Reprinted from Proceedings of The
ENTOMOLOGICAL SOCIETY OF WASHINGTON, Vol. 62, March, 1960, No. 1
Pages 1–32

SUPPLEMENTARY STUDIES ON THE LARVAE OF THE MYRMICINAE

(HYMENOPTERA: FORMICIDAE)

GEORGE C. WHEELER *and* JEANETTE WHEELER, *Department of Biology, University of North Dakota, Grand Forks*

Subsequent to the publication of our several articles on the larvae of the tribes of the subfamily Myrmicinae we have collected or received from other myrmecologists so much additional material that it has become necessary to publish a supplement.

The purpose of this supplement is (1) to characterize the genera acquired since previous publication; (2) to describe species in such genera; (3) to describe additional species in previously studied genera; (4) to revise our published characterizations as required by new material; (5) to cite recent references in the literature; (6) to cite older references previously overlooked.

Tribe **Myrmicini** F. Smith

Our previous characterization of this tribe (1952*b*, p. 106) should be replaced by the following:

Stout; diameter greatest at the fourth or fifth abdominal somite; slightly attenuated anteriorly; thorax very stout (when mature) and arched or bent ventrally, but not differentiated into a neck; posterior end broadly rounded. Antennae with three (rarely two or four) sensilla, each of which bears a spinule. Head hairs short to long; mostly denticulate. Labrum small or moderate-sized, short, breadth 1.5-2 X length; bilobed; anterior surface of each lobe with 4-10 sensilla and/or minute hairs; posterior surface spinulose and bearing 8-20 sensilla. Mandibles rather small or moderate-sized (ratio of head width to mandible length 2.1-2.9, average 2.5); stout (ratio of length to width at base 1.8-2.4, average 2.1); heavily sclerotized. Apex of maxilla usually spinulose; palp paxilliform and bearing five or six sensilla; galea paxilliform or digitiform; palp slightly shorter than or equal to galea. Anterior surface of labium usually spinulose; palp a short projection bearing 4-8 sensilla. Opening of sericteries a short transverse slit. Hypopharynx usually sparsely spinulose, the spinules minute and generally in transverse rows.

Genus **Pogonomyrmex** Mayr

To include *badius*, our characterization of *Pogonomyrmex* (1952*b*, p. 106) should be amended as follows: . . . Head hairs short to long, simple or sparsely denticulate on the distal half. Labrum small and short; breadth 2-3 X the length; . . .

Subgenus **Pogonomyrmex** Mayr

Medial mandibular teeth conspicuous, long, robust and round-pointed.

Pogonomyrmex badius (Latreille)

Major Worker Larva.—Length (through spiracles) about 8.8 mm. Stout; with the thorax curved ventrally and tapering to a little larger than the head-size; abdomen widest at the fifth abdominal somite. Anus postero-ventral. Leg, wing and gonopod vestiges present. About nine differentiated somites. Integument sparsely spinulose, the spinules minute and in very short rows. Body hairs sparse. Of two types: (1) short (0.058-0.156 mm), slightly curved, with the distal half denticulate, on every somite; (2) long (0.156-0.369 mm), slightly curved to sinuous, without denticles, longest on the thorax, becoming very short posteriorly. Cranium subcircular in anterior view. Antennae small, each with three sensilla, each of which bears a spinule. Head hairs few, simple, slightly curved, 0.039-0.156 mm long. Labrum small, short (breadth 3X length), somewhat narrowed ventrally, bilobed, with a median furrow extending dorsally on the anterior surface; anterior surface of each lobe with seven sensilla; ventral half of anterior surface spinulose, the spinules longer and more numerous ventrally; ventral border spinulose and with two or three sensilla on each lobe; posterior surface spinulose, the spinules smaller and in longer rows dorsally; posterior surface of each lobe with two or three isolated sensilla and two pairs of contiguous sensilla. Mandibles robust, heavily sclerotized; apical tooth long, tapering only slightly to a rounded point; the two medial teeth are shorter but still quite long, subequal and round-pointed. Maxillae with apex subconical and bearing a few large isolated spinules; palp a skewed peg with four apical (three bearing a spinule each and one encapsulated) and one lateral (bearing a spinule) sensilla; galea digitiform with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in numerous short transverse rows; palp a short peg with five sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit on the anterior surface.

Minor Worker Larva.—Length (through spiracles) about 6.7 mm. Similar to the major worker larva except in the following details: Diameter more nearly uniform throughout. Body hairs shorter (0.019-0.027 mm). Head hairs fewer. Mandibles slenderer.

(Material studied: numerous larvae from Georgia, courtesy of Dr. P. B. Kannowski.)

Pogonomyrmex barbatus (F. Smith)

Correction, Wheeler and Wheeler, 1952*b*, p. 107: the two medial teeth of the mandibles are *long*.

Barnes and Nerney, 1953: "The larvae . . . remain in the chambers of the colony. They are cream colored and are shaped like crook-necked squashes, the smaller, crooked portion ending in a very small head. The full-grown larvae are about ¼ inch long" (p. 4). Fig. 2D, larva [semipupa?].

Wheeler, 1907, p. 189: "I had previously found that this species does not feed its larvae by regurgitation but with pieces of seