464, 501; Tulloch, 1930: 202; Mallis, 1941: 71 (in part); Smith, 1943: 300; Smith, 1947: 565; Smith, 1952: 810; Cook, 1953: 160-163 (in part).

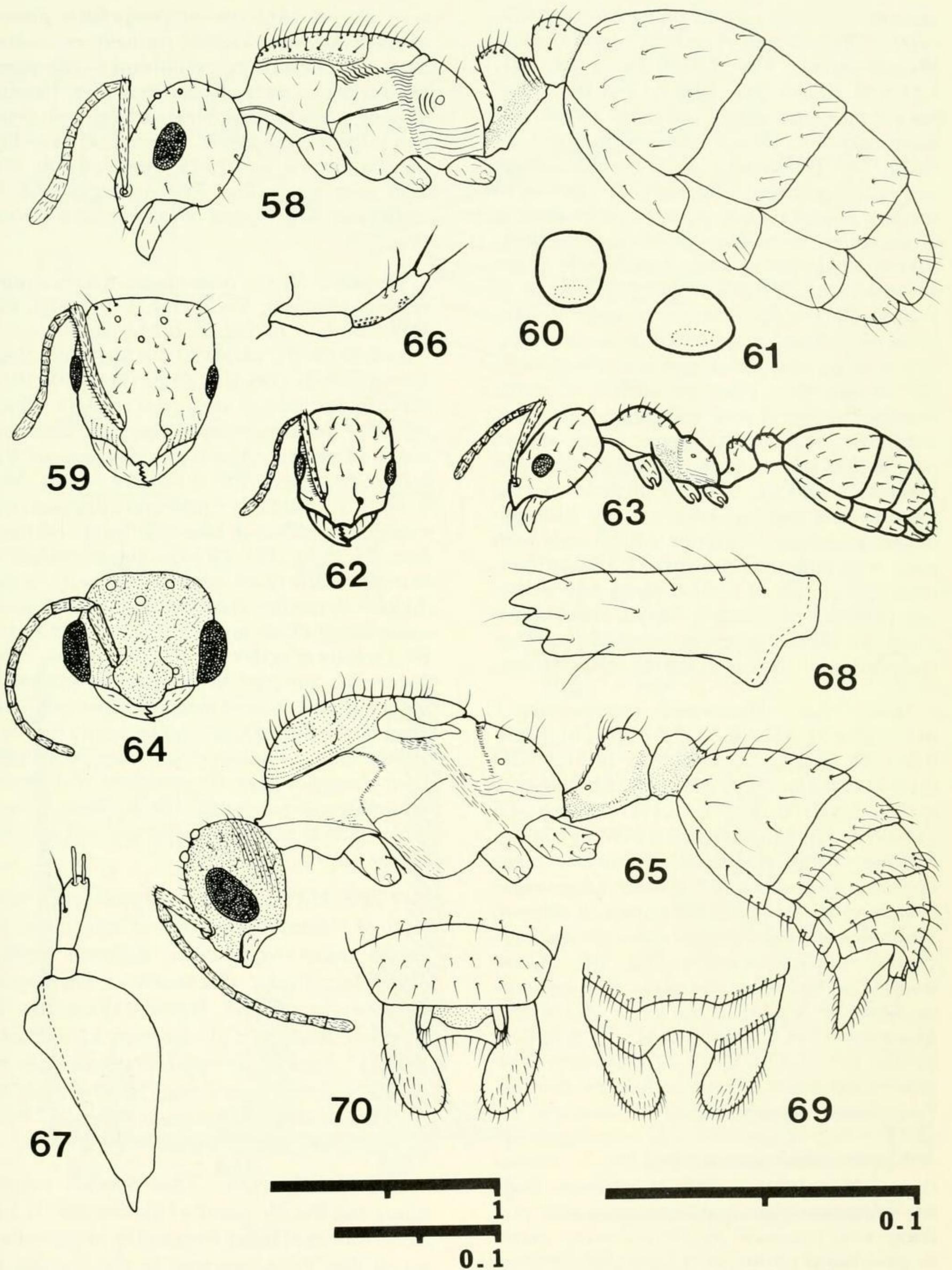
*Monomorium minutum* subsp. *minima* var. *ergatogyna*: Emery, 1921: 173.

*Monomorium minimum*: Essig, 1926: 857 (in part); Mallis, 1941: 71 (in part); Creighton, 1950: 219 (in part); Cook, 1953: 160-163 (in part); Smith, 1958: 128 (in part); Ettershank, 1966: 90 (in part); Smith, 1967: 356 (in part); Smith, 1979: 1382-1383 (in part); Snelling and George, (unpubl.).

*Monomorium ergatogyna*: Essig, 1926: 857.

DIAGNOSIS. QUEEN: Wingless; head (excluding lateral margin of clypeus) lacking non-piliferous punctures and rugae; alitrunk with more than 30 erect to suberect setae projecting above dorsal outline; petiole and postpetiole as in Figures 58, 60 and 61; antennal pilosity as in Figure 59. MALE: Genitalia and sterna as in Figures 65, 69, 70, and 72-78. WORKER: Propodeum, petiole and postpetiole as in Figure 63; mesopleuron punctate; PI 35-44 (38).

DESCRIPTION. As described for *M. cyaneum* except as indicated. QUEEN: HEAD: Measurements (representing different localities;  $N=10$ ). HL 0.59-0.71 (0.67), HW 0.55-0.65 (0.61), SL 0.41-0.52 (0.47), IOD 0.12-0.18 (0.17), OD 0.04-0.05 (0.05), EL 0.12-0.15 (0.14), MOD 0.09-0.11 (0.10). Structure—CI 79-95 (90), SIL 58-77 (70), SIW 63-91 (77). Side straight to slightly convex. Frontal carinae diverging strongly posteriorly. Pilosity—Setae erect near clypeus, frons, gula, occiput, and ocelli, suberect to decumbent on malar area, appressed on remainder. Setae of scape erect on anterior edge (forming a fringe of setae, Figure 59), decumbent to appressed on remainder, of pedicel and flagellum (except club) suberect to decumbent, of antennal club appressed. Sculpture—Smooth and shining except as follows: moderate, parallel, longitudinal rugae beginning all along lateral margin of clypeus and extending to level of



FIGS. 58-70. *Monomorium ergatogyna*. 58—Queen, lateral view. 59—Head of queen, frontal view. 60—Petiole of queen, posterior view. 61—Postpetiole of queen, posterior view. 62—Head of worker, frontal view. 63—Worker, lateral view. 64—Head of male, frontal view. 65—Male, lateral view. 66—Labial palp of male. 67—Maxilla and maxillary palp of male. 68—Mandible of male. 69—Male genitalia (*in situ*), dorsal view. 70—Male genitalia (*in situ*), ventral view. Scales: Top left (1 mm) for Figures 58-65, and 69-70. Lower left (0.1 mm) for Figure 68. Right (0.1 mm) for Figures 66 and 67.

antennal insertion. Small piliferous punctures evenly distributed on head. *ALITRUNK*: Measurements PW 0.40-0.48 (0.43), PL 0.21-0.31 (0.28), WL 1.00-1.15 (1.06). *Structure*—Propodeum evenly rounded (basal and declivitous faces do not meet at an angle). PI 19-28 (26). *Pilosity*—As in *M. minimum*. *Sculpture*—Large piliferous punctures on dorsum of scutum, smaller piliferous punctures on dorsum of scutellum, propodeum and side of alitrunk. Several moderate to large semicircular rugae anterior to propodeal spiracle. *PETIOLE*: As in Figures 58 and 60. Dorsum of node convex. Setae decumbent to appressed on anterior surface of node, erect on dorsum and side of node, and absent from posterior surface of node. Posterior surface of node with large, transverse, concentric, semicircular rugae which extend over half of side of node. *POSTPETIOLE*: As in Figures 58 and 61. Dorsum of node convex. Dorsum and sides of node smooth with piliferous punctures. Posterior 1/5 of node with some non-piliferous punctures. >Sometimes, lower 2/3 of side of node covered with dense, non-piliferous punctures<. *COLOR*: Head brown except as follows: antenna, mandible, and lateral margin of clypeus yellow to yellow brown.

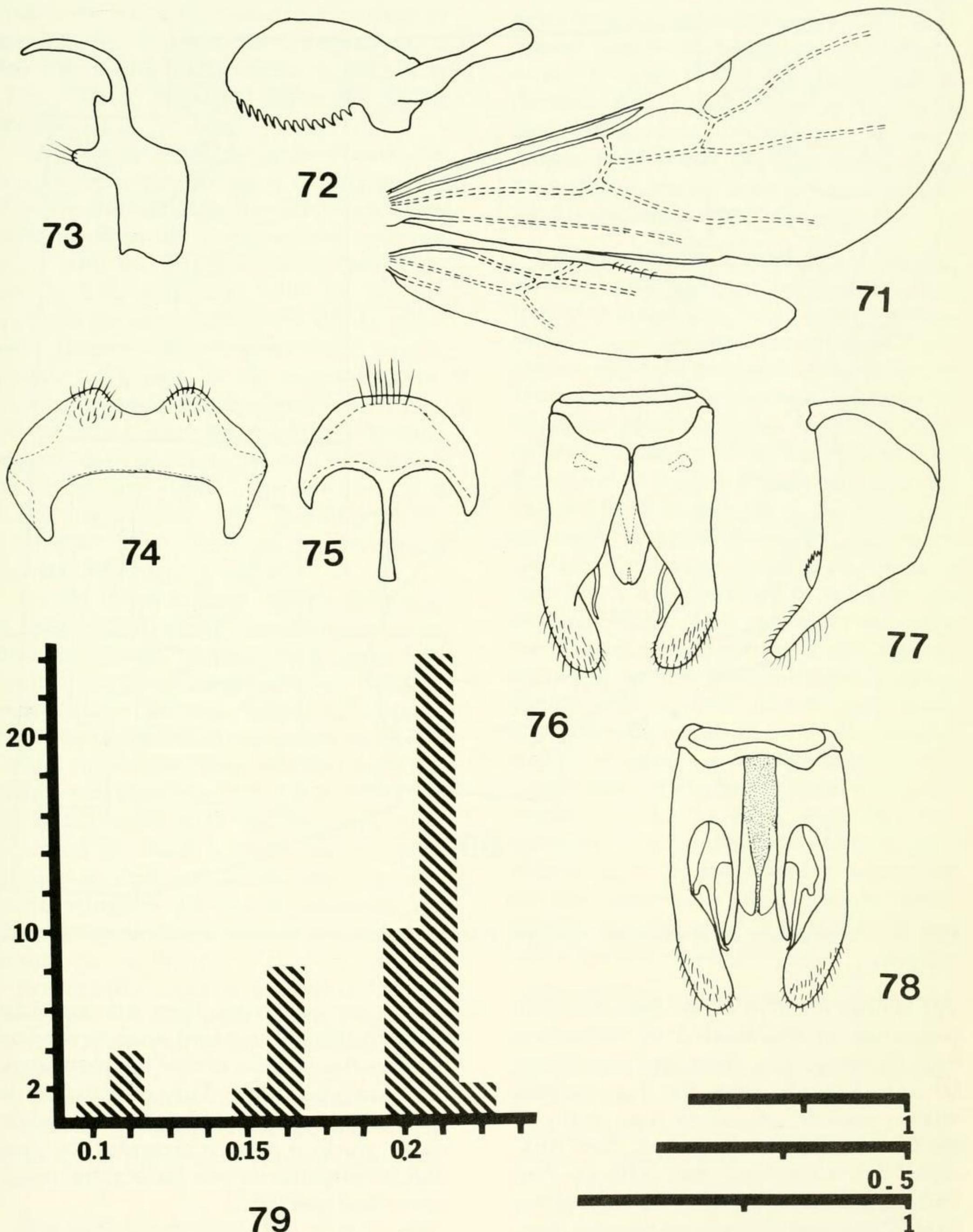
*MALE*: *HEAD*: *Measurements* (representing 1 nest;  $N=5$ ) HL 0.55-0.58 (0.56), HW 0.66-0.71 (0.69), SL 0.29-0.35 (0.31), IOD 0.18-0.20 (0.19), OD 0.06 (0.06), EL 0.24-0.26 (0.25), MOD 0.12-0.16 (0.15). *Structure*—CI 114-127 (123), SIL 53-60 (55), SIW 41-53 (45). *Sculpture*—Large, concentric, transverse rugae occurring on posterior 1/3 of head. Large rugae beginning all along lateral margin of clypeus, continuing behind antennal insertion and converging with frontal carina (Fig. 64). >Occasionally, several moderate rugae may converge on anterior ocellus (Fig. 64)<. *ALITRUNK*: *Measurements* PW 0.49-0.56 (0.51), PL 0.38-0.42 (0.40), WL 1.28-1.29 (1.29). *Structure*—Pronotal-scutal suture located medially on alitrunk. Propodeum angular (Fig. 65), basal and declivitous faces of approximately equal length. PI 29-33 (31). Wings present (Fig. 71); 5-7 hamuli on hindwing. *Pilosity*—As in *M. minimum*. *Sculpture*—Anterior edge of mesopleuron, near procoxa, with series of small transverse rugae. Sculpturing of sutures as in Figure 65. *PETIOLE*: As in Figure 65. Dorsum of node convex. Setae subdecumbent to appressed on anterior surface of node, suberect to erect on dorsum, absent from posterior surface of node. Side of petiole with small non-piliferous punctures; dorsum smooth and shining with a few piliferous punctures. *POSTPETIOLE*: As in Figure 65. Dorsum of

node convex. Anterior subpostpetiolar process of moderate size, located medially on venter. Setae erect to suberect on dorsum and/or posterior surface of node; absent elsewhere. Dorsum of node smooth, remaining surfaces with dense non-piliferous punctures. *GENITALIA*: As in Figures 65, 69, 70, and 72-78. Ninth sternite with 7-10 erect setae (Fig. 75). Aedeagus with 13 teeth (Fig. 72). Cuspis of volsella with 3 setae (Fig. 73).

*WORKER*: *HEAD*: *Measurements* (representing separate localities;  $N=10$ ) HL 0.40-0.60 (0.49), HW 0.33-0.42 (0.39), SL 0.31-0.40 (0.35), EL 0.06-0.10 (0.07), MOD 0.04-0.06 (0.05). *Structure*—CI 70-91 (79), SIL 62-85 (71), SIW 79-98 (89). In full frontal view, side straight. Scape reaching or surpassing occiput by less than length of pedicel. *ALITRUNK*: *Measurements* PW 0.20-0.28 (0.25), PL 0.18-0.24 (0.20), WL 0.48-0.59 (0.52). *Structure*—Propodeum rounded; declivitous face half length of basal face. PI 35-44 (38). *Pilosity*—Dorsal surface of alitrunk with 18-25 erect to suberect setae. *Sculpture*—Anterior propodeal suture with moderate, longitudinal rugae. *PETIOLE*: As in Figure 63. Dorsum of node convex. *POSTPETIOLE*: As in Figure 63. Anterior subpostpetiolar process of moderate size, located medially on venter. Setae erect on dorsum of node and on venter (beneath node), erect to suberect on sides, remainder bare. Posterior edge of postpetiole with dense, non-piliferous punctures. *COLOR*: Base of mandible, lateral margin of clypeus, and antenna yellow brown.

*TYPE MATERIAL*. Syntypic series consists of "numerous workers and eight females taken from three different nests" (Wheeler, 1904). *CALIFORNIA*: Los Angeles Co., Catalina Island, Baker; (16 queens, 21 workers; AMNH), (17 queens, 12 workers; MCZ). Lectotype queen selected from AMNH series bears red, handwritten label: *Monomorium/ergatogyna/* Wheeler/ Lectotype/ M. DuBois 1980/.

*DISTRIBUTION*. This species ranges along the Pacific coast of California. It has been collected most frequently in the vicinity of San Francisco and in the vicinity of Los Angeles (including several offshore islands). The range extends inland in the southern portions of California (Fig. 80). The most northern records for this species are Marin Co. (Fairfax, Mill Valley, Mt. Tamalpias, San Anselmo, and Woodacre).



FIGS. 71-79. *Monomorium ergatogyna*. 71—Wings (right side) of male. 72—Aedeagus of male. 73—Volsella of male. 74—Eighth sternite of male. 75—Ninth sternite of male. 76—Male genital capsule, dorsal view. 77—Male genital capsule, lateral view. 78—Male genital capsule, ventral view. 79—Histogram of larval head capsule widths (interval is 0.11 mm). Scales: Top scale (1 mm) for Figure 71. Middle scale (0.5 mm) for Figures 72-73. Bottom scale (1 mm) for Figures 74-78.

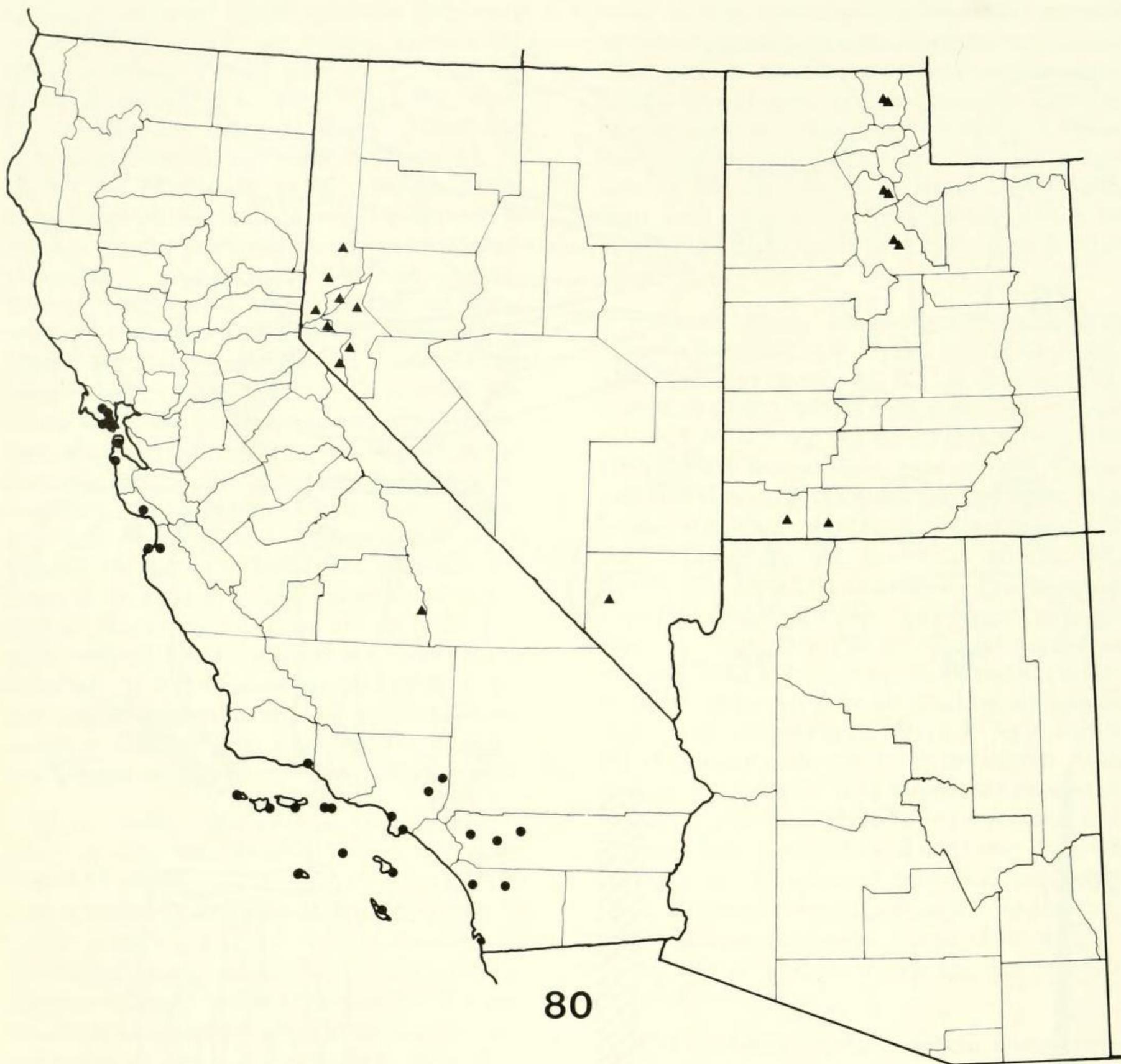


FIG. 80. Distribution of *Monomorium ergatogyna* (closed circles) and *Monomorium wheelerorum* (closed triangles).

The southern extent of the San Francisco population is represented by collections from Monterey Co. (Fort Ord and Pacific Grove). Records from the Los Angeles vicinity include collections from many of the Channel Islands (Anacapa, East Anacapa, San Clemente, San Miguel, San Nicholas, Santa Barbara, Santa Catalina, Santa Cruz, and Santa Rosa islands). Records in the Los Angeles vicinity range from the San Gabriel Mountains in the north to Camp Pendleton and Mount Palomar in the south. The easternmost record for this species is Palm Springs.

Although future collecting may show the northern and southern populations of this

species are connected, there are currently no records from Fort Ord south to the Los Angeles Basin, a distance of approximately 320 Km (Fig. 80). This distribution is similar to that of *M. viridum* on the Atlantic coast which is also represented by two disjunct populations (see further discussion under that species).

**DISCUSSION. BIOLOGY.** Recorded as nesting under stones (Brues, 1903), in soil or in rotten wood (Essig, 1926). Mallis (1941) records this species (misidentified as *M. minimum*) nesting in a dry, unshaded area (in the Berkeley Hills) with tumuli forming tiny craters (2-4 cm in diameter).

Further details of nest architecture are unknown. In addition to the variety of nesting sites occupied by *M. ergatogyna*, it has a wide altitudinal tolerance, from 9 m (Long Beach) through 1500 m (H. James Reserve).

*Monomorium ergatogyna* queens have the longest recorded life span in this genus. Colonies (collected in the field) have been maintained in the laboratory for over two years with the original queens (pers. observ.). This compares with an average queen longevity of 39 weeks for *M. pharaonis* (Peacock and Baxter, 1950) and 8 months to 1 year for *M. minimum* (pers. observ.). *Monomorium ergatogyna* worker longevity varies from 4-8 months (4 months appears to be the usual life span for workers of this genus). There appear to be three larval instars (Fig. 79). Colonies of *M. ergatogyna* have multiple, functioning queens (2-6) (pers. observ.).

Sexual forms emerge during July and August {collections of reproductives: Santa Barbara Island, 12 June 1978 (gyne larvae); Santa Cruz Island, 23 July 1963 (1 male); East Anacapa Island, 23 August 1978 (10 males and 20 unmated queens)}. Only 2 males have been collected from the mainland {Pasadena, 17 April 1929}. If this date is correct, *M. ergatogyna* may produce sexuals twice a year. Another possibility is that an undescribed species occurs sympatrically with *M. ergatogyna*; no morphological differences have been found to support this theory.

Brues (1903) reported a species of *Microdon* (Diptera: Syrphidae) from a nest at Pacific Grove. No other symbionts have been reported.

It appears that the Argentine Ant, *Iridomyrmex humilis* (Mayr), occupies much of the habitat once utilized by *M. ergatogyna* (pers. observ.).

**SYSTEMATICS.** A great deal of confusion in previous literature has resulted from the erroneous assumption that *M. minimum* and *M. viridum peninsulatum* occurred in California (see further discussion under *M. viridum*). Furthermore, *M. ergatogyna* was thought to inhabit only the coastal islands (Essig, 1926; Mallis, 1941; Cook, 1953).

Although the San Francisco and Los Angeles populations of this species currently appear allopatric, much more collecting must be done before this point can be decided. Additionally, there appear to be some minor size differences between queens from island localities versus those from the mainland. It seems best to regard all this material as *M. ergatogyna*.

**COMPARISONS.** Although all known populations of *M. ergatogyna* are geographically removed from any other native *Monomorium*, it is possible that queens of this species might be confused with queens of *M. cyaneum* or *M. wheelerorum*. *Monomorium ergatogyna* queens can be separated from those of *M. cyaneum* by the fringe of setae on the antennal scape (Figure 61) and the reduced head sculpturing in *M. ergatogyna*. Although *M. ergatogyna* and *M. wheelerorum* are the only species included in this revision which have a fringe of setae on the antennal scape, they can easily be separated, since *M. wheelerorum* has a slightly depressed scutum and scutellum, a mesonotum with a notal furrow, and more extensive sculpturing on the head. Workers of *M. ergatogyna* can be separated by the combination of characters listed in the diagnosis and in the keys, especially: *M. ergatogyna* workers have a rounded propodeum while the prododeum of workers of the other species are more angular. Additionally, workers of *M. wheelerorum* do not have a punctate mesopleuron.

#### *Monomorium wheelerorum* new species

Figures 11, 17, 80, and 81-86

*Monomorium minimum*: Wheeler, 1917a: 464-465, 501 (in part).

**DIAGNOSIS.** QUEEN: Wingless; head sculpture as in Figure 82; petiole as in Figures 81 and 83; scutum and scutellum flat or slightly depressed dorsally; metanotum projecting to level of propodeum and scutellum; propodeum angular. WORKER: Propodeum angular; mesopleuron not punctate; petiole as in Figure 85; PI 26-40 (34).

**DESCRIPTION.** As described for *M. cyaneum* except as follows: QUEEN (DATA FOR HOLOTYPE IN BRACKETS {}): HEAD: Measurements (representing different localities; N=10) HL 0.46-0.79

(0.73){0.71}, HW 0.54-0.68 (0.62){0.59}, SL 0.37-0.58 (0.52){0.48}, IOD 0.15-0.21 (0.17){0.15}, OD 0.04-0.05 (0.04){0.04}, EL 0.14-0.17 (0.15){0.17}, MOD 0.10-0.13 (0.11){0.13}. *Structure*—CI 80-92 (86) {83}, SIL 54-78 (72){68}, SIW 64-95 (84){81}. In full frontal view, side straight. *Pilosity*—As in *M. ergatogyna*. *Sculpture*—Several small, parallel, longitudinal rugae beginning between frontal carinae, extending towards anterior ocellus (but never exceeding 2/3 the distance between posterior end of frontal carina and anterior ocellus). *ALITRUNK: Measurements* PW 0.31-0.46 (0.38){0.46}, PL 0.25-0.34 (0.30){0.25}, WL 1.06-1.29 (1.20){1.08}. *Structure*—Mesonotum with notal furrow. Scutum and scutellum flat to slightly depressed dorsally. Mesopleural suture straight with pit on anterior end. Metanotum (in lateral view) reaching or exceeding level of propodeum and scutellum. Propodeum angular >rarely rounded<, basal and declivitous faces of approximately equal length. PI 22-27 (25){22}. *PETIOLE*: As in Figures 81 and 83. Subpetiolar process moderate to enlarged. Setae subdecumbent to decumbent on anterior surface of node, suberect to erect on dorsum, side, and posterior surface of node, absent elsewhere. Posterior surface with small to moderate, semicircular, concentric, transverse rugae. Side with small, parallel, longitudinal rugae extending to and fusing with posterior transverse rugae. *POSTPETIOLE*: As in Figures 81 and 84. Dorsum of node smooth and shining with few small, piliferous punctures, remainder covered with dense, moderate to large, non-piliferous punctures. *COLOR*: Head brown to dark brown, mandible and lateral margin of clypeus yellow brown. Alitrunk dark brown to brown, legs brown to yellow brown, tibiae and tarsi yellow brown to yellow. Petiole, postpetiole, and gaster dark brown to brown. All setae white >rarely, some setae on gaster light yellow<.

*MALE*: Unknown in *M. wheelerorum*.

*WORKER. HEAD: Measurements* (representing different localities;  $N=10$ ) HL 0.46-0.54 (0.50), HW 0.35-0.42 (0.39), SL 0.30-0.38 (0.36), EL 0.06-0.09 (0.07), MOD 0.05-0.06 (0.06). *Structure*—CI 71-87 (79), SIL 61-76 (72), SIW 85-95 (91). *ALITRUNK: Measurements* PW 0.21-0.26 (0.24), PL 0.12-0.21 (0.17), WL 0.46-0.56 (0.50). *Structure*—Propodeum angular, basal face 1.5X as long as declivitous face. PI 26-40 (34). *Pilosity*—Dorsal outline of alitrunk with more than 10 erect to suberect setae. Setae absent from side, although leg pilosity as in queen. *Sculpture*—As in *M. minimum*. *PETIOLE*: As in Figure 85. Dorsum of node convex.

*POSTPETIOLE*: As in Figure 85. Dorsum of node convex.

*TYPE MATERIAL. NEVADA: Clark Co.*; Wheeler Spring, Spring Mountains, 2012 m, G. C. & J. Wheeler 1561. Holotype queen [LACM] bears red, handwritten label: *Monomorium/ wheelerorum/ Holotype/ M. DuBois 1983/*. Two paratype workers [LACM, MBDPC] from same locality bear blue, handwritten label: *Monomorium/ wheelerorum/ Paratype/ M. DuBois 1983/*. Additional paratypes distributed as follows (all bearing paratype labels similar to one described above). Localities refer to those listed in detail below which are surrounded by brackets []. Davis Creek Park - 1 queen, 2 workers [MBDPC], Mullen Gap - 1 queen, 2 workers [KU], Sand Canyon - 1 queen, 2 workers [MCZ], Ophir Grade - 1 queen, 2 workers [NMNH].

*ETYMOLOGY*. This species is named in honor of Drs. George and Jeanette Wheeler who provided many specimens of it.

*DISTRIBUTION*. This species is known from scattered localities in California, Nevada, and Utah. The majority of collections have come from the vicinity of Lake Tahoe (Fig. 80). *CALIFORNIA: Tulare Co.*, Kennedy Meadows, 1859 m, R. J. Hamton & B. S. Ikeda (under rock). *NEVADA: Clark Co.*, 4.8 km ENE Charleston Peak, 2134 m, G. C. & J. Wheeler 839; *Douglas Co.*, 6.4 km WSW Wellington, 1676 m, G. C. & J. Wheeler 1093; [*Lyon Co.*, Sand Canyon, 1981 m, R. Bechtel]; 12.9 km NW Smith, 1432 m, G. C. & J. Wheeler 1945; [*Storey Co.*, Ophir Grade, 3.2 km WSW Virginia City, 1981 m, G. C. & J. Wheeler 2280]; 32 km E. Reno, T19S R20E s 8, 1463 m G. C. & J. Wheeler 2767; [*Washoe Co.*, Davis Creek Park, 1554 m, G. C. & J. Wheeler 2366]; [Mullen Gap, W of S end of Pyramid Lake, I. LaRivers 1484]; 27.4 km N Sparks, 1341 m, G. C. & J. Wheeler 2751. *UTAH: Cache Co.*, Green Canyon, G. Knowlton; Logan Canyon, G. Knowlton; *Kane Co.*, 32 km N Kanab, A. C. Cole; *Salt Lake Co.*, Mill Creek, Chamberlin; Salt Lake City, P. Miles; *Utah Co.*, Provo, Brigham Young

University Campus, M. Tanner; Springville, G. Knowlton; Washington Co., La Verkin, A. Sturtevant.

**DISCUSSION.** Although the known range of *M. wheelerorum* is allopatric from any other species included in this revision, future collecting may reveal some overlap between this species and *M. cyaneum* and possibly *M. ergatogyna*. Although both queens of *M. wheelerorum* and *M. ergatogyna* have a similar fringe of erect to suberect setae on the scape, *M. wheelerorum* can easily be separated since it also has a flat to slightly depressed scutum and scutellum and a notal furrow on the mesonotum. *Monomorium wheelerorum* queens differ from those of *M. cyaneum* in that queens of the former have the fringe of setae on their scape as described above. Additionally, queens of *M. cyaneum* never have a flat to slightly depressed scutum and scutellum nor a notal furrow on the mesonotum. Workers of *M. wheelerorum* may be separated from workers of *M. ergatogyna* since the latter have a rounded propodeum. Workers of *M. wheelerorum* may be distinguished from workers of *M. cyaneum* since the former possess a propodeum with basal and declivitous faces of equal length while the latter possess a propodeum with the basal face longer than the declivitous face.

### *Monomorium compressum* Wheeler

Figures 87-93

*Monomorium minimum* subsp. *compressum*  
Wheeler, 1914b: 43; 1917a: 464, 501;  
Kempf, 1972: 144.

*Monomorium minutum* subsp. *minima* var. *compressum*: Emery, 1921: 173.

*Monomorium compressum*: Ettershank, 1966: 88.

**DIAGNOSIS.** **QUEEN:** Wingless; scutum and scutellum depressed dorsally; metanotum (in lateral view) projecting to level of propodeum and scutellum; propodeum angular; petiole as in Figures 87 and 89. **WORKER:** Propodeum angular; mesopleuron not punctate; petiole as in Figure 91; PI 36-39 (38).

**DESCRIPTION.** As described for *M. cyaneum* except as follows. **QUEEN: HEAD: Measurements** (representing type locality - probably from same nest;  $N=3$ ) HL 0.60-0.68 (0.64), HW 0.55-0.60 (0.58), SL 0.45-0.50 (0.48), IOD 0.12-0.14 (0.13), OD 0.02-0.04 (0.03), EL

0.11-0.14 (0.12), MOD 0.10 (0.10). **Structure**—CI 80-96 (90), SIL 73-75 (74), SIW 77-91 (83). Eye small. **Pilosity**—Setae erect near clypeus, frontal carinae, mandibles and ocelli, decumbent to appressed on malar area, appressed on remainder of head (including gular region). **Sculpture**—Small parallel rugosities extending from distal portion of clypeus (between clypeal teeth) to level of antennal insertions between frontal carinae (Fig. 88). **ALITRUNK: Measurements** PW 0.38-0.40 (0.39), PL 0.25-0.28 (0.26), WL 0.88-0.90 (0.89). **Structure**—Scutum and scutellum depressed. Mesopleural suture deflected ventrally at posterior end (with a small pit on anterior end). Propodeum angular (Fig. 87), basal and declivitous faces of approximately equal length. PI 27-32 (29). **Pilosity**—Dorsal outline of alitrunk with 8-16 erect to suberect setae (projecting over 3/4 their lengths above outline). **PETIOLE:** As in Figures 87 and 89. Dorsum of node convex to flat. Anterior surface and side of node with small non-piliferous punctures; dorsum smooth with few piliferous punctures; posterior surface with moderate, transverse, concentric, semicircular rugae. **POSTPETIOLE:** As in Figures 87 and 90. Dorsum of node convex to slightly emarginate. Dorsum of node smooth (with few piliferous punctures), remaining surfaces with dense non-piliferous punctures. **GASTER:** As in *M. minimum*. **COLOR:** Head and antenna brown except as follows: base of mandible and lateral margin of clypeus yellow to yellow brown.

**MALE:** Unknown in *M. compressum*.

**WORKER. HEAD: Measurements** (representing different localities;  $N=9$ ) HL 0.46-0.55 (0.49), HW 0.37-0.44 (0.39), SL 0.27-0.40 (0.33), EL 0.08 (0.08), MOD 0.05-0.06 (0.06). **Structure**—CI 76-87 (80), SIL 54-78 (68), SIW 71-92 (85). Scape reaching but never surpassing occiput. **ALITRUNK: Measurements** PW 0.22-0.28 (0.25), PL 0.17-0.24 (0.20), WL 0.44-0.62 (0.54). **Structure**—PI 36-39 (38). **Pilosity**—Dorsal outline of alitrunk with 8-14 erect to suberect setae. **PETIOLE:** As in Figure 91. Dorsum of node convex. Setae erect on dorsum of node, remainder bare. Lower 1/3 of side with small, non-piliferous punctures (leading to a granular appearance); remainder smooth and shining (dorsum of node with piliferous punctures). **POSTPETIOLE:** As in Figure 91. Posterior 1/3 of postpetiole with dense, non-piliferous punctures; remaining surfaces smooth and shining (dorsum of node with piliferous punctures). **GASTER:** As in *M. minimum*. **COLOR:** Head brown except as follows: base of mandible and antenna yellow brown.

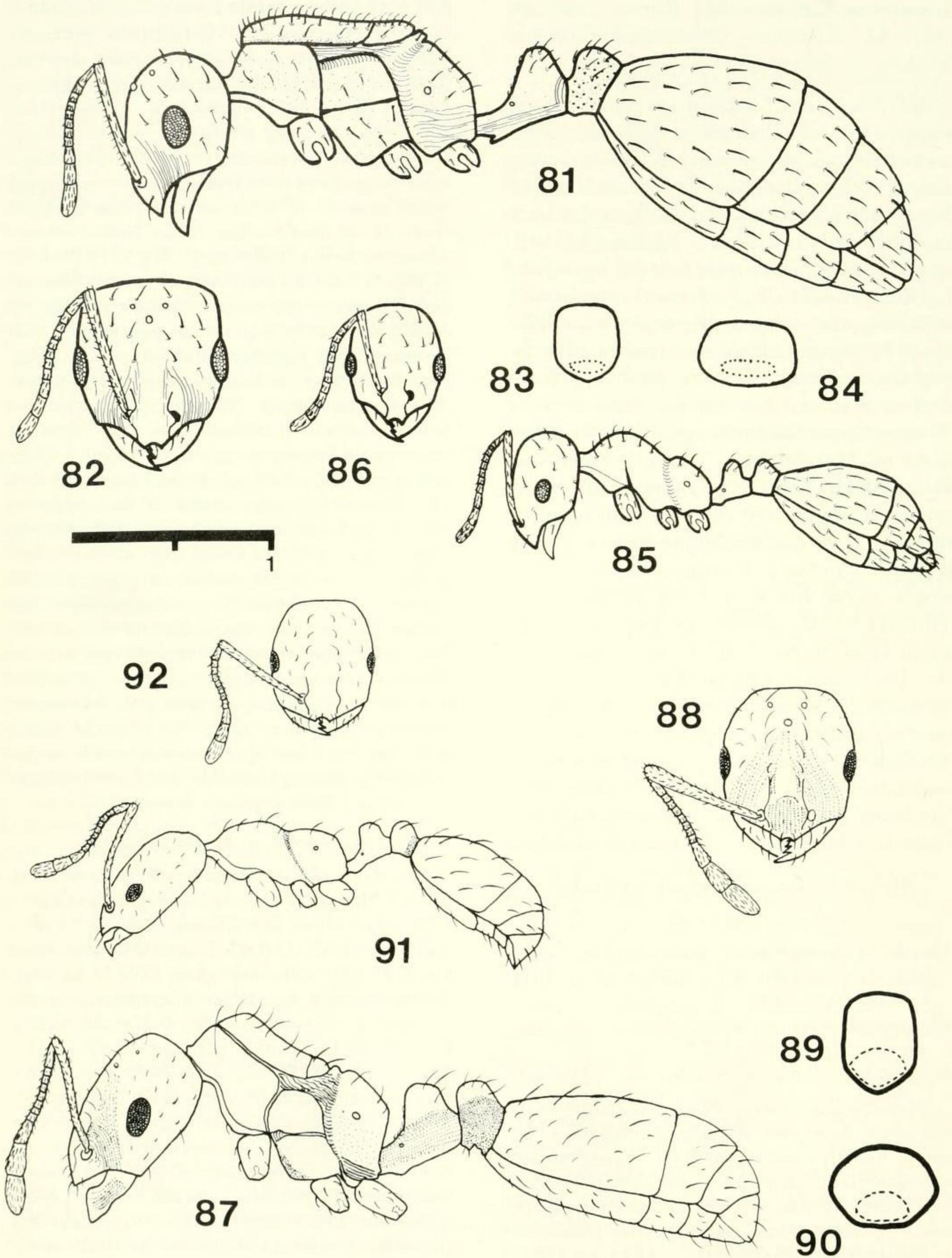


FIG. 81-86. *Monomorium wheelerorum*. 81—Queen, lateral view. 82—Head of queen, frontal view. 83—Petiole of queen, posterior view. 84—Postpetiole of queen, posterior view. 85—Worker, lateral view. 86—Head of worker, frontal view. FIG. 87-92. *Monomorium compressum*. 87—Queen, lateral view. 88—Head of queen, frontal view. 89—Petiole of queen, posterior view. 90—Postpetiole of queen, posterior view. 91—Worker, lateral view. 92—Head of worker, frontal view. Scale: (1 mm) for Figures 81-92.

**TYPE MATERIAL.** Syntypic series consisting of "4 females and several workers" (Wheeler, 1914b): MEXICO: *Hidalgo*: San Miguel [spring or summer, 1913], W. M. Mann (3 queens, 12 workers; NMNH). Lectotype queen here designated from NMNH series bears red, handwritten label: *Monomorium/ minimum/ compressum/ Wheeler/ Lectotype Queen/ M. DuBois 1983/*. The lectotype is mounted on same point with 2 workers which could not be removed.

**DISTRIBUTION.** This species is known from scattered localities across the Mexican

Plateau and extending west to the Pacific coast (Morelos and Hidalgo to Sinaloa) (Figure 93). Collection data for this species follow: MICHUACAN: San José Purula, R. & A. Hamton, B. Ikeda; MORELOS: Cuernavaca, N. Krauss; NAYARIT: San Blas, R. Hamton; San Blas Playa, E. Schlinger; Tepic; SINALOA: Los Mochis; Proterillo 10.5 km E. One collection [TEXAS: Marathon, Garden Springs (2 queens, 8 workers; LACM)] may be mislabelled, or this species has a much wider range than is indicated above.

**DISCUSSION.** BIOLOGY. This species



FIG. 93. Distribution of *Monomorium compressum* (closed triangles).

nests under stones (Wheeler, 1914b) but nest architecture is unknown. Colonies of *M. compressum* may have multiple, functioning queens (Wheeler, 1914b).

COMPARISONS. Queens of *M. compressum* can be distinguished from queens of the other species that occurs in its range (*M. cyaneum*), since the former have a depressed scutum and scutellum, an emarginate postpetiole, and fewer than 30 erect to suberect setae projecting above dorsal outline of alitrunk. Workers of *M. compressum* are separated from those of *M. cyaneum* since the former have a smooth mesopleuron and more than 10 erect to suberect setae projecting above dorsal outline of alitrunk.

### *Monomorium viridum* Brown

Figures 9, 15, 21, and 94-100

*Monomorium minutum* var. *minimum*: Emery, 1895: 274-275 (in part); Wheeler, 1905b: 377 (misidentification).

*Monomorium minutum* subsp. *minima*: Emery, 1921: 172 (in part).

*Monomorium minimum*: Smith, 1930: 3; Wheeler, 1932: 9; Van Pelt, Jr., 1948: 58-59, 64; Van Pelt, Jr., 1956: 377, 384; Van Pelt, Jr., 1958: 26 (mididentifications).

*Monomorium viridum* Brown, 1943: 243-248; Smith, 1947: 565; Creighton, 1950: 223; Smith, 1952: 811; Ettershank, 1966: 93; Smith, 1967: 356; Crozier, 1970: 116-117; Crozier, 1975: 50, 55; Smith, 1979: 1384; Jones et al., 1980: 789, 791; Jones et al., 1982: 287.

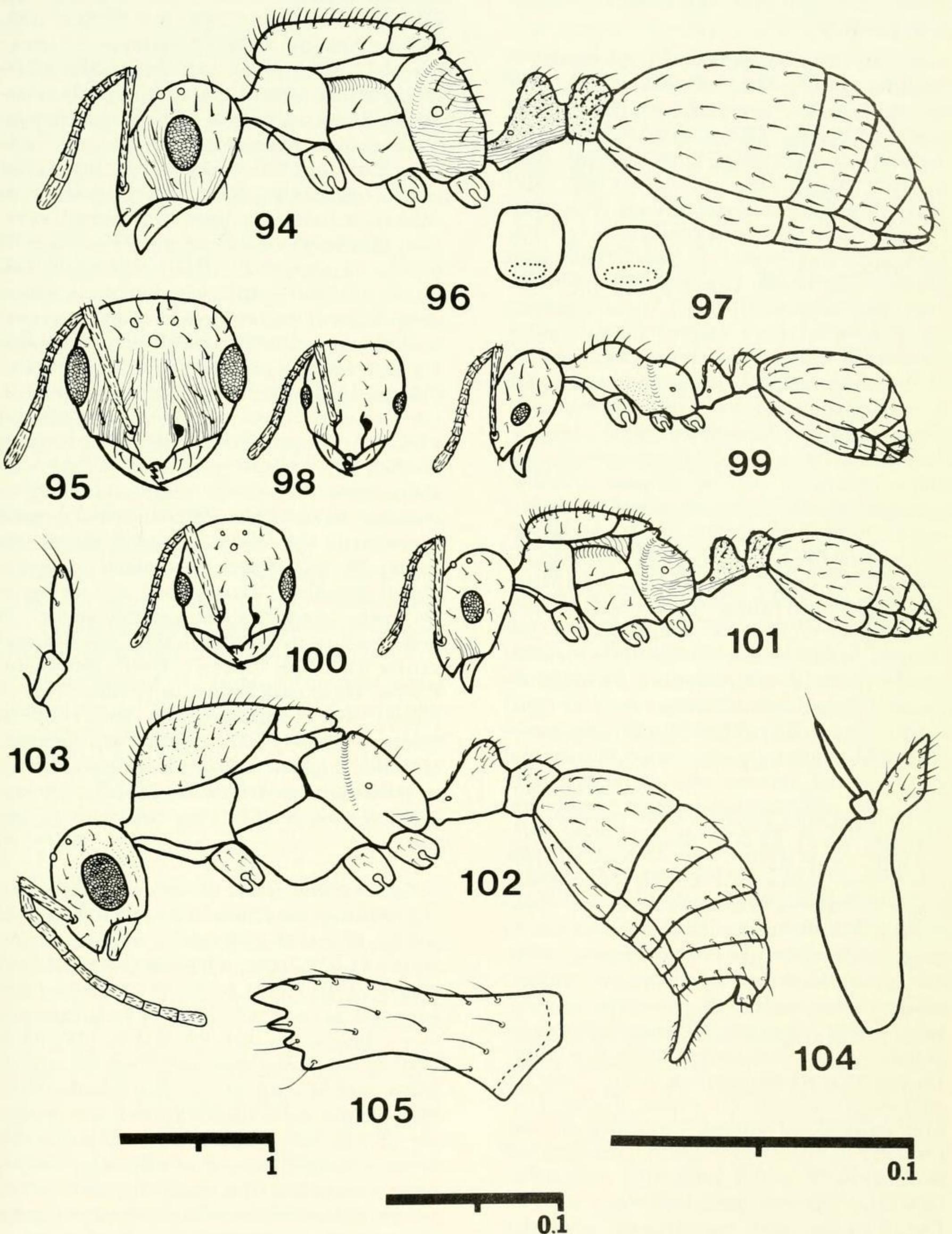
*Monomorium peninsulatum* Gregg, 1945: 62-66; Smith, 1952: 811; Ettershank, 1966: 91 (NEW SYNONYMY).

*Monomorium viridum peninsulatum*: Creighton, 1950: 223-224; Smith, 1958: 128; Smith, 1967: 356; Smith, 1979: 1384.

DIAGNOSIS. QUEEN: Winged; head with rugae as in Figure 95; alitrunk with greater than 30 erect to suberect setae projecting above dorsal outline; petiole and postpetiole as in Figures 94, 96, and 97. MALE: Mandible with four teeth (Fig. 105); genitalia and sterna as in Figures 102 and 107-110. WORKER: Propodeum, petiole, and postpetiole as in Figure 99; mesopleuron punctate; PI 31-36 (34).

DESCRIPTION. As described for *M. minimum* except as follows: QUEEN: HEAD: Measurements: (representing different localities,

$N=8$ ) HL 0.72-0.88 (0.81), HW 0.80-0.95 (0.88), SL 0.58-0.69 (0.63), IOD 0.16-0.22 (0.19), OD 0.10-0.12 (0.11), EL 0.18-0.28 (0.23), MOD 0.14-0.22 (0.18). Structure—Head a little broader than long, CI 102-113 (107), distinctly longer than scape SIL 73-83 (77); SIW 67-76 (72). Scape reaching or surpassing occiput by an amount less than length of pedicel. Sculpture—Moderate, parallel, longitudinal rugae beginning all along lateral margin of Clypeus, extending behind antennal insertion, and curving towards frontal carina, reaching frontal carina near apex; small, parallel, longitudinal rugae beginning along malar area, extending towards compound eye, paralleling ocular suture and vanishing near level of anterior ocellus; small, parallel, longitudinal rugae beginning near apex of frontal carina and extending to level of anterior ocellus; moderate, parallel, longitudinal rugae beginning near labium and continuing also on gular region ending near occiput. Large piliferous punctures evenly distributed over entire surface of head. ALITRUNK: Measurements PW 0.60-0.85 (0.72), PL 0.30-0.50 (0.38), WL 1.55-1.90 (1.70). Structure—Mesonotum with notal furrow. Mesopleural suture straight (small pits on anterior and posterior ends). Propodeum rounded (Basal and declivitous faces of equal length). PI 18-27 (22). Sculpture—Moderate, piliferous punctures on dorsum of scutum, scutellum and mesopleural suture. Propodeum covered with moderate, parallel, longitudinal rugae throughout. Sculpturing of sutures as in Figure 94. PETIOLE: As in Figures 94 and 96. Dorsum of node flat to slightly emarginate. Setae appressed on anterior surface of node, erect to decumbent on sides, dorsum, and posterior surface of node. Entire surface of petiole covered with small, non-piliferous punctures (obscuring small piliferous punctures where they occur). Lower half of side of petiole sometimes including lower parts of node with small, parallel, longitudinal rugae. Posterior surface of node with moderate, transverse, concentric, semicircular rugae. POST-PETIOLE: As in Figures 94 and 97. Dorsum of node flat to slightly emarginate. Setae decumbent to appressed on anterior surface of node, suberect to erect on sides, dorsum, and posterior surface of node. Entire surface covered with large to small non-piliferous punctures. COLOR: Head dark greenish-brown >green is more pronounced in living or freshly preserved specimens< except as follows: mandibles and antenna dark reddish-brown. Alitrunk and legs reddish-brown with green overlay >green tends to fade in older specimens<. Petiole and postpetiole reddish-brown to brown with slight



FIGS. 94-105. *Monomorium viridum*. 94—Queen, lateral view. 95—Head of queen, frontal view. 96—Petiole of queen, posterior view. 97—Postpetiole of queen, posterior view. 98—Head of worker, frontal view. 99—Worker, lateral view. 100—Head of ergatogyne, frontal view. 101—Ergatogyne, lateral view. 102—Male, lateral view. 103—Labial palp of male. 104—Maxilla and maxillary palp of male. 105—Mandible of male. *Scales*: Left scale (1 mm) for Figures 94-102. Middle scale (0.1 mm) for Figure 105. Right scale (0.1 mm) for Figures 103 and 104.

green tint. Gaster black with green or blue hues in some specimens.

**MALE: HEAD: Measurements** (representing 2 localities,  $N=5$ ) HL 0.56-0.69 (0.62), HW 0.90-0.95 (0.93), SL 0.28-0.35 (0.31), IOD 0.21-0.26 (0.24), OD 0.14-0.15 (0.15), EL 0.40-0.44 (0.42), MOD 0.25-0.31 (0.28). *Structure*—CI 138-164 (151), SIL 44-55 (50), SIW 30-37 (33). Mandible with 4 teeth (Fig. 105). *Pilosity*—Setae erect to decumbent over entire head, appressed on gula. *Sculpture*—Entire head covered with dense, moderate, non-piliferous punctures. Moderate, parallel, rugae beginning along lateral margin of clypeus and converging at antennal insertion; several moderate, parallel, rugae beginning at malar area, continuing to level of compound eye then paralleling ocular suture; clypeus with small to moderate, parallel, longitudinal rugae arising between clypeal teeth and extending to level of antennal insertion; moderate, parallel rugae extending from frontal carinae to level of anterior ocellus. **ALITRUNK: Measurements** PW 0.84-0.97 (0.93), PL 0.44-0.52 (0.48), WL 1.68-1.84 (1.76). *Structure*—Mesonotum with notal furrow. Scuto-scutellar suture near middle of alitrunk. Mesopleural suture straight. Metanotum not projecting to level of scutellum and propodeum. Propodeum rounded (basal and declivitous faces of equal length, Figure 102). PI 24-29 (28). *Sculpture*—Moderate piliferous punctures on scutum and scutellum and anterior edge of mesopleuron, small, non-piliferous punctures on propodeum. Sculpturing of sutures as in Figure 102. **PETIOLE:** As in Figure 102. Dorsum of node emarginate. Subpetiolar process of moderate size with anterior edge forming angle. Setae appressed to decumbent on anterior surface of node, subdecumbent to erect on dorsum, sides, and posterior surface of node. All surfaces except dorsum, with small, non-piliferous punctures. Lower 1/3 of side of petiole, below node, longitudinal rugae. **POSTPETIOLE:** As in Figure 102. Dorsum of node slightly emarginate. Setae decumbent to erect on all surfaces of node. Dorsum smooth and shining, remaining surfaces covered with small non-piliferous punctures. All surfaces with small piliferous punctures. **GENITALIA:** As in Figures 102, and 107-110. Eighth sternite with emargination possessing setae; emargination approximately half as deep as wide (Fig. 107). Ninth sternite with 18-20 erect setae (Fig. 108). Aedeagus with 12 teeth; toothed margin straight (Fig. 109). Cuspis of volsella with 7 setae (Fig. 110). **COLOR:** As in queen. Genitalia yellow brown to brown.

**WORKER. HEAD: Measurements** (representing

different localities;  $N=10$ ) HL 0.45-0.58 (0.51), HW 0.39-0.50 (0.44), SL 0.30-0.40 (0.35), EL 0.08-0.13 (0.09), MOD 0.06-0.08 (0.06). *Structure*—CI 83-89 (85), SIL 53-78 (69), SIW 65-90 (81). Summit of head concave to slightly emarginate. Scape reaching or surpassing occiput by an amount less than length of pedicel. *Sculpture*—Small to moderate, parallel, longitudinal rugae beginning along lateral margin of clypeus, extending to level of antennal insertion. **ALITRUNK: Measurements** PW 0.24-0.33 (0.27), PL 0.18-0.22 (0.20), WL 0.52-0.66 (0.58). *Structure*—Anterior propodeal suture deep (almost reaching to level of propodeal suture). Propodeum rounded; declivitous face 1/3 to 1/2 length of basal face. PI 32-36 (34). *Pilosity*—Dorsal outline of alitrunk with 8-12 erect to suberect setae. *Sculpture*—Mesopleuron with dense, small, non-piliferous punctures throughout; anterior propodeal suture with short, large, parallel, longitudinal rugae. **PETIOLE:** As in Figure 99. Subpetiolar process of moderate size. Setae appressed on anterior surface of node, erect on dorsum of nodes, absent elsewhere. **POSTPETIOLE:** As in Figure 99. Setae appressed on anterior surface of node, erect to decumbent on sides, dorsum, and venter (beneath node), absent elsewhere. **COLOR:** Head dark brown to brown except as follows: occiput with green tint (most visible in living or recently killed specimens), antenna, mandible, and lateral margin of clypeus brown to yellow-brown. **ALITRUNK:** Dark brown with green tint on dorsum; legs brown to yellow-brown.

**ERGATOGYNE. HEAD: Measurements** (representing different localities;  $N=2$ ) HL 0.66-0.69 (0.68), HW 0.64-0.74 (0.69), SL 0.50 (0.50), IOD 0.14-0.15 (0.14), OD 0.05 (0.05), EL 0.15 (0.15), MOD 0.09-0.10 (0.10). *Structure*—Head as broad as long, CI 97-107 (102), distinctly longer than scape, SIL 72-76 (74); SIW 68-78 (73). In full frontal view, head broadest slightly above eyes; side straight; occiput rounded laterally, summit flat to slightly convex. Eye moderate in size (intermediate between queen and worker). Scape reaching or surpassing occiput by an amount less than length of pedicel. Ocelli present. Mandible, maxillary palp, labial palp, clypeal teeth, and frontal carinae as in queen. *Pilosity*—Setae erect to decumbent over entire surface of head. Antennal pilosity as in queen. *Sculpture*—Smooth and shining except as follows: trace of small, longitudinal, parallel rugae extending from lateral margin of clypeus and converging near frontal carinae. Moderate piliferous punctures evenly distributed over entire

surface (Fig. 100). *ALITRUNK*: Measurements PW 0.48-0.49 (0.48), PL 0.30-0.31 (0.30), WL 1.11-1.26 (0.18). *Structure*—Mesonotum with small pit in place of notal furrow. Scuto-scutellar suture on dorsal 1/3 of alitrunk. Remaining description of alitrunk as in queen except that wings are absent (fusion of sclerites indicate the ergatogynes are wingless). *Pilosity*—As in queen with many erect to suberect setae on sides of propodeum and mesopleuron. *Sculpture*—Smooth and shining with many piliferous punctures throughout thorax. Sculpture of propodeum as in queen (Fig. 101). *PETIOLE*: Dorsum evenly convex to flat. Remaining description as in queen. *POSTPETIOLE*: Dorsum evenly convex to flat. Remaining description as in queen. *GASTER*: As in queen. *COLOR*: As in queen.

*TYPE MATERIAL*. Type series consisting of holotype female and numerous paratype females, males and workers (Brown, 1943) *NEW JERSEY*: *Ocean Co.*, Lakehurst, August 23, 1940, W. L. Brown, Jr. [Holotype female - Academy of Natural Sciences, Philadelphia, Pennsylvania Number 10561; paratypes in NMNH and MCZ].

Synonymous *M. peninsulatum* type series consisting of "64 females ... and numerous workers" (Gregg, 1945) *FLORIDA*: *Dade Co.*, South Miami, E. V. Gregg. [Holotype queen - R. E. Gregg personal collection; paratypes in AMNH, LACM, and NMNH].

*DISTRIBUTION*. This species occurs in two allopatric populations along the Atlantic coast: one in the Pine Barrens of New Jersey and the other in Georgia and Florida (Fig. 106). In spite of intensive collecting by W. L. Brown, Jr., E. O. Wilson, and others, only one collection has been made in the coastal plain between New Jersey and Georgia (*NORTH CAROLINA*: *Beaufort Co.*, Wilmar 1.6 km N, W. L. Brown, Jr., & E. O. Wilson). In many areas, this species is replaced by *M. minimum*. Apparently this difference is due to microhabitat selection for nest sites by queens of both species. *Monomorium viridum* prefers sand, while *M. minimum* prefers clay soils (W. L. Brown, Jr. pers. comm.).

In the New Jersey population of *M. viridum*, collections range from Lakehurst (*Ocean Co.*) and Island Heights (*Ocean Co.*)

in the north to Cape May (*Cape May Co.*) in the south. Further north, *M. viridum* is replaced by *M. emarginatum* and *M. minimum* replaces both species to the west. In the Florida population, collections are common throughout the eastern and central portions of the peninsula from Jacksonville (*Duval Co.*) in the north to Miami (*Dade Co.*) in the south. The furthest western records for this species appear to be Sarasota (*Sarasota Co.*) and Gainesville (*Alachua Co.*). This population apparently ranges as far north as Georgia (W. L. Brown, Jr., pers. comm.). *Monomorium trageri* occurs in portions of northern Florida (Tallahassee and Gainesville) while *M. minimum* occurs to the north and west of the Florida *M. viridum* population.

*DISCUSSION*. *BIOLOGY*. This species nests in open sandy soil. Brown (1943) records it nesting along a roadside with tumuli forming craters 12-20 cm in diameter. Gregg (1945) also mentions the crater nests of this species. Although I have attempted to excavate several nests (*FLORIDA*, Orlando vicinity and Daytona Beach vicinity), I could not determine additional details of nest architecture due to the shifting, loose sand.

Colonies of *M. viridum* may have multiple, functioning queens (1-5) (Brown, 1943). It is not known whether nests are established by one or several queens although Gregg (1945) encountered over 60 queens (most dealate) in one nest. Nuptial flights apparently occur since males and queens are winged, although no flights have been reported and I have not encountered collections of males or queens found away from nests. Sexual forms are produced during July {collection of males: *NEW JERSEY*: *Burlington Co.*, July 31, 1954; *Ocean Co.*, July 29, 1954}. No males have yet been collected outside of New Jersey.

*SYSTEMATICS*. Some confusion in the literature has resulted from Gregg's re-description of *M. viridum* as *M. peninsulatum* (Gregg, 1945). Gregg mentions that the species are quite similar and reported characters to separate them (Gregg, 1945: 66). The color characters mentioned are unus-

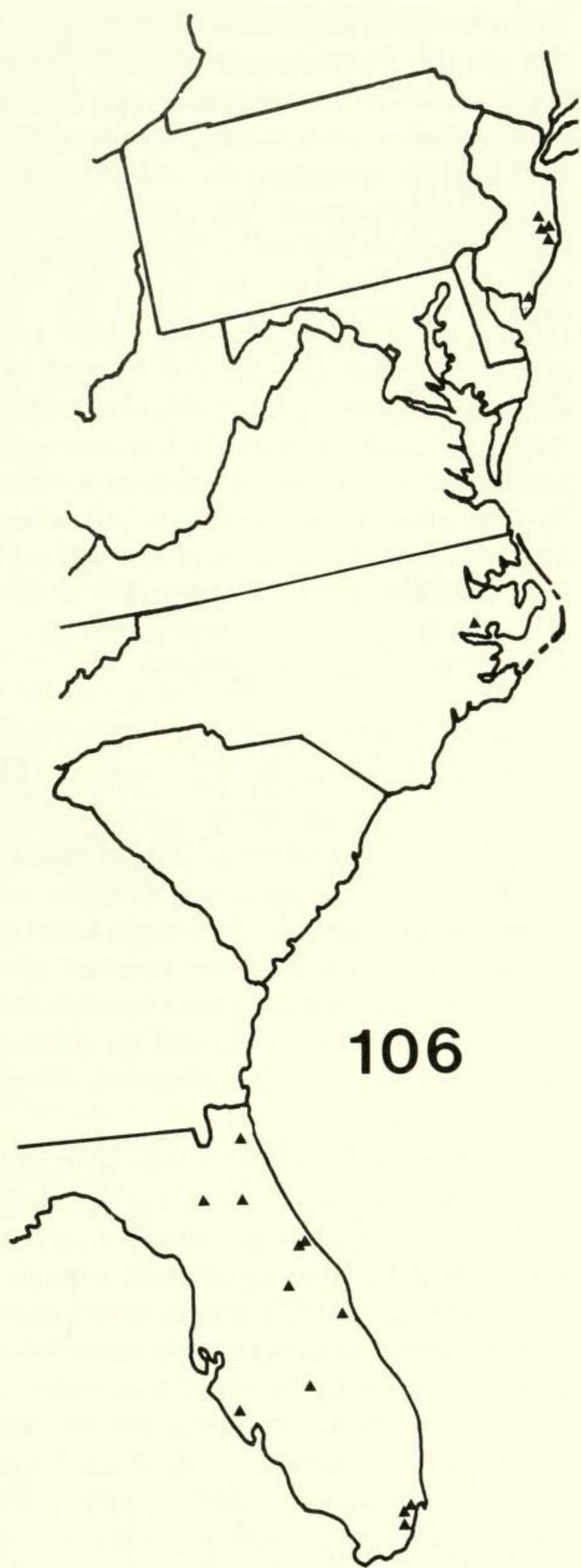


FIG. 106. Distribution of *Monomorium viridum* (closed triangles).

able for a number of reasons. First, Brown stated that his specimens were examined in direct sunlight, while Gregg makes no mention of the light source he used. Second, these colors change and fade over time (the exact sequence is not known). Furthermore, color differences mentioned by Gregg are variable within and among

nests. Gregg's characters dealing with the sculpture of the ocellar triangle and the sculpture of the anterior surface of the petiole and postpetiole are equally variable. Size measurements given by Gregg are not useful since they were based upon total length, including gaster (composed of many membranes which shrink as the specimen dries). Length of the gaster can also vary greatly with development of the ovaries (this is true for workers also). This leaves one character, the shape of the clypeal teeth. Gregg described them as blunt but gave no figure for comparison. In fact, they are of the same general shape in specimens from New Jersey and Florida.

This confusion led Creighton (1950) to place *M. peninsulatum* as a subspecies of *M. viridum*. While *M. viridum* continued to be known only from type material, Creighton (using Gregg's variable characters) extended the range of *M. peninsulatum* across the southern United States to Arizona and California, confusing it with *M. minimum*, *M. cyaneum*, and *M. ergatogyna*. Creighton's error has been perpetuated to the present (Gregg, 1963; Smith, 1979).

COMPARISONS. Ranges of three other species (*M. emarginatum*, *M. minimum*, and *M. trageri*) overlap the range of *M. viridum*. These species can be separated by characters found in the keys and diagnoses. Queens of *M. viridum* possess a notal furrow on the mesonotum while queens of *M. minimum* and *M. trageri* do not. *Monomorium viridum* queens can be separated from *M. emarginatum* queens since the metanotum of the latter does not project to the level of the propodeum and scutellum. Additionally, head sculpturing is reduced in *M. emarginatum* queens. Furthermore, both petiole and postpetiole are emarginate in *M. viridum* queens.

Workers of *M. viridum* can be separated from *M. trageri* and *M. emarginatum* workers since the latter two species have a propodeum with basal face shorter than declivitous face. *Monomorium viridum* workers can be separated from those of *M. minimum* since the former have a punctate mesopleuron.

***Monomorium emarginatum* new species**

Figures 111-118

*Monomorium minimum*: Wheeler, 1916: 584 (misidentification).

**DIAGNOSIS.** QUEEN: Winged; mesonotum with notal furrow; mandible with 4 teeth, basal tooth reduced (Fig. 113); head sculpturing as in Figure 112; petiole and postpetiole as in Figures 111, 114, and 115. WORKER: Propodeum not angular (Fig. 117); mesopleuron not punctate (Fig. 117); petiole and postpetiole as in Figure 117; 4-6 erect setae projecting above dorsal outline of alitrunk; PI 34-42 (37).

**DESCRIPTION.** As described for *M. viridum* except as follows. QUEEN: **HEAD: Measurements** (representing different localities;  $N=6$ ) HL 0.71-0.80 (0.74){0.80}, HW 0.69-0.81 (0.75){0.81}, SL 0.52-0.64 (0.58){0.62}, IOD 0.16-0.18 (0.17) {0.18}, OD 0.05-0.06 (0.05) {0.05}, EL 0.15-0.19 (0.18) {0.19}, MOD 0.09-0.12 (0.11) {0.12}. **Structure**—Head as broad as long, CI 96-106 (101){101}, distinctly longer than scape, SIL 68-86 (78) {78}; SIW 68-88 (77){76}. Scape not surpassing occiput. {Holotype lacks left antenna}. Mandible with 4 teeth, basal tooth reduced (Fig. 113). **Sculpture**—Moderate, faint, parallel, longitudinal rugae beginning along lateral margin of clypeus, extending past antennal insertion, and converging with frontal carinae. Large to moderate, piliferous punctures evenly distributed (Fig. 112). **ALITRUNK: Measurements** PW 0.58-0.66 (0.62) {0.58}, PL 0.29-0.40 (0.34) {0.40}, WL 1.26-1.65 (1.52) {1.52}. **Structure**—Mesopleural suture straight with small pit on posterior end. Metanotum (in lateral view) not projecting to level of propodeum and scutellum. PI 20-26 (23) {26}. Wings present {lacking on holotype}. **Sculpture**—Smooth and shining with moderate piliferous punctures except as follows: lower 1/3 of propodeum (below spiracle) with moderate to large, parallel, longitudinal rugae. **PETIOLE:** As in Figures 111 and 114. All surfaces smooth and shining (moderate piliferous punctures where applicable) with small non-piliferous punctures (leading to a granular appearance) along lower 1/2 of side. **POSTPETIOLE:** As in Figures 111 and 115. Dorsum of node flat. Setae appressed to decumbent on anterior surface of node, decumbent to suberect on dorsum, erect on posterior surface and side of node, absent elsewhere. Postpetiolar surface smooth and shining with small piliferous punctures throughout. **COLOR:** Head dark brown to brown except as follows: antenna, mandible, and lateral margin of clypeus brown to yellow. Alitrunk dark brown

to brown, legs brown to yellow-brown. Petiole, postpetiole, and gaster dark brown to brown. All setae yellow.

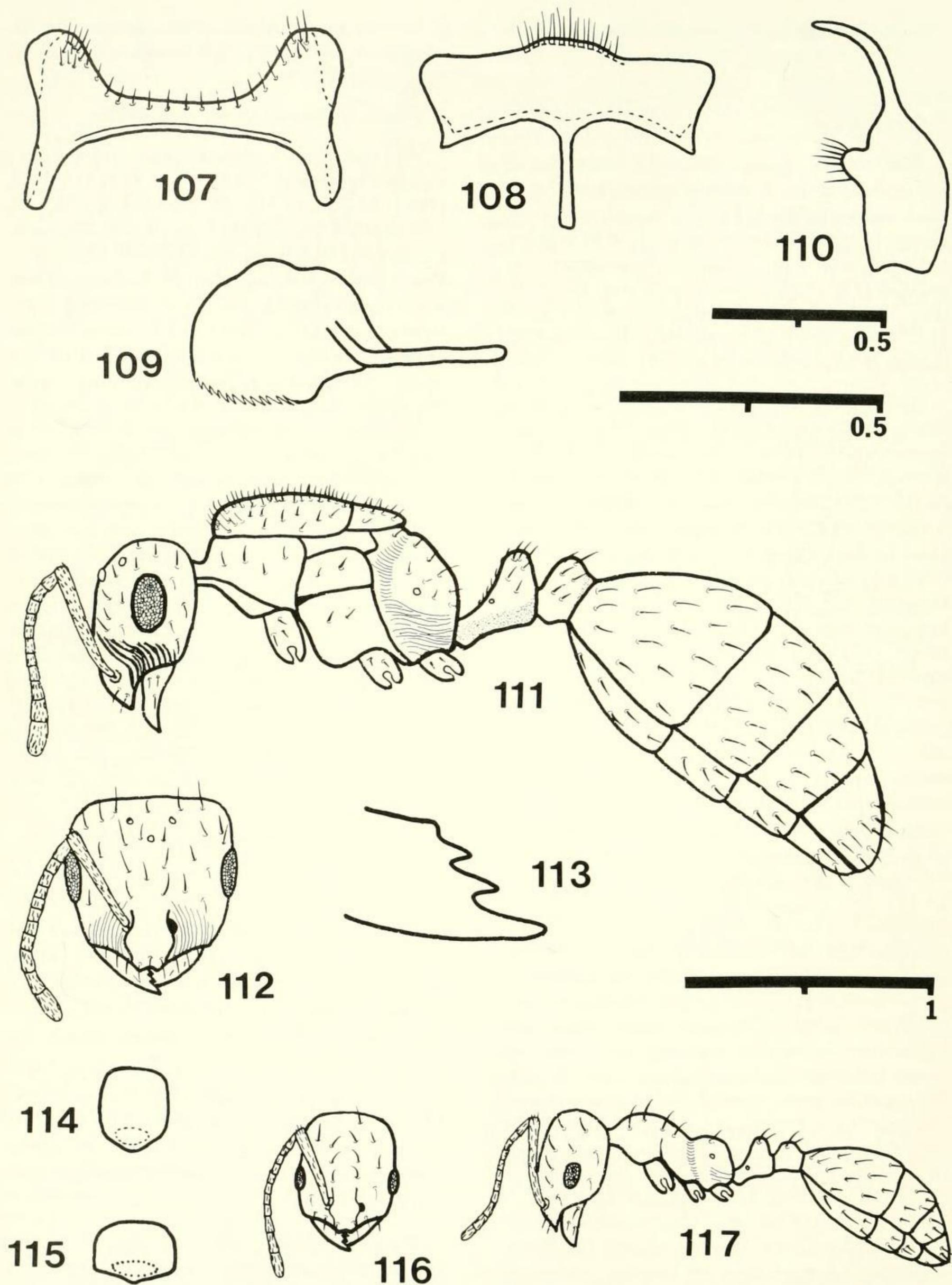
**MALE:** Unknown in *M. emarginatum*.

**WORKER. HEAD: Measurements** (representing separate localities;  $N=5$ ) HL 0.44-0.51 (0.48), HW 0.38-0.44 (0.41), SL 0.28-0.41 (0.35), EL 0.09-0.10 (0.09), MOD 0.06 (0.06). **Structure**—CI 80-87 (84), SIL 64-80 (72), SIW 74-93 (86). Scape not surpassing occiput. **Sculpture**—Head smooth and shining with small piliferous punctures evenly distributed. **ALITRUNK: Measurements** PW 0.22-0.29 (0.26), PL 0.18-0.21 (0.19), WL 0.49-0.62 (0.53). **Structure**—Anterior propodeal suture of moderate depth (Fig. 117). Propodeum rounded, basal face 2/3 as long as declivitous face (Fig. 117). PI 34-42 (37). **Pilosity**—Dorsal outline of alitrunk with 4-6 erect setae projecting above dorsal outline. **Sculpture**—Anterior propodeal suture with short, parallel, longitudinal rugae; lower 1/3 of side of propodeum (below spiracle) with small, sometimes faint, parallel, longitudinal rugae. **PETIOLE:** As in Figure 117. Dorsum of node flat to slightly convex. Setae erect on dorsum of node, remainder bare. **COLOR:** Head dark brown except as follows: antenna and mandible yellow-brown to brown. Alitrunk brown, legs brown to yellow-brown. Petiole, postpetiole, and gaster brown to dark brown. All setae yellow.

**TYPE MATERIAL. VIRGINIA:** *Rappahannock Co.*; Amissville 3.2 km W, June 21, 1957, W. L. Brown, Jr., & E. O. Wilson. Holotype queen [MCZ] bears red, handwritten label: *Monomorium/ emarginatum/ Holotype/ M. DuBois 1983/*. Paratypes distributed as follows (localities refer to those listed in detail below which are surrounded by brackets []): Brewster, Cape Cod - 1 queen, 3 workers [MCZ], Woods Hole - 2 queens, 4 workers [NMNH]. All paratypes bear blue, handwritten labels: *Monomorium/ emarginatum/ Paratype/ M. DuBois 1983/*.

**ETYMOLOGY.** This species is named for the furrow (emargination) on the mesonotum.

**DISTRIBUTION.** This species is known from scattered localities throughout the northeastern United States (Fig. 118). Collection data follow: **MASSACHUSETTS:** [*Barnstable Co.*, Cape Cod, Brewster, Au-



FIGS. 107-110. *Monomorium viridum*. 107—Eighth sternite of male. 108—Ninth sternite of male. 109—Aedeagus of male. 110—Volsella of male. Scales: Top scale (0.5 mm) for Figures 107 and 108. Bottom scale (0.5 mm) for Figures 109 and 110. FIG. 111-117. *Monomorium emarginatum*. 111—Queen, lateral view. 112—Head of queen, frontal view. 113—Mandible of queen (schematic). 114—Petiole of queen, posterior view. 115—Postpetiole of queen, posterior view. 116—Head of worker, frontal view. 117—Worker, lateral view. Scale: (1 mm) for Figures 111, 112, 114-117.

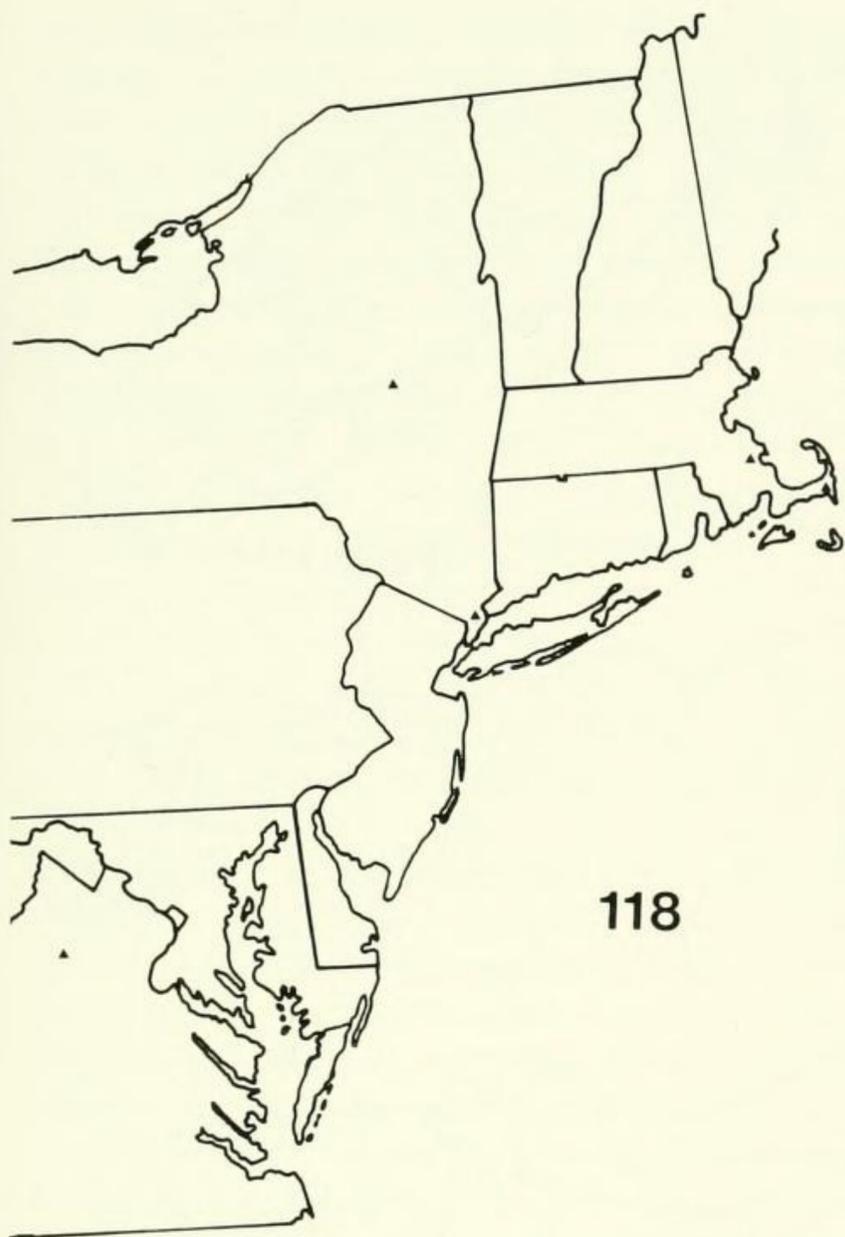


FIG. 118. Distribution of *Monomorium emarginatum* (closed triangles).

gust 4, 1955, W. L. Brown, Jr.]; [*Plymouth Co.*, Woods Hole, July 15, 1930, A. H. Sturtevant]. *NEW YORK*: New York City [several collectors]; *Montgomery Co.*, Johnstown, A. Sturtevant.

**DISCUSSION. BIOLOGY.** Previous literature records (Wheeler, 1916) indicate that this species prefers to nest in sandy or gravelly soil with tumuli forming tiny craters. Further details of nest architecture and biology are unknown.

**SYSTEMATICS.** Although the collections of this species are sporadic in the northeastern United States, it appears to be the only species which occurs there. Since workers could be easily mistaken for *M. minimum*, I assume this was the species that Wheeler (1916) discussed. Unfortunately, he did not collect any queens during his study and workers are difficult to separate. It is possible this species occurs sympatrically with *M. viridum* in coastal areas.

**COMPARISONS.** This species is most likely

to be confused with *M. minimum* and *M. viridum*. Queens of *M. minimum* can be separated from those of *M. emarginatum* since the latter possess a furrow on the mesonotum. Queens of *M. viridum* can be separated from those of *M. emarginatum* since the petiole and postpetiole of the former are always emarginate while those of the latter are not. Additionally, *M. emarginatum* queens have less facial sculpturing (Fig. 112). Workers of *M. emarginatum* can be separated from both these species since the basal face of the propodeum is shorter than the declivitous face.

### *Monomorium ebeninum* Forel

Figures 8, 14, 16 and 119-133

*Monomorium carbonarium*: Forel, 1881: 8; Forel, 1899: 78; Kusnezov, 1949: 425 (misidentifications).

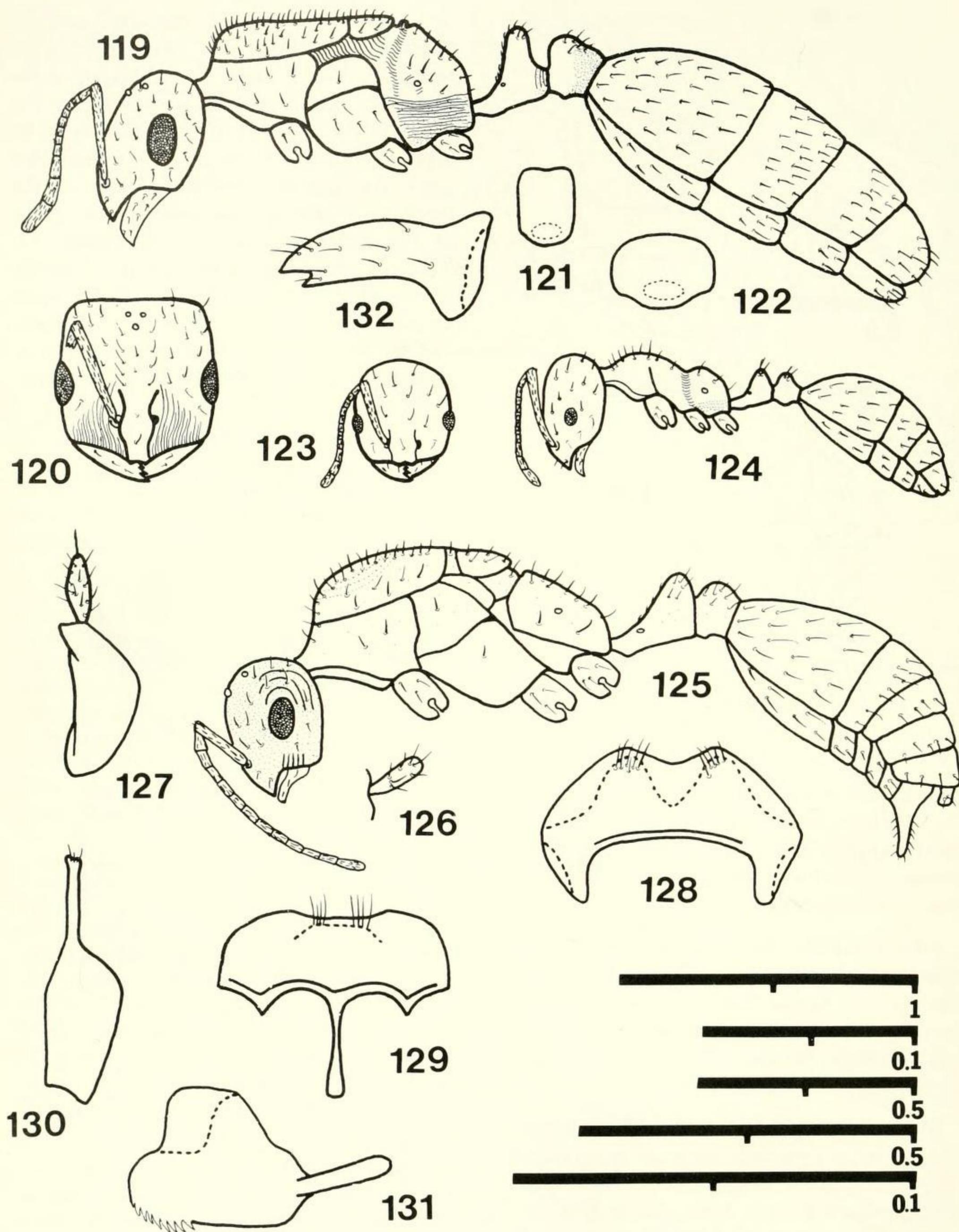
*Monomorium ebeninum* Forel, 1891: 165; Etershank, 1966: 88 (misspelled as *ebininum*); Jones et al., 1982: 287.

*Monomorium carbonarium ebeninum*: Forel, 1899: 78; Wheeler, 1905a: 88-89; Wheeler, 1908: 423; Wheeler, 1917b: 458; Tulloch, 1930: 203; Smith, 1936b: 832-833; Wheeler, 1936: 199; Wolcott & Martorell, 1937: 577-579; Wolcott, 1948: 814-815; Creighton, 1950: 218 (misspelled as *ebininum*); Kempf, 1972: 143; Lavigne, 1977: 224.

*Monomorium carbonarium ebenina*: Emery, 1921: 171.

**DIAGNOSIS. QUEEN:** Wingless; petiole and postpetiole as in Figures 119, 121, and 122; scutum and scutellum slightly depressed dorsally or flat; metanotum projecting to level of propodeum and scutellum; propodeum angular. **MALE:** Genitalia and sterna as in Figures 125, 128-131. **WORKER:** Propodeum angular; mesopleuron not punctate; petiole as in Figure 121; PI 40-44 (41).

**DESCRIPTION.** As described for *M. minimum* except as follows. **QUEEN: HEAD: Measurements** (representing different localities;  $N=10$ ) HL 0.65-0.72 (0.68) {0.72}, HW 0.55-0.65 (0.60) {0.61}, SL 0.42-0.52 (0.49) {0.52}, IOD 0.10-0.17 (0.14) {0.12}, OD 0.04-0.07 (0.05) {0.05}, EL 0.15-0.18 (0.16) {0.18}, MOD 0.10-0.13 (0.12) {0.13}. **Structure**—CI 80-93 (88) {85}, SIL 62-77 (72) {72}, SIW 76-88 (82) {85}. Side of head straight. Scape not reaching occiput. Masticatory margin of mandible with 4 >rarely 5< teeth. Clypeal



FIGS. 119-132. *Monomorium ebeninum*. 119—Queen, lateral view. 120—Head of queen, frontal view. 121—Petiole of queen, posterior view. 122—Postpetiole of queen, posterior view. 123—Head of worker, frontal view. 124—Worker, lateral view. 125—Male, lateral view. 126—Labial palp of male. 127—Maxilla and maxillary palp of male. 128—Eighth sternite of male. 129—Ninth sternite of male. 130—Volsella of male. 131—Aedeagus of male. 132—Mandible of male. *Scales*: Top scale (1 mm) for Figures 119-125. Second scale (0.1 mm) for Figure 132. Third scale (0.5 mm) for Figures 128 and 129. Fourth scale (0.5 mm) for Figures 130 and 131. Bottom scale (0.1mm) for Figures 126 and 127.

teeth moderately sharp to blunt, short. Frontal carinae diverging strongly posteriorly. *Sculpture*—Moderate, parallel, longitudinal rugae beginning all along lateral margin of clypeus, continuing to level of middle of compound eye after converging slightly near frontal carinae. Rugae above frontal carinae may be absent or greatly reduced (Fig. 120). *ALITRUNK: Measurements* PW 0.40-0.52 (0.42) {0.43}, PL 0.23-0.32 (0.29) {0.23}, WL 1.05-1.18 (1.11) {1.13}. *Structure*—Scutum and scutellum slightly depressed dorsally. Mesopleural suture deflected ventrally at posterior end (with small pit on anterior end and larger pit on posterior end). Propodeum angular, basal and declivitous faces of approximately equal length. PI 20-30 (26) {20}. Wings absent (fusion of sclerites indicate queens are wingless). *Sculpture*—Entire propodeum covered with small, non-piliferous punctures (leading to a granular appearance); declivitous surface of propodeum with moderate, parallel, transverse rugae. *PETIOLE: As in Figures 119 and 121.* Dorsum of node flat to slightly emarginate. Setae decumbent to appressed on anterior surface of node, subdecumbent to decumbent on dorsum, absent elsewhere. Entire petiole smooth and shining (with small, piliferous punctures on anterior surface and dorsum) except as follows: posterior 1/5 of petiole with moderate, concentric, semi-circular, transverse rugae. *POSTPETIOLE: As in Figures 119 and 122.* Dorsum of node flat. Setae subdecumbent to decumbent on posterior surface of node, absent elsewhere. Postpetiolar surface smooth and shining except as follows: posterior 1/2 with dense, moderate, non-piliferous punctures. *COLOR: Entire body and appendages usually brown to dark brown. All setae white.*

**MALE: HEAD: Measurements** (representing different localities;  $N=3$ ) HL 0.55-0.61 (0.59), HW 0.61-0.68 (0.64), SL 0.24-0.28 (0.26), IOD 0.18-0.20 (0.19), OD 0.06-0.08 (0.07), EL 0.22-0.25 (0.24), MOD 0.12-0.18 (0.16). *Structure*—CI 100-113 (109), SIL 39-47 (44), SIW 39-41 (40). Maxillary palp 1-segmented (Fig. 127); labial palp 1-segmented (Fig. 126). Clypeal teeth absent. Frontal carinae not diverging posteriorly. *Pilosity*—Setae erect near clypeus, mandible, and occiput, decumbent to appressed elsewhere. *Sculpture*—Several moderate to large, parallel, longitudinal rugae beginning all along lateral margin of clypeus, extending to antennal insertion. Several small to moderate, parallel, longitudinal rugae extending from clypeus to level of frontal carinae. Additionally, several moderate, concentric,

semicircular rugae extending from level of compound eye to occiput and following contour of occiput. *ALITRUNK: Measurements* PW 0.50-0.60 (0.56), PL 0.30-0.36 (0.32), WL 1.12-1.27 (1.20). *Structure*—Pronotal-scutal suture on dorsal 1/2 of alitrunk. Mesopleural suture as in queen except as follows: pit absent on anterior end. Metanotum (in lateral view) not projecting to level of propodeum and scutellum. Propodeum angular, basal face 2 times as long as declivitous face. PI 25-28 (27). *Sculpture*—Several moderate, semi-circular, concentric rugae with vertex at anterior edge of pronotum, extending posteriorly (as parallel, longitudinal rugae) to scutum; sculpturing of sutures as in Figure 125. *PETIOLE: As in Figure 125.* Setae appressed on anterior surface of node, erect to suberect on dorsum, absent elsewhere. Entire surface of node, erect to suberect on dorsum, absent elsewhere. Entire surface smooth and shining. *POSTPETIOLE: As in Figure 125.* Setae decumbent to subdecumbent on anterior surface of node, erect to suberect on posterior surface of node and venter, absent elsewhere. All surfaces smooth and shining. *GASTER: Setae of first gastral tergite reaching or exceeding level of dorsum of postpetiolar node. GENITALIA: As in Figures 125 and 128-131.* Eighth sternite with emargination approximately 1/2 as deep as wide (Fig. 128). Ninth sternite with 8 erect setae (Fig. 129). Aedeagus with 8 teeth; toothed margin straight (Fig. 131). Volsella with reduced digitus; lacking cuspis (Fig. 130). *COLOR: Head and antenna brown to dark brown except as follows: mandible yellow to yellow-brown. Alitrunk brown to dark brown, legs yellow to yellow-brown. Petiole and postpetiole brown to yellow-brown, gaster brown to dark brown. Genitalia brown to yellow-brown. All setae white to yellow.*

**WORKER. HEAD: Measurements** (representing different localities;  $N=10$ ) HL 0.48-0.55 (0.51), HW 0.38-0.42 (0.40), SL 0.35-0.40 (0.39), EL 0.07-0.09 (0.08), MOD 0.05-0.06 (0.05). *Structure*—CI 76-84 (78), SIL 67-95 (78), SIW 71-105 (95). Side of head straight. Clypeal teeth short, blunt. *Sculpture*—Several small, short, parallel, longitudinal rugae on clypeus; several small, short, parallel, longitudinal rugae beginning all along lateral margin of clypeus, continuing to antennal insertion. *ALITRUNK: Measurements* PW 0.25-0.28 (0.26), PL 0.21-0.25 (0.23), WL 0.52-0.62 (0.56). *Structure*—Propodeum angular, both faces of approximately equal length. PI 40-44 (41). *PETIOLE: As in Figure 124.* Dorsum of node flat to slightly emarginate. Setae erect to suberect on dorsum

of node, absent elsewhere. *POSTPETIOLE*: As in Figure 124. Dorsum of node flat to slightly emarginate. *GASTER*: Setae of first gastral tergite reaching or exceeding level of dorsum of postpetiolar node. *COLOR*: Head dark brown to brown except as follows: mandibles yellow-brown to brown. Alitrunk and legs dark brown to brown. Gaster dark brown.

*TYPE MATERIAL*. Syntypic series consisting of 2 queens, 1 male, and 16 workers (MHNG) from the following localities: GRENADA (male), ST. VINCENT (queens), ST. THOMAS (ANTILLE) (workers). Six workers bear the date 14 X 78. Lectotype queen here designated from MHNG series bears red, handwritten label: *Monomorium/ ebeninum/ Forel/ Lectotype/ M. DuBois 1983/*. It is from St. Vincent.

Forel (1891: 165) described the distinguishing characters of this species: "La race de l'Amérique tropicale que j'avais cru devoir rapporter au *carbonarium* (Ameisen der Antille St. Thomas, 1881) et que j'ai recue dès lors du Guatemala, etc., se distingue nettement par les deux élévations du métanotum, par sa large échancrure méso-métanotale, par la face déclive plus haute du métanotum plus élève qui forme presque un angle avec la face basal, par le premier noeud du pédicule plus mince et plus longuement pétiolé. Je propose de l'appeler *ebeninum*." Presumably, the material from Guatemala was provided through Pergande (W. L. Brown, Jr., pers. comm.); however, none of this material can be discovered in the remains of Pergande's collection. The remainder of this type series is in Geneva (MHNG). A few of these specimens are clearly labelled "TYPUS"; these include the male, both queens, and 6 workers. I assume that Forel regarded these specimens as part of his type series and merely chose to list their localities as "etc." when he described *M. ebeninum*. I chose the lectotype, designated above, in an effort to restrict the type locality and to reduce future confusion since queens are easier to identify than workers.

*DISTRIBUTION*. This species ranges throughout the Caribbean region. It has been collected from many of the islands

and from Atlantic and Pacific coastlines in many parts of Central America (Fig. 133). Many collections were examined from the following islands which range from the Bahamas in the north through Tobago in the south: Andros (Bahama Islands), Antigua (Lesser Antilles), Barbados (Lesser Antilles), Cuba (Greater Antilles), Dominican Republic (Greater Antilles), Grenada (Lesser Antilles), Haiti (Greater Antilles), Isla de Pinos (Greater Antilles), Jamaica (Greater Antilles), Martinique (Lesser Antilles), Montserrat (Lesser Antilles), Nassau (Bahama Islands), Nevis (Lesser Antilles), Puerto Rico (Greater Antilles), St. Croix (Virgin Islands), St. John (Virgin Islands), St. Vincent (Lesser Antilles), and Tobago (Lesser Antilles). Mainland collection localities range from Tamalupias and Vera Cruz in Mexico to Panama along the Atlantic coast. Only a few collections have been made along the Pacific coast of Central America. These include localities in Oaxaca in Mexico, El Salvador, and Guanacaste Province in Costa Rica. I was unable to examine any specimens of this species collected in the northern coastal regions of South America or from peninsular Florida. It is probable that additional collecting will reveal colonies from both these regions.

*DISCUSSION. BIOLOGY*. This species presumably nests under stones and in plant cavities. Forel (1899) indicated that *M. ebeninum* lives in stems and hollow branches. Wheeler (1905a) recorded it from under stones, in cavities of *Tillandsia* spp., and in dry twigs of buttonwood bushes. Smith (1936b: 832) elaborated further: "This is one of the most common ants of the West Indies... It forms populous colonies which are characterized by having many reproductive queens to a colony. Their great adaptability is indicated by the fact that this species nests in both soil and wood, back of the leaf sheaths or [*sic*] corn and bananas, in cabbage heads, *Tillandsias*, and in the fruits of *Hibiscus sabdariffa*. The workers are exceedingly fond of honeydew. They have been noted attending such insects as *Saissetia hemispherica* Targ., *Coccus viridus* Green, the

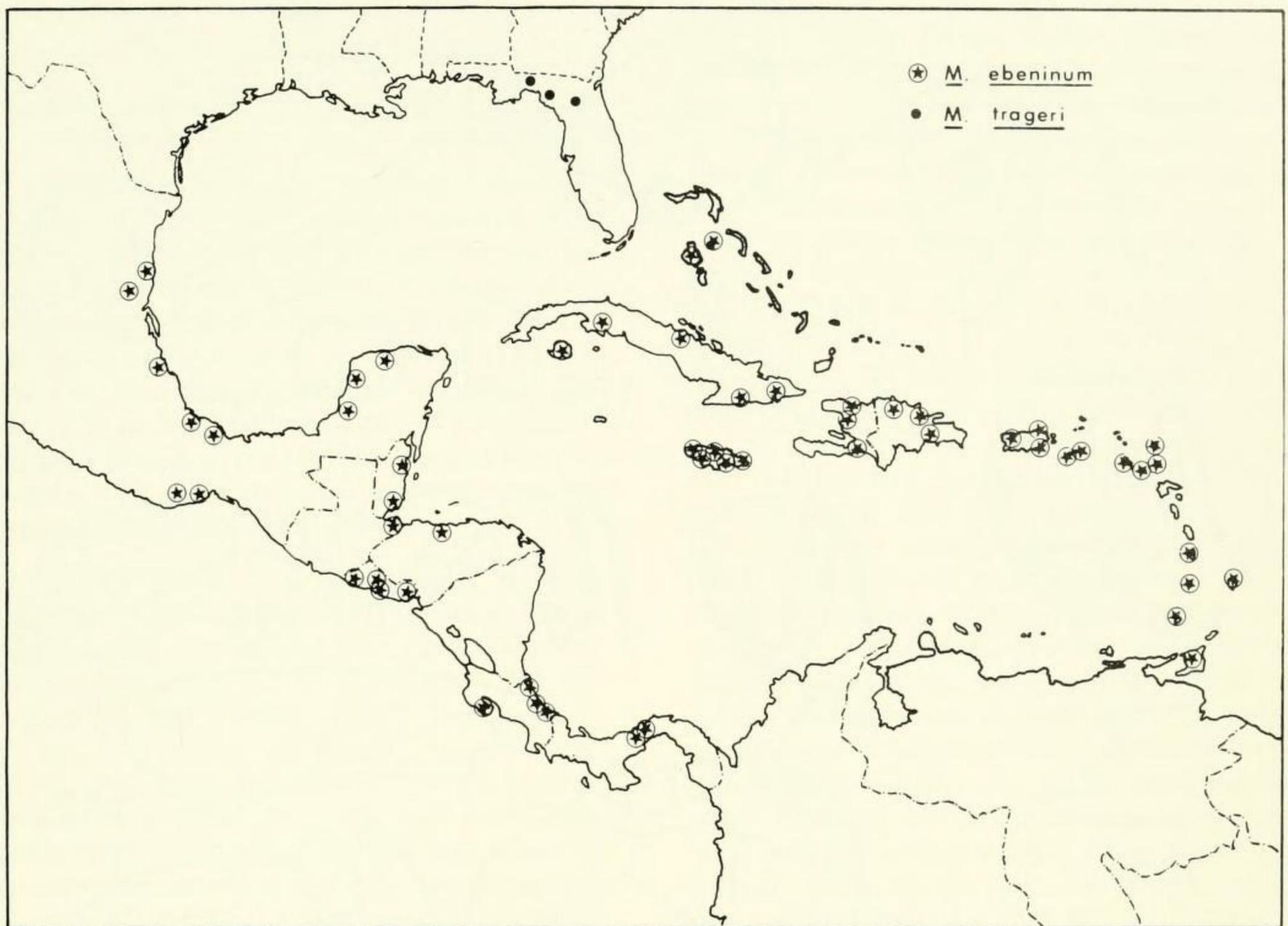


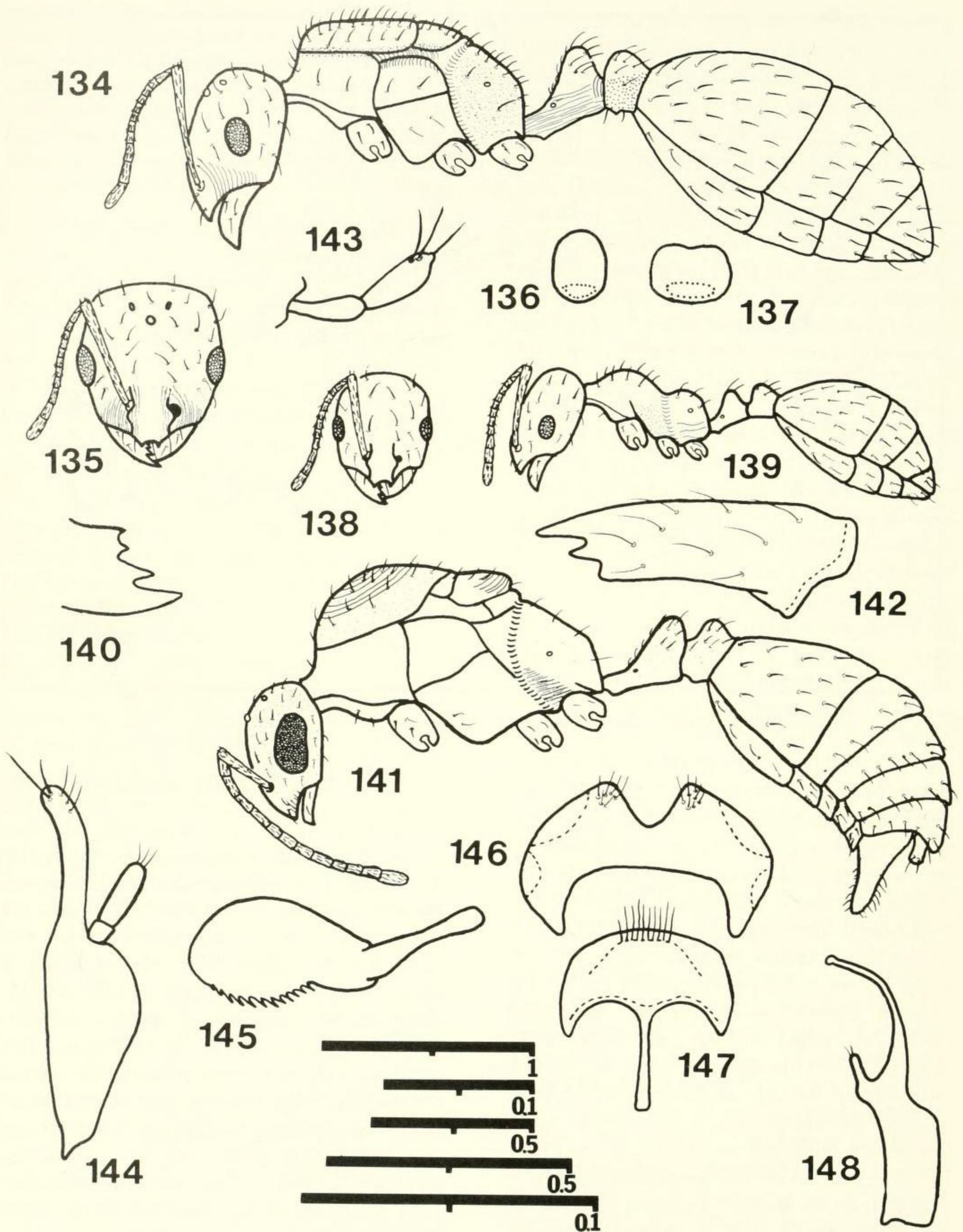
FIG. 133. Distribution of *Monomorium ebeninum* and *Monomorium trageri*.

aphid *Sipha flava* Forbes, etc. The ants are also highly predacious." Wolcott and Martorell (1937) recorded this ant as a predator on the eggs of the sugarcane moth borer, *Diatraea saccharalis* Fabricius (Lepidoptera: Pyralidae). Although Lavigne (1977) recorded this species from lawns in Puerto Rico, he provided no details on the nest's microhabitat nor structure. Wheeler (1905a) recorded multiple queens per nest (up to 12). Although *M. ebeninum* has a moderately broad altitudinal tolerance (0-1600 m above sea level), it is most frequently collected in coastal areas (Fig. 133). Sexual forms are produced in spring {collections of males: JAMAICA: Montego Bay, March 14, 1911; ANDROS ISLAND (Bahama Islands): Mangrove Cay, May 31, 1904}.

Wolcott (1948) mentions this ant is eaten by the lizards *Anolis stratulus* and *A. cristatellus*. Lavigne (1977) collected workers from stomachs of the following two frog

species: *Eleutherodactylus cochranæ* and *E. coqui*.

COMPARISONS. Since *Monomorium ebeninum* is the only species with wingless queens that occurs in the Caribbean region, it should not be confused with any other species. Three other species occur in areas which border the range of *M. ebeninum*: *M. cyaneum*, *M. trageri*, and *M. viridum*. Queens of *M. ebeninum* are separated from those of these other species since the profile of the scutum and scutellum of *M. ebeninum* queens is flat or slightly concave while the profile of the remaining species is clearly convex. Additionally, the head sculpturing in *M. ebeninum* is quite reduced. Workers of *M. ebeninum* can be separated from the other species since their propodeum has basal and declivitous faces of approximately equal length. Although this is also true of *M. cyaneum* workers, the mesopleuron in *M. ebeninum* workers is smooth and shining, while it is punctuate in *M. cyaneum* workers.



FIGS. 134-148. *Monomorium trageri*. 134—Queen, lateral view. 135—Head of queen, frontal view. 136—Petiole of queen, posterior view. 137—Postpetiole of queen, posterior view. 138—Head of worker, frontal view. 139—Worker, lateral view. 140—Mandible of queen (schematic). 141—Male, lateral view. 142—Mandible of male. 143—Labial palp of male. 144—Maxilla and maxillary palp of male. 145—Aedeagus of male. 146—Eighth sternite of male. 147—Ninth sternite of male. 148—Volsella of male. *Scales*: Top scale (1 mm) for Figures 134-139, 141. Second scale (0.1 mm) for Figures 140 and 142. Third scale (0.5 mm) for Figures 146 and 147. Fourth scale (0.5 mm) for Figures 145 and 148. Bottom scale (0.1 mm) for Figures 143 and 144.

*Monomorium trageri* new species

Figures 7, 20, and 133-148

*Monomorium* new sp. near *minimum*: Jones et al., 1982: 287.

**DIAGNOSIS.** QUEEN: Wingless >usually<; mandible with 4 teeth, basal 2 reduced (Fig. 140); head smooth and shining except for rugosities near lateral margin of clypeus (Fig. 135); mesonotum lacking notal furrow. MALE: Genitalia and sterna as in Figures 141, and 145-148. WORKER: Propodeum angular (basal face 1/2 as long as declivitous face); mesopleuron punctate; petiole and postpetiole as in Figure 139; 8-12 erect to suberect setae on dorsum of alitrunk; PI 31-38 (35).

**DESCRIPTION.** As described for *M. ebeninum* except as follows. QUEEN: **HEAD: Measurements** (representing 2 localities;  $N=5$ ) HL 0.62-0.70 (0.66) {0.68}, HW 0.53-0.62 (0.59) {0.53}, SL 0.38-0.55 (0.46) {0.55}, IOD 0.12-0.18 (0.15) {0.12}, OD 0.05 (0.05) {0.05}, EL 0.14-0.16 (0.15) {0.14}, MOD 0.10-0.11 (0.10) {0.10}. **Structure**—CI 80-97 (88) {88}, SIL 59-81 (68) {81}, SIW 63-104 (78) {104}. Eye small to moderate in size. Scape usually not surpassing occiput >or surpassing it by less than length of pedicel<. Mandible with 4 teeth (basal two reduced, Figure 140). Clypeal teeth sharp, short to moderate in length. Frontal carinae diverging slightly posteriorly. **Pilosity**—Setae erect to suberect over entire surface of head except as follows: setae suberect to decumbent on mandible. **Sculpture**—Moderate, parallel, longitudinal rugae beginning all along lateral margin of clypeus, extending past antennal insertion and converging with frontal carina. **ALITRUNK: Measurements** PW 0.42-0.48 (0.44) {0.42}, PL 0.25-0.31 (0.29) {0.30}, WL 1.02-1.20 (1.13) {1.15}. **Structure**—Scutum and scutellum not depressed or flat. Mesopleural suture straight with no pits at either end. PI 24-28 (25) {26}. **Sculpture**—All sutures surrounding scutum and scutellum covered with small, dense, non-piliferous punctures (Fig. 134). Propodeum covered with dense, small, non-piliferous punctures throughout (obscuring any trace of rugae on lower side of propodeum). **PETIOLE:** As in Figures 134 and 136. Setae appressed on anterior surface of node, erect to suberect on dorsum, side, and posterior surface of node, absent elsewhere. Dorsum of node smooth and shining with small piliferous punctures; side covered with moderate to large longitudinal and transverse rugae (Fig. 134). **POSTPETIOLE:** As in Figures 134 and 137. Dorsum of node slightly emarginate. Setae suberect to erect on dorsum,

posterior surface, side, and venter of node, absent elsewhere. Dorsal surface of postpetiole smooth and shining with small piliferous punctures; lower 2/3 of side (below node) with small to moderate, dense, non-piliferous punctures. **GASTER:** Setae of first gastral tergite exceeding level of dorsum of postpetiolar node.

**MALE: HEAD: Measurements** (representing 1 locality;  $N=5$ ) HL 0.55-0.60 (0.58), HW 0.70-0.72 (0.71), SL 0.25-0.30 (0.26), IOD 0.18-0.22 (0.19), OD 0.05-0.08 (0.06), EL 0.25-0.28 (0.27), MOD 0.15-0.18 (0.17). **Structure**—CI 117-131 (124), SIL 42-50 (45), SIW 35-42 (36). Maxillary palp 2-segmented (Fig. 144); labial palp 2-segmented (Fig. 143). Frontal carinae diverging slightly posteriorly. **Sculpture**—Moderate to large, parallel, longitudinal rugae beginning all along lateral margin of clypeus, extending to level of middle of compound eye. Moderate, parallel, longitudinal rugae beginning all along distal border of clypeus (between clypeal teeth) and continuing up clypeus and frons to level of antennal insertion. Several moderate, faint, semicircular rugae occurring on occiput and following contours laterally around occiput (these rugae are partially obscured by punctation). **ALITRUNK: Measurements** PW 0.62-0.65 (0.64), PL 0.30-0.38 (0.34), WL 1.30-1.35 (1.33). **Structure**—Mesopleural suture straight with small pit present on both anterior and posterior ends. Metanotum (in lateral view) projecting to level of scutellum and propodeum. Propodeum angular, basal face 2/3 as long as declivitous face. **Pilosity**—Several setae suberect to erect on lower 1/3 of mesopleuron (katapisternum). Propodeum with 2 - 4 erect to suberect setae. **Sculpture**—Smooth and shining with large piliferous punctures on dorsum. Entire propodeum smooth and shining. **PETIOLE:** As in Figure 141. Dorsum of node flat to slightly emarginate. Setae erect to suberect on dorsum, side and posterior surface, absent elsewhere. Entire petiole smooth and shining; lower 1/3 of side with faint, moderate rugae. **POSTPETIOLE:** As in Figure 141. Dorsum of node emarginate. Setae erect to suberect on anterior surface, side, posterior surface, and venter, absent elsewhere (including dorsum of node). Entire surface of postpetiole smooth and shining except for posterior 1/2 of node which is covered with small to moderate, non-piliferous punctures. **GASTER:** Setae of first gastral tergite not exceeding level of dorsum of postpetiolar node. **GENITALIA:** As in Figures 141, and 145-148. Eighth sternite with emargination approximately as deep as wide (Fig. 146). Ninth sternite with 10 erect setae (Fig. 147). Aedeagus with 12 teeth, toothed margin rounded (Fig.

145). Volsella with curved digitus and reduced cuspis; cuspis with 2 setae (Fig. 148). *COLOR*: Head dark brown except as follows: antenna and clypeus brown. Alitrunk brown, legs yellow brown, wings hyaline. Petiole, postpetiole, and gaster brown to dark brown. Genitalia brown to yellow brown. All setae white.

*WORKER. HEAD: Measurements* (representing 1 locality;  $N=5$ ) HL 0.45-0.52 (0.49), HW 0.35-0.45 (0.42), SL 0.25-0.38 (0.30), EL 0.08-0.10 (0.09), MOD 0.05-0.08 (0.07). *Structure*—CI 75-93 (86), SIL 48-76 (61), SIW 56-84 (72). Side of head convex. Scape reaching occiput but not surpassing it by length greater than length of pedicel. Mandible with 4 teeth >sometimes, basal 2 reduced<. Clypeal teeth sharp, of moderate length. *Sculpture*—Smooth and shining with moderate piliferous punctures evenly distributed throughout. *ALITRUNK: Measurements* PW 0.25-0.28 (0.27), PL 0.15-0.20 (0.18), WL 0.45-0.53 (0.50). *Structure*—Propodeum angular, basal face  $1/2$  as long as declivitous face. PI 31-38 (35). *Pilosity*—Dorsal outline of alitrunk with 8-12 erect to suberect setae. Leg pilosity as in queen. *Sculpture*—Mesopleuron covered with dense, small, non-piliferous punctures. Anterior propodeal suture with short, parallel, moderate, longitudinal rugae. *PETIOLE*: As in Figure 139. Dorsum of node convex. Setae erect on dorsum of node, absent elsewhere. *POSTPETIOLE*: As in Figure 139. Dorsum of node flat. Setae erect on dorsum and posterior surface of node, absent elsewhere. *GASTER*: Setae of first gastral tergite not projecting to level of dorsum of postpetiolar node. *COLOR*: Head dark brown (with bluish reflections) except as follows: antenna and mandible brown to light brown. Alitrunk brown to dark brown, legs light brown. Petiole, postpetiole, and gaster dark brown with bluish reflections. All setae white.

*TYPE MATERIAL. HOLOTYPE QUEEN: FLORIDA: Alachua Co., Gainesville, April 5, 1980, J. C. Trager. Holotype, deposited in NMNH, bears red, handwritten label: Monomorium/ trageri/ Holotype/ M. DuBois 1983/. Paratypes are deposited as follows: CAS (1 queen, 1 male, 1 worker), AMNH (1 queen, 1 male, 1 worker), JCTPC (1 queen, 1 male, 1 worker), KU (1 queen, 2 males, 3 workers), LACM (1 queen, 1 male, 1 worker), MBDPC (1 queen, 2 males, 3 workers), MCZ (1 queen, 1 male, 1 worker), NMNH (1 queen, 1 male, 1 worker). All paratypes bear blue, hand-*

written labels: *Monomorium/ trageri/ paratype/ M. DuBois 1983/*.

*ETYMOLOGY*. This species is named in honor of James C. Trager, who provided many specimens of it.

*DISTRIBUTION*. This species is quite rare; it is known from only four localities in Florida. In addition to the type locality, specimens have been collected in Tallahassee, LaCrosse, and Punta Gorda (Fig. 133). It is possible that earlier records of *M. minimum* from Florida (e.g., Van Pelt, 1958) may have represented collections of this species. However, no specimens from these earlier studies could be located. It is more probable earlier records referred to *M. viridum* which is more common in peninsular Florida, but does not range as far west as Tallahassee. Additional collecting in northern Florida and southern Georgia may elucidate the distribution of *M. trageri*.

*DISCUSSION. BIOLOGY*. Although details of nesting preferences are unknown (little can be inferred from 4 collections), the colony which yielded the holotype and paratypes was collected from beneath a board in a cow pasture (J. Trager, pers. comm.). The colony collected in LaCrosse (Alachua Co.) was collected in cow dung.

The type colony was reared in the laboratory from 5 April through 20 June when portions of it were killed. At that time, numerous males and queens were present. One male and queen were preserved *in coitu* indicating that mating may occur between males and closely related queens. Several specimens examined are probably intersexes (female head and male alitrunk and gaster). These may have been caused by some form of mechanical damage to the developing individuals (W. L. Brown, Jr., pers. comm.).

Recently, James Trager provided additional specimens of the Gainesville colony. A few queens are winged, indicating that genes which code for wings are still present within this population; approximately 90% of the queens are wingless and 10% are winged.

*COMPARISONS*. *Monomorium trageri* is likely to be confused with the following

species: *M. ebeninum*, *M. minimum*, and *M. viridum*. Queens of *M. trageri* may be separated from those of *M. ebeninum* since the latter have a flat or concave scutum and scutellum. Queens of *M. trageri* may be separated from those of *M. viridum* since the latter have a furrow on the mesonotum. Queens of *M. trageri* may be separated from those of *M. minimum* since the former have reduced sculpturing on the head; the only rugae are along the lateral margin of the clypeus. *Monomorium minimum* queens have more facial sculpturing. Workers of *M. trageri* may be separated from workers of the other three species since they have the basal face length of the propodeum less than the length of the declivitous face.

### *Monomorium marjoriae* new species

Figures 149-154

**DIAGNOSIS.** QUEEN: Winged; petiole as in Figures 149 and 151; scutum and scutellum not depressed; metanotum (in lateral view) projecting to level of propodeum and scutellum; propodeum angular (basal face 2X length of declivitous face). WORKER: Propodeum angular (basal face 2X length of declivitous face); mesopleuron not punctuate; petiole as in Figure 153; PI 35-38 (36).

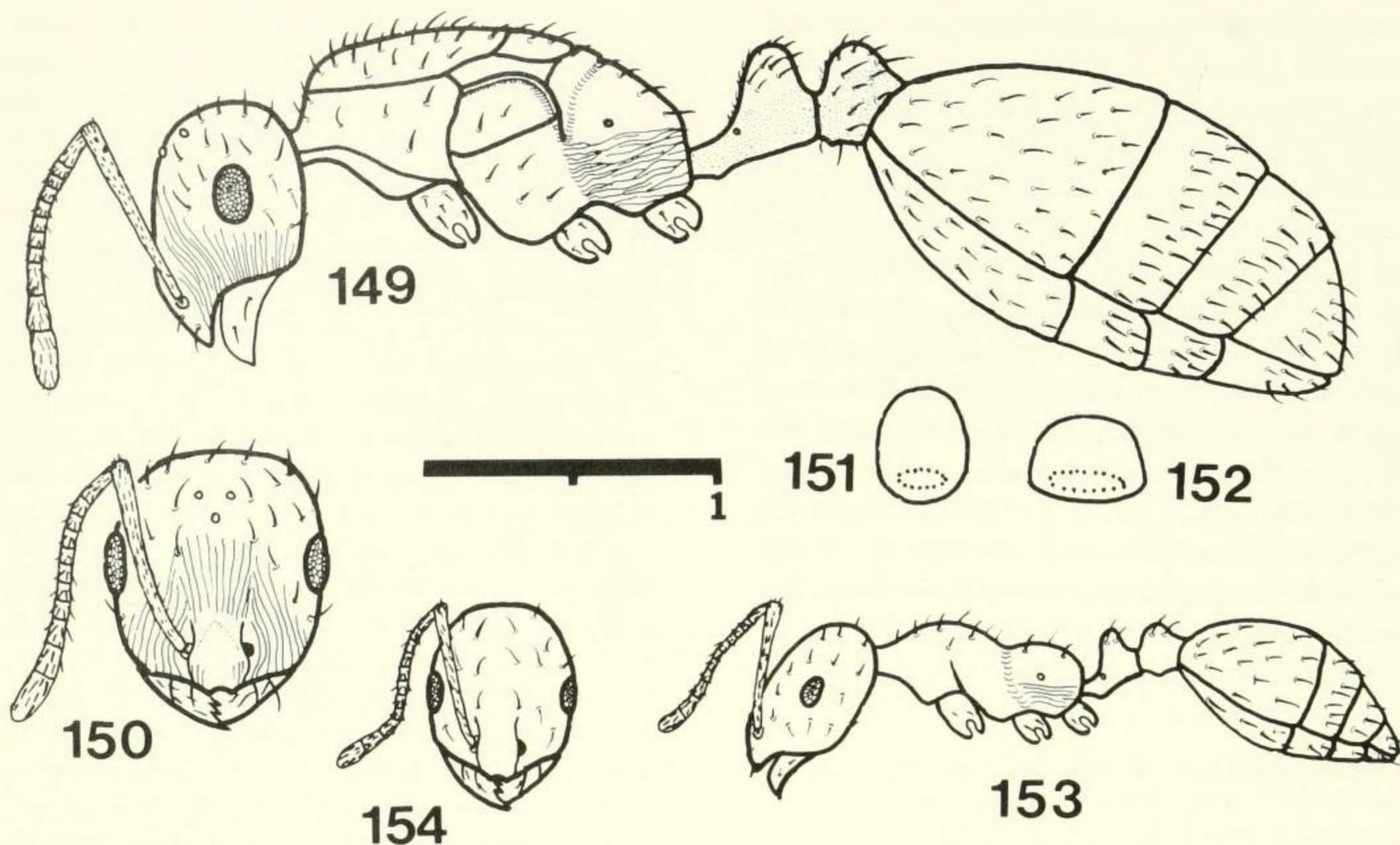
**DESCRIPTION.** As described for *M. minimum* except as follows. QUEEN: **HEAD:** *Measurements* (representing type locality;  $N=3$ ) HL 0.75-0.81 (0.78) {0.81}, HW 0.64-0.68 (0.67) {0.68}, SL 0.52-0.61 (0.56) {0.61}, IOD 0.16-0.18 (0.17) {0.17}, OD 0.04-0.05 (0.05) {0.05}, EL 0.16-0.22 (0.19) {0.22}, MOD 0.12-0.17 (0.14) {0.17}. **Structure**—CI 84-87 (85) {84}, SIL 67-75 (72){75}, SIW 76-90 (84){90}. Side of head straight. Scape reaching or surpassing occiput by less than length of pedicel. **Pilosity**—Setae erect to subdecumbent on clypeus, frons, gular region, mandible, and occiput, decumbent to appressed elsewhere. **Sculpture**—Small, parallel, longitudinal rugae beginning all along lateral margin of clypeus, extending past antennal insertion, and converging with frontal carina. Several small, parallel, longitudinal rugae beginning between clypeal teeth, extending to level of antennal insertion. Several small, parallel, longitudinal rugae beginning between frontal carinae (near posterior edge of carinae) and extending towards (but not reaching) anterior ocellus (Fig. 150). **ALITRUNK:** *Measurements* PW 0.40-0.48

(0.43){0.48}, PL 0.26-0.40 (0.34) {0.26}, WL 1.30-1.40 (1.35) {1.30}. **Structure**—Mesopleural suture deflected dorsally at each end (resulting in U-shaped suture), with pits lacking on both ends. Propodeum angular, basal face 2X length of declivitous face. PI 20-30 (26){20}. **Pilosity**—Fewer than 30 erect to suberect setae projecting above dorsal outline of alitrunk. **PETIOLE:** As in Figures 149 and 151. Setae appressed on anterior surface of node, suberect to erect (a few decumbent) on side, dorsum, and posterior surface of node, absent elsewhere. **POSTPETIOLE:** As in Figures 149 and 152. Setae appressed on anterior surface of node, suberect to erect elsewhere (including venter). Anterior surface and dorsum of node smooth and shining with small piliferous punctures; remainder covered with, moderately dense, non-piliferous punctures. **GASTER:** Setae of first gastral tergite not reaching level of dorsum of postpetiolar node. **COLOR:** Head (including mandible and antenna) brown to dark brown. Alitrunk brown to dark brown, legs brown to yellow brown. Petiole, postpetiole, and gaster brown to dark brown. All setae white.

**MALE:** UNKNOWN IN *M. marjoriae*.

**WORKER:** **HEAD:** *Measurements* (representing type locality;  $N=2$ ) HL 0.55-0.61 (0.58), HW 0.45-0.46 (0.46), SL 0.41-0.45 (0.43), EL 0.08-0.09 (0.08), MOD 0.05-0.06 (0.06). **Structure**—CI 75-82 (78), SIL 74-75 (74), SIW 89-98 (94). Scape reaching or surpassing occiput by an amount less than length of pedicel. **Pilosity**—Setae erect to subdecumbent on clypeus, frons, gular region, mandible, and occiput, decumbent to appressed elsewhere. **ALITRUNK:** *Measurements* PW 0.26-0.28 (0.27), PL 0.24-0.25 (0.24), WL 0.65-0.68 (0.66). **Structure**—Propodeum angular, basal face 2X length of declivitous face. PI 35-38 (36). **POSTPETIOLE:** As in Figure 153. Moderately dense, non-piliferous punctures on posterior surface of node. **COLOR:** Head brown to dark brown, mandible and antenna brown to yellow brown. Alitrunk brown, legs yellow brown to yellow. Petiole, postpetiole, and gaster brown to dark brown. All setae white.

**TYPE MATERIAL.** HOLOTYPE QUEEN: MEXICO: Nayarit; Punga, May 26, 1923, H. C. Millender. Holotype (NMNH) bears red, handwritten label: *Monomorium/ marjoriae/ Holotype/ M. DuBois 1983/*. Two paratype queens and 9 paratype workers collected with holotype. All paratypes bear



FIGS. 149-154. *Monomorium marjoriae*. 149—Queen, lateral view. 150—Head of queen, frontal view. 151—Petiole of queen, posterior view. 152—Postpetiole of queen, posterior view. 153—Worker, lateral view. 154—Head of worker, frontal view. Scale: (1 mm) for Figures 149-154.

blue, handwritten labels: *Monomorium/ marjoriae/ Paratype/ M. DuBois 1983/*.

**ETYMOLOGY.** This species is named in honor of my mother, Marjorie A. (Black) DuBois.

**DISTRIBUTION.** This species is known only from the type locality listed above.

**DISCUSSION.** *Monomorium marjoriae* is most likely to be confused with *M. cyaneum* or *M. compressum* which may occur in similar habitats. Additionally, *M. marjoriae* closely resembles *M. ebeninum* in habitus; however, these species do not appear to overlap. Queens of *M. marjoriae* may be separated from those of *M. compressum* and *M. ebeninum* since in the latter two species the scutum and scutellum are concave or flat. Queens of *M. marjoriae* may be separated from those of *M. cyaneum* since the latter are wingless and the former have a propodeum with the length of the basal face 2X the length of the declivitous face. Workers of *M. marjoriae* may be separated from workers of these other species since they possess a propodeum with the basal face length 2X the declivitous face length.

### *Monomorium talbotae* DuBois

Figures 155-163

*Monomorium* sp.: Talbot, 1975: 245; Talbot, 1979: 88; DuBois, 1980: 626.

*Monomorium talbotae* DuBois, 1981a: 31-34.

**DIAGNOSIS.** FEMALE: Winged; petiole convex (Fig. 155); scutum and scutellum convex; metanotum (in lateral view) not projecting to level of propodeum and scutellum; propodeum rounded; clypeus scarcely emarginate, lacking teeth; anterior edge of scutum not projecting over pronotum; no depression on first gastral tergite. MALE: Genitalia and sterna as in Figures 156, and 160-163.

**DESCRIPTION.** As described for *M. minimum* except as follows. FEMALE: **HEAD:** Measurements (representing type locality;  $N=8$ ) HL 0.40-0.48 (0.44), HW 0.39-0.43 (0.40), SL 0.31-0.36 (0.34), IOD 0.09-0.10 (0.10), OD 0.04-0.06 (0.05), EL 0.08-0.09 (0.09), MOD 0.05-0.06 (0.06). **Structure**—CI 81-98 (92), SIL 74-80 (77), SIW 80-92 (84). In full frontal view, head broadest at or a little below occiput. Eye small in size. Scape reaching or surpassing occiput by an amount less than length of pedicel. Mandible with two teeth; maxillary palp 1-segmented; labial palp 1-segmented. Clypeal teeth absent (emargination greatly reduced

where space between teeth should occur). *Pilosity*—Setae erect to suberect over entire surface of head. *Sculpture*—Entire surface of head smooth and shining with small to moderate piliferous punctures. *ALITRUNK: Measurements* PW 0.27-0.33 (0.32), PL 0.19-0.22 (0.21), WL 0.63-0.72 (0.68). *Structure*—Mesopleural suture deflected ventrally at posterior end. Metanotum (in lateral view) not projecting to level of propodeum and scutellum. Propodeum rounded, basal and declivitous faces of approximately equal length. PI 30-32 (31). Three to 5 hamuli on hindwing. *Sculpture*—Smooth and shining throughout with small piliferous punctures. *PETIOLE: As in Figure 155.* Setae erect to suberect on all surfaces except venter which lacks setae. Entire surface smooth and shining with small piliferous punctures. *POSTPETIOLE: As in Figure 155.* Dorsum of node convex. Anterior subpostpetiolar process enlarged into spine, located medially on venter. Setae erect to suberect on all surfaces, including venter. Entire surface (except dorsum of node) covered with small, dense, non-piliferous punctures. Dorsum of node smooth and shining with small piliferous punctures. *GASTER: Setae of first gastral tergite not reaching level of dorsum of postpetiolar node.* *COLOR: Head and mandible light brown. Alitrunk and legs light brown, except for light yellow tibiae and tarsi. Petiole, postpetiole, and gaster light brown. All setae white.*

**MALE: HEAD: Measurements** (representing type locality;  $N=2$ ) HL 0.39-0.43 (0.41), HW 0.42-0.43 (0.42), SL 0.32-0.35 (0.34), IOD 0.07-0.08 (0.08), OD 0.04-0.05 (0.04), EL 0.09-0.10 (0.10), MOD 0.06-0.08 (0.07). *Structure*—CI 100-108 (104), SIL 81-82 (82), SIW 76-81 (79). Eye small in size. Mandible with 2 teeth (Fig. 157); maxillary palp 1-segmented (Fig. 159); labial palp 1-segmented (Fig. 158). Clypeal teeth and frontal carinae as in female. *Pilosity*—As in female. *Sculpture*—As in female. *ALITRUNK: Measurements* PW 0.29-0.30 (0.30), PL 0.20-0.22 (0.21), WL 0.63-0.68 (0.66). *Structure*—As in female. PI 32 (32). Wings as in female. *Pilosity*—As in female. *Sculpture*—As in female. *PETIOLE: As in female.* *POSTPETIOLE: As in female.* *GASTER: As in female.* *GENITALIA: As in Figures 156 and 160-163.* Eighth sternite with emargination approximately 1/2 as deep as wide (Fig. 162). Ninth sternite with 10-12 erect setae (Fig. 163). Aedeagus with 7 teeth; toothed margin straight (Fig. 161). *COLOR: As in female.*

**WORKER:** Unknown and apparently non-existent in *M. talbotae*.

**TYPE MATERIAL.** Type series consisting of 8 females and 2 males (DuBois, 1981a): *MICHIGAN: Livingston Co., E. S. George Reserve, 30 June 1966, M. Talbot.* Holotype (MCZ) bears red, handwritten label: *Monomorium/ talbotae/ M. DuBois 1981/ Holotype/.* Allotype male also in MCZ. Paratypes distributed as follows: 6 females, 1 male (MBDPC), 1 female (KU). Allotype and paratypes bear red, handwritten labels: *Monomorium/ talbotae/ M. DuBois 1981/ Paratype (or Allotype)/.*

**DISTRIBUTION.** This species is currently known only from the type locality listed above.

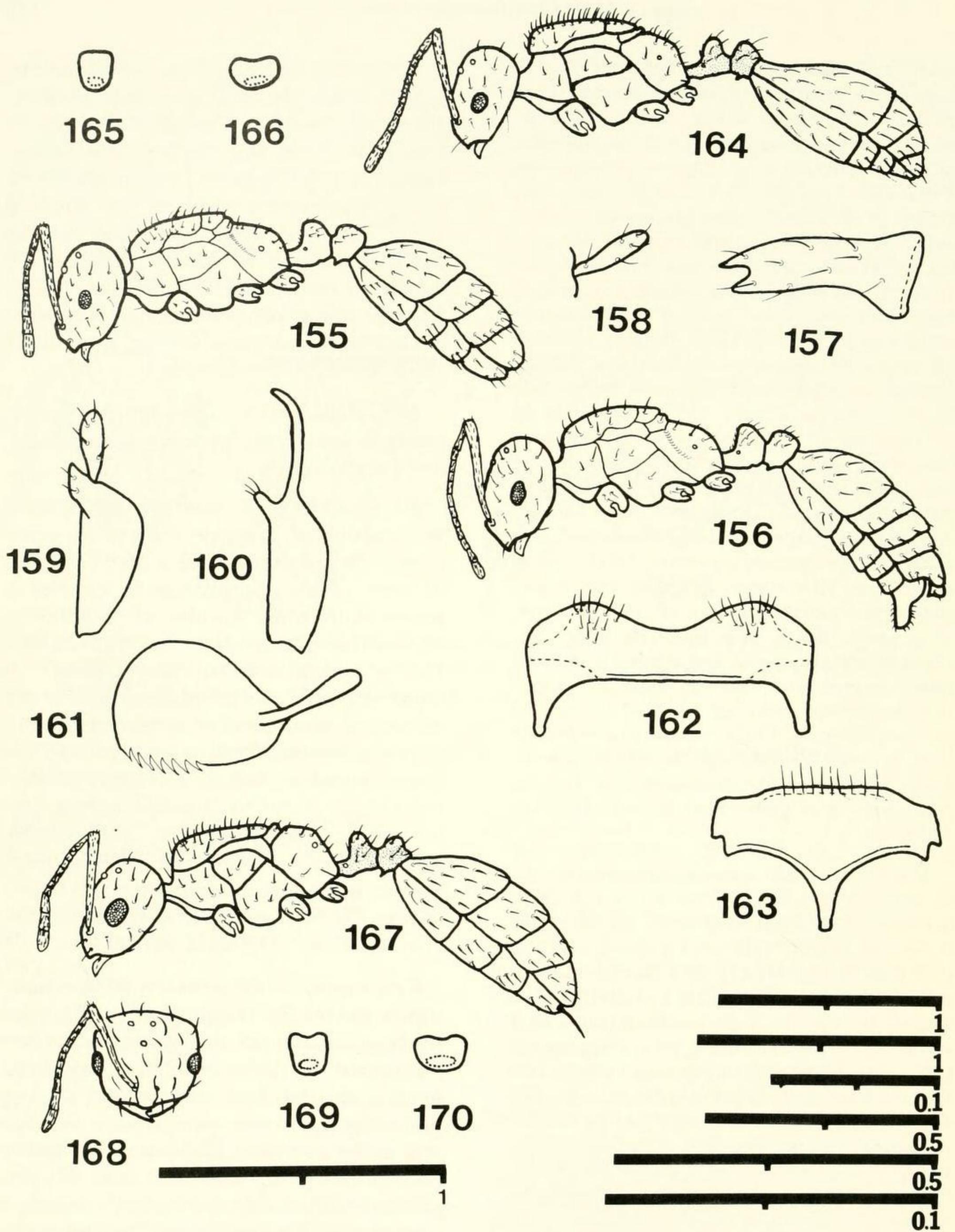
**DISCUSSION. BIOLOGY.** This species was discovered in three nests of *M. minimum*. It is presumed to be a social parasite in view of the morphological features it shares with other species of inquiline *Monomorium* (see section on inquilinism). Habitat (from notes of M. Talbot): "A high, dry field where vegetation was not dense and small patches of bare sandy soil were numerous. Grasses were mostly *Poa compressa* and *Aristida* sp. A variety of scattered forbes included *Lespedeza capitata*, *Liatris aspersa*, *Rumex acetosella*, and *Solidago* spp. Patches of *Polytrichum piliferum* moss were large and frequent and the red-tipped lichen, *Cladonia cristatella* var. *vestita*, was characteristic." (DuBois, 1981a).

**COMPARISONS.** *Monomorium talbotae* specimens are easily recognized by the relatively small size of the female and male (compared to the size of host male and female) and by their smooth and shining integument. *Monomorium talbotae* females and males are most likely to be confused with those of *M. inquilinum* and *M. pergandei*. The first differs from both the other species since the metanotum does not reach the level of the propodeum and scutellum.

### *Monomorium pergandei* (Emery)

Figures 164-166

*Epoecus pergandei* Emery, 1892 (1893): cclxxvi-cclxxvii; Emery, 1895: 272-274; Wheeler, 1910: 498; Emery, 1921: 204-205; Smith, 1943: 301-302; Smith, 1947: 569-570; Creighton, 1950: 239-241; Smith, 1952: 815.



FIGS. 155-163. *Monomorium talbotae*. 155—Female, lateral view. 156—Male, lateral view. 157—Mandible of male. 158—Labial palp of male. 159—Maxilla and maxillary palp of male. 160—Volsella of male. 161—Aedeagus of male. 162—Eighth sternite of male. 163—Ninth sternite of male. FIGS. 164-166. *Monomorium pergandei*. 164—Female, lateral view. 165—Petiole of female, posterior view. 166—Postpetiole of female, posterior view. FIGS. 167-170. *Monomorium inquilinum*. 167—Female, lateral view. 168—Head of female, frontal view. 169—Petiole of female, posterior view. 170—Postpetiole of female, posterior view. Scales: Left (1 mm) for Figures 167-170. Right top (1 mm) for Figures 164-166. Right second (1 mm) for Figures 155-156. Right third (0.1 mm) for Figure 157. Right fourth scale (0.5 mm) for Figures 160-161. Right fifth scale (0.5 mm) for Figures 162-163. Right bottom scale (0.1 mm) for Figures 158-159.

*Monomorium pergandei*: Ettershank, 1966: 82-91; Wilson, 1971: 354; Smith, 1979: 1383; DuBois, 1981a: 36.

**DIAGNOSIS.** FEMALE: Winged; petiole as in Figures 164 and 165; scutum and scutellum convex; metanotum (in lateral view) projecting above level of propodeum and scutellum; propodeum angular; clypeus emarginate, teeth blunt and reduced; anterior edge of scutum projecting over pronotum as in Figure 164.

**DESCRIPTION.** As described for *M. talbotae* except as follows. FEMALE: **HEAD:** *Measurements* (representing type locality;  $N=2$ ) HL 0.44-0.48 (0.46), HW 0.39-0.40 (0.40), SL 0.40-0.42 (0.41), IOD 0.09-0.10 (0.10), OD 0.04-0.05 (0.04), EL 0.09-0.10 (0.10), MOD 0.08-0.09 (0.08). *Structure*—CI 83-89 (86), SIL 88-90 (89), SIW 103-105 (104). Scape surpassing occiput by an amount slightly greater than length of pedicel. Mandible with three teeth. Clypeal teeth blunt, short. **ALITRUNK:** *Measurements* PW 0.30-0.33 (0.32), PL 0.22-0.28 (0.25), WL 0.72-0.81 (0.76). *Structure*—Mesonotum with small notal furrow. Scutum and scutellum not depressed. Anterior edge of scutum projecting over pronotum as in Figure 164. Mesopleural suture deflected dorsally at posterior end and ventrally at anterior end; small pit at each end. Metanotum (in lateral view) projecting above level of propodeum and scutellum. Propodeum angular. PI 30-35 (32). **PETIOLE:** As in Figures 164 and 165. Dorsum of node flat, smooth and shining with small piliferous punctures. Remaining surfaces covered with moderately dense, non-piliferous punctures. **POSTPETIOLE:** As in Figures 164 and 166. Dorsum of node weakly emarginate. **GASTER:** As in *M. minimum* except as follows: first gastral tergite with basal depression. **COLOR:** Head brown to dark brown except as follows: mandible and antenna yellow brown to yellow. Alitrunk brown, legs yellow brown to yellow. Petiole, postpetiole, and gaster brown. All setae white.

**MALE:** Although males and females of *M. pergandei* were collected from the same nest, no male specimens could be located for this study. One badly damaged specimen (gaster missing) is labelled as a male in the NMNH collection. The head and alitrunk resemble those of a female. This may actually be a male if the sexes in *M. pergandei* are as similar as they are in *M. talbotae*.

**WORKER:** Unknown and apparently non-existent in *M. pergandei*.

**TYPE MATERIAL.** Type series consist-

ing of lectotype and 6 paralectotype queens, designated by DuBois (1981a): **DISTRICT OF COLUMBIA:** Washington, 12 July (year unknown but before 1892), T. Pergande. Lectotype and 4 paralectotypes in NMNH, remaining paralectotypes in MCZ. All specimens bear red, handwritten labels: *Monomorium/ pergandei/* Lectotype (or Paralectotype)/ M. DuBois 1980/.

**DISTRIBUTION.** This species is known only from the type locality.

**DISCUSSION.** **BIOLOGY.** This species was discovered in a nest of *M. minimum*. It is presumed to be a social parasite in view of the morphological features it shares with other species of inquiline *Monomorium* (see section on inquilinism).

This species has only been collected once (almost 100 years ago), and is probably now extinct. One detail recorded, and perpetuated through the literature (i.e., Wheeler, 1910: 498; Creighton, 1950: 239-241), was that when the colony containing *M. pergandei* was taken to the laboratory, Pergande noted that reproductives of *M. minimum* were also present in the nest. As he watched, the *M. pergandei* females attacked and killed some of the *M. minimum* males. This seems rather unusual behavior if the reproductives of the two species coexisted previously in the same nest. However, Wheeler (1910: 498) points out that Pergande may have collected two colonies in close proximity to each other, with one colony containing *M. pergandei* reproductives and *M. minimum* workers, while the other colony contained *M. minimum* reproductives. Wheeler then supposed these two colonies were combined in the laboratory and the observed behavior ensued.

**COMPARISONS.** *Monomorium pergandei* is easily recognized by the small size of the female (compared to the size of the host), the smooth and shining integument, the abundance of erect to suberect setae over most of the body, the spine projecting where the postpetiolar process is usually located, and the large depression on the dorsum of the first gastral tergite.

Females of this species are most similar

to *M. inquilinum*. However, these two species can easily be separated, since the metanotum only projects to the level of the propodeum and scutellum and there are only two mandibular teeth in *M. inquilinum*. The petiolar node is flat and the anterior edge of the scutum does not project over the pronotum in *M. inquilinum*. These same characters distinguish females of *M. talbotae*, which also lack a dorsal impression on the first gastral tergite.

### *Monomorium inquilinum* DuBois

Figures 167-170

*Monomorium* sp.: DuBois, 1980: 626.

*Monomorium inquilinum* DuBois, 1981a: 34-36.

**DIAGNOSIS.** FEMALE: Winged; petiole emarginate (Fig. 167); scutum and scutellum not depressed; metanotum (in lateral view) projecting to level of propodeum and scutellum; propodeum angular; clypeus emarginate, lacking teeth; anterior edge of pronotum rounded.

**DESCRIPTION.** As described for *M. talbotae* except as follows. FEMALE: **HEAD:** Measurements {representing holotype only} HL 0.45, HW 0.39, SL 0.40, IOD 0.10, OD 0.04, EL 0.10, MOD 0.08. **Structure**—CI 89, SIL 89, SIW 100. Scape surpassing occiput by amount slightly greater than length of pedicel. Labial palp 2-segmented. Clypeal teeth absent (clypeus retaining emargination where space between teeth should occur). **ALITRUNK:** Measurements PW 0.30, PL 0.15, WL 0.66. **Structure**—Mesopleural suture straight. Metanotum (in lateral view) projecting to level of propodeum and scutellum. Propodeum angular, basal face length half length of declivitous face. PI 22. Wings absent (presence of basal sclerites indicate holotype once possessed wings). **Pilosity**—As in *M. cyaneum*. **Sculpture**—As in *M. talbotae*. **PETIOLE:** As in Figures 167 and 169. Dorsum of node emarginate. Entire surface (except dorsum of petiolar node) covered with small, dense, non-piliferous punctures (causing a granular appearance); dorsum of node smooth and shining with small piliferous punctures. **POSTPETIOLE:** As in Figures 167 and 170. Dorsum of node emarginate. **GASTER:** As in *M. pergandei*. **COLOR:** Head dark brown, antenna yellow. Alitrunk dark brown, legs brown (tibiae and tarsi yellow). Petiole, postpetiole, and gaster dark brown. All setae white.

**MALE:** Unknown in *M. inquilinum*.

**WORKER:** Unknown and apparently non-existent in *M. inquilinum*.

**TYPE MATERIAL.** Known only from the holotype (DuBois, 1981a): *ESTADO DE MEXICO:* Highway 57 (between Mexico City and Queretaro), km 127 (measured from Mexico City), high desert, Cornell University Mexico Field Party, 9 August 1965 (1 female, MCZ).

**DISTRIBUTION.** This species is known only from the type locality.

**DISCUSSION.** **BIOLOGY.** This species was discovered in a nest of *M. cyaneum* beneath a stone. It is presumed to be a social parasite because of the morphological features shared with other inquilinous *Monomorium* (see section on inquilinism).

**COMPARISONS.** The *Monomorium inquilinum* female is most similar to *M. pergandei* and *M. talbotae* females. It can be easily separated from these species since the petiole is emarginate only in *M. inquilinum*. Furthermore, the metanotum does not reach the level of propodeum and scutellum in *M. talbotae*, and the mesonotum possesses a furrow in *M. pergandei*.

### ACKNOWLEDGMENTS

Throughout this investigation I have received assistance from numerous colleagues. I am particularly grateful for the continued assistance of my thesis advisor, Charles D. Michener, who provided many useful comments and suggestions. I also wish to thank William L. Brown, Jr., Mary Talbot, Murray Blum, and William F. Buren for enlightening discussions concerning *Monomorium*. My colleagues at the State Biological Survey of Kansas assisted me in collecting ants throughout Kansas. This revision was supported in part by a grant from Sigma Xi.

Finally, I wish to thank my wife, Jeri, and son, Benjamin, for assisting me on numerous collecting trips and for their boundless patience while I wrote this manuscript.

### LITERATURE CITED

- BROWN, W. L., JR. 1943. A new metallic ant from the pine barrens of New Jersey. *Entomol. News* 54:243-248.

- . 1964. Some tramp ants of Old World origin collected in tropical Brazil. *Entomol. News* 75:14-15.
- . 1973. A comparison of the Hylean and Congo-West African rain forest ant faunas, pp. 161-185. In B. J. Meggers, E. S. Ayensu, and W. D. Duckworth (eds.), *Tropical Forest Ecosystems in Africa and South America: A Comparative Review*. Smithsonian Inst. Press, Washington, D.C.
- BROWN, W. L., JR. and E. O. WILSON. 1957. A new parasitic ant of the genus *Monomorium* from Alabama, with a consideration of the status of genus *Epixenus* Emery. *Entomol. News* 68:239-246.
- BRUES, C. 1903. Notes on some California myrmecophiles. *Entomol. News* 14:147-149.
- BUCKLEY, S. B. 1867. Descriptions of new species of North American Formicidae. *Proc. Entomol. Soc. Philadelphia* 6:335-350.
- BUREN, W. F. 1944. A list of Iowa ants. *Iowa State J. Sci.* 18:277-312.
- . 1958. A review of the species of *Crematogaster*, *sensu stricto*, in North America, Part I. *J. New York Entomol. Soc.* 56:119-134.
- BURNHAM, L. 1978. Survey of social insects in the fossil record. *Psyche* 85:85-133.
- CARPENTER, F. M. 1930. The fossil ants of North America. *Bull. Mus. Comp. Zool.* 70:1-66.
- COLE, A. C., JR. 1937. An annotated list of the ants of Arizona (Hymenoptera: Formicidae). *Entomol. News* 48:97-101, 134-140.
- . 1953. Studies of New Mexico ants VI. The genera *Monomorium*, *Solenopsis*, *Myrmecina*, and *Trachymyrmex* (Hymenoptera: Formicidae). *J. Tennessee Acad. Sci.* 28:299-300, 316.
- COOK, T. 1953. *The Ants of California*. Pacific Books, Palo Alto. 462 pp.
- CREIGHTON, W. S. 1950. The ants of North America. *Bull. Mus. Comp. Zool.* 104:1-585.
- CROZIER, R. 1970. Karyotypes of twenty-one ant species (Hymenoptera: Formicidae), with reviews of the known ant karyotypes. *Can. J. Genet. Cytol.* 12:109-128.
- . 1975. *Animal Cytogenetics: Hymenoptera*. Gerbruder Borntraeger, Berlin. 95 pp.
- DENNIS, C. A. 1938. The distribution of ant species in Tennessee with reference to ecological factors. *Ann. Entomol. Soc. Amer.* 31:267-308.
- DIETZ, R. S. and J. C. HOLDEN. 1970. Reconstruction of Pangea: breakup and dispersion of the continents, Permian to present. *J. Geophys. Res.* 75:4939-4956.
- DUBOIS, M. B. 1980. Notes on the inquiline *Monomorium* of North America (Hymenoptera: Formicidae). *J. Kansas Entomol. Soc.* 53:626.
- . 1981a. Two new species of inquiline *Monomorium* from North America (Hymenoptera: Formicidae). *Univ. Kansas Sci. Bull.* 52:31-37.
- . 1981b. New records of ants in Kansas III. *Tech. Publ. State Biol. Surv. Kansas* 10:32-44.
- . 1981c. A revision of the native New World species of the ant genus *Monomorium* (*minimum* group) (Hymenoptera: Formicidae). Masters Thesis, Univ. Kansas, Lawrence.
- EMERY, C. 1892 (1893). Diagnoses de cinq nouveaux genres de formicides. *Bull. Soc. Entomol. France* 61: cclxxv-cclxxcii.
- . 1894. Studi sulle formiche della fauna neotropica. *Bull. Soc. Entomol. Italiana* 26:137-241.
- . 1895. Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna. *Zool. Jahrb. (Syst.)* 7:257-360.
- . 1921 (1922). Hymenoptera, Fam. Formicidae, Subfam. Myrmicinae. *Genera Insectorum*. Ed. P. Wytsman 174:1-397.
- ESSIG, E. 1926. *Insects of Western North America*. Macmillan, N.Y. 1050 pp.
- ETTERSHANK, G. 1966. A generic revision of the world Myrmicinae related to *Solenopsis* and *Pheidologeton* (Hymenoptera: Formicidae). *Australian J. Zool.* 14:73-171.
- FOREL, A. 1881. Die ameisen der Antille St. Thomas. *Münch. entomol. Ges. Mitth.* 5:1-16.
- . 1891. Histoire naturelle des formicides de Madagascar. In A. Grandidier (ed.), *Histoire physique, naturelle et politique de Madagascar*. 2:1-280.
- . 1899-1900. Formicidae. In *Biologia Centrali-Americana, Insecta. Hymenoptera* 3:1-169.
- . 1908. Ameisen aus São Paulo (Brasilien), Paraguay, etc. *Verh. Zool.-bot. Ges. Wien* 8:340-418.
- FRANCOEUR, A. 1973. Révision taxonomique des espèces néarctiques du groupe *fusca*, genre *Formica* (Formicidae, Hymenoptera). *Mém. Soc. Entomol. Quebec* 3:1-316.
- GREGG, R. E. 1944. The ants of the Chicago region. *Ann. Entomol. Soc. Amer.* 37:447-480.
- . 1945. Two new forms of *Monomorium* (Formicidae). *Psyche* 52:62-69.
- . 1963. *The Ants of Colorado*. Univ. Colorado Press, Boulder. 792 pp.
- HALL, D. W. and I. C. SMITH. 1951. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.). 6. External characters, size variation, and cephalic ratios. *Entomol. Mon. Mag.* 87:217-221.
- . 1952. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.). 7. Thoracic structures, typical and atypical. *Entomol. Mon. Mag.* 88:97-102.
- . 1953. Atypical forms of the wingless worker and the winged female in *Monomorium pharaonis* (L.). (Hymenoptera: Formicidae). *Evolution* 7:127-135.
- HESS, C. G. 1958. The ants of Dallas County, Texas, and their nesting sites; with particular reference to soil texture as an ecological factor. *Field and Laboratory* 26:3-72.
- HUNT, J. H. and R. R. SNELLING. 1975. A checklist of the ants of Arizona. *Arizona Acad. Sci.* 10:20-23.
- JONES, T. H., M. S. BLUM, R. W. HOWARD, C. A. MCDANIEL, H. M. FALES, M. B. DUBOIS, and J. TORRES. 1982. Venomous chemistry of ants in the genus *Monomorium*. *J. Chem. Ecol.* 8:285-300.
- JONES, T. H., J. B. FRANKO, M. S. BLUM, and H. M. FALES. 1980. Unsymmetrical, 2,5-dialkylpyrrolidines via reductive amination of 1,4-diketones. *Tetrahedron Letters* 21:789-792.

- KANNOWSKI, P. B. 1956. The ants of Ramsey County, North Dakota. *Amer. Midl. Natur.* 56:168-185.
- KEMPF, W. W. 1972. Catálogo abreviado das formigas da região neotropical (Hymenoptera: Formicidae). *Studia Entomol.* 15:3-344.
- KUGLER, C. 1978. A comparative study of the myrmicine sting apparatus (Hymenoptera, Formicidae). *Studia Entomol.* 20:413-548.
- KUSNEZOV, N. 1949. El genero *Monomorium* (Hymenoptera, Formicidae) en la Argentina. *Acta Zool. Lilloana* 7:423-448.
- LAVIGNE, R. 1977. Notes on the ants of Luquillo Forest, Puerto Rico (Hymenoptera: Formicidae). *Proc. Entomol. Soc. Washington* 79:216-237.
- MALLIS, A. 1941. A list of the ants of California with notes on their habits and distribution. *Bull. S. California Acad. Sci.* 40:61-100.
- MAYR, G. 1855. Formicina Austriaca. Beschreibung der bisher im oster. Kaisertadte aufgefundenen Ameisen, etc. *Verh. Zool.-bot. Ges. Wien* 5:273-478.
- MITCHELL, J. D. and W. D. PIERCE. 1912. The ants of Victoria County, Texas. *Proc. Entomol. Soc. Washington* 14:67-76.
- PEACOCK, A. D. 1950a. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.). 2. Methods of recording observations on artificial colonies. *Entomol. Mon. Mag.* 86:129-135.
- . 1950b. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.). 4. Egg production. *Entomol. Mon. Mag.* 86:294-298.
- . 1951. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.) 5. Pupal and adult sex ratios. *Entomol. Mon. Mag.* 87:185-191.
- PEACOCK, A. D. and A. T. BAXTER. 1949. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.). I. The rearing of artificial colonies. *Entomol. Mon. Mag.* 85:256-261.
- . 1950. Studies in Pharaoh's ant, *Monomorium pharaonis* (L.). 3. Life history. *Entomol. Mon. Mag.* 86:171-178.
- SANTSCHI, F. 1925. Contribution à la fauna myrmécologique de la Chine. *Bull. Soc. Vaudoise Sci. Nat.* 56:81-96.
- . 1927. Révision myrmécologique. *Bull. Ann. Soc. Entomol. Belgique* 67:240-245.
- . 1936. Étude sur les fourmis due genre *Monomorium* Mayr. *Bull. Soc. Sci. Nat. Maroc* 16:32-64.
- SMITH, D. R. 1979. Superfamily Formicoidea, pp. 1323-1467. In K. Krombein, P. Hurd, Jr., D. Smith, and B. Burks (eds.). *Catalog of Hymenoptera in America north of Mexico*. Smithsonian Inst. Press, Washington, D.C.
- SMITH, I. C. and A. D. PEACOCK. 1957. The cytology of Pharaoh's ant, *Monomorium pharaonis* (L.). *Proc. Roy. Soc. Edinburgh (ser. B)* 65:235-261.
- SMITH, M. R. 1930. A list of Florida ants. *Florida Entomol.* 14:1-6.
- . 1935. A list of the ants of Oklahoma. *Entomol. News* 46:235-241.
- . 1936a. A list of the ants of Texas. *J. New York Entomol. Soc.* 44:155-170.
- . 1936b. The ants of Puerto Rico. *J. Agric. Univ. Puerto Rico* 20:819-875.
- . 1943. A generic and subgeneric synopsis of the male ants of the United States. *Amer. Midl. Natur.* 30:273-321.
- . 1947. A generic and subgeneric synopsis of the United States ants, based on the workers (Hymenoptera: Formicidae). *American Midl. Nat.* 37:521-647.
- . 1952. Family Formicidae. In K. Krombein (ed.). *Hymenoptera of America north of Mexico synoptic catalog*. USDA Monog. 2:778-875.
- . 1958. Family Formicidae. In K. Krombein (ed.). *Hymenoptera of America north of Mexico synoptic catalog*. First supplement. USDA Monog. 2:108-162.
- . 1965. House-infesting ants of the eastern United States: Their recognition, biology and economic importance. USDA Tech. Bull. 1326:1-105.
- . 1967. Family Formicidae. In K. Krombein (ed.). *Hymenoptera of America north of Mexico synoptic catalog*. Second supplement. USDA Monog. 2:343-374.
- SNELLING, R. R. 1976. A revision of the honey ants, genus *Myrmecocystus* (Hymenoptera: Formicidae). *Natur. Hist. Mus. Los Angeles Co. Sci. Bull.* 24:1-163.
- SNODGRASS, R. E. 1935. *Principles of Insect Morphology*. McGraw-Hill, Inc., N.Y. 667 pp.
- . 1941. The male genitalia of Hymenoptera. *Smithsonian Misc. Coll.* 99:1-86.
- TALBOT, M. 1934. Distribution of ant species in the Chicago region with reference to ecological factors and physiological toleration. *Ecol.* 15:416-439.
- . 1953. Ants of an old-field community on the Edwin S. George Reserve, Livingston County, Michigan. *Contrib. Lab. Vert. Biol. Univ. Michigan* 63:1-13.
- . 1975. A list of the ants (Hymenoptera: Formicidae) of the Edwin S. George Reserve, Livingston County, Michigan. *Great Lakes Entomol.* 8:245-246.
- . 1979. Social parasitism among ants at the E. S. George Reserve in southern Michigan. *Great Lakes Entomol.* 12:87-89.
- TULLOCH, G. S. 1930. Thoracic modifications accompanying the development of subaptery and aptery in the genus *Monomorium*. *Psyche* 33:202-206.
- VAN PELT, A., JR. 1948. A preliminary study to the worker ants of Alachua County, Florida. *Florida Entomol.* 30:57-67.
- . 1956. The ecology of the ants of the Welaka Reserve, Florida (Hymenoptera: Formicidae). *Amer. Midl. Natur.* 56:358-387.
- . 1958. The ecology of the ants of the Welaka Reserve, Florida (Hymenoptera: Formicidae), part II. Annotated list. *Amer. Midl. Natur.* 59:1-57.
- VAN PELT, A., JR. and S. A. VAN PELT. 1972. *Microdon* in nests of *Monomorium* in Texas. *Ann. Entomol. Soc. America* 65:977-978.

- WHEELER, G. C. and J. WHEELER. 1955. The ant larvae of the myrmicine tribe Solenopsidini. *Amer. Midl. Natur.* 54:119-141.
- . 1960a. Supplementary studies on the larvae of the Myrmicinae. *Proc. Entomol. Soc. Washington* 62:1-32.
- . 1960b. The ant larvae of the subfamily Myrmicinae. *Ann. Entomol. Soc. Amer.* 53:98-110.
- . 1963. The ants of North Dakota. Univ. North Dakota Press, Grand Forks. 326 pp.
- . 1973. Supplementary studies on ant larvae: Cerapachyinae, Pseudomyrmecinae, and Myrmicinae. *Psyche* 80:204-211.
- . 1976. Ant larvae: review and synthesis. *Mem. Entomol. Soc. Washington* 7:1-108.
- WHEELER, W. M. 1902. A consideration of S. B. Buckley's "North American Formicidae." *Trans. Texas Acad. Sci.* 4:19-31.
- . 1904. Ants from Catalina Island, California. *Bull. Amer. Mus. Nat. Hist.* 20:269-271.
- . 1905a. The ants of the Bahamas, with a list of the known West Indian species. *Bull. Amer. Mus. Nat. Hist.* 21:79-135.
- . 1905b. An annotated list of the ants of New Jersey. *Bull. Amer. Mus. Nat. Hist.* 21:371-403.
- . 1906. The ants of the Grand Cañon. *Bull. Amer. Mus. Nat. Hist.* 22:329-345.
- . 1908. The ants of Texas, New Mexico and Arizona. *Bull. Amer. Mus. Nat. Hist.* 24:399-485.
- . 1910. Ants: Their structure, development and behavior. Columbia Univ. Press, N.Y. 663 pp.
- . 1914a. The ants of the Baltic Amber. *Physikalisch ökonomischen Gesellschaft, Königsberg* 55:1-142.
- . 1914b. Ants collected by W. M. Mann in the state of Hidalgo, Mexico. *J. New York Entomol. Soc.* 22:37-61.
- . 1916. Formicoidea. *In* H. Viereck (ed.). *The Hymenoptera, or Wasp-like insects of Connecticut.* Connecticut Geol. Nat. Hist. Surv. Bull. 22:577-601.
- . 1917a. The mountain ants of western North America. *Proc. Amer. Acad. Arts Sci.* 52:457-569.
- . 1917b. Jamaican ants collected by Prof. C. T. Brues. *Bull. Mus. Comp. Zool.* 61:457-471.
- . 1932. A list of the ants of Florida with descriptions of new forms. *J. New York Entomol. Soc.* 40:1-17.
- . 1936. Ants from Hispanola and Mona island. *Bull. Mus. Comp. Zool.* 80:195-211.
- WILSON, E. O. 1955. A monographic revision of the ant genus *Lasius*. *Bull. Mus. Comp. Zool.* 113:1-199.
- . 1971. *The Insect Societies.* Harvard Univ. Press, Cambridge. 548 pp.
- WILSON, E. O. and W. L. BROWN, JR. 1958. The worker caste of the parasitic ant *Monomorium metoecus* Brown and Wilson, with notes on behavior. *Entomol. News* 69:33-38.
- WILSON, E. O., F. M. CARPENTER, and W. L. BROWN, JR. 1967a. The first Mesozoic ants. *Science* 157:1038-1040.
- . 1967b. The first Mesozoic ants with a description of a new subfamily. *Psyche* 65:108-114.
- WOLCOTT, G. N. 1948. Formicidae: ants. *In* *The insects of Puerto Rico.* J. Agric. Univ. Puerto Rico 32:810-839.
- WOLCOTT, G. N. and L. F. MARTORELL. 1937. The ant, *Monomorium carbonarium ebeninum* Forel, in a new role: as predator on the egg clusters of *Diatraea saccharalis* in Puerto Rican cane fields. *J. Agric. Univ. Puerto Rico* 21:577-579.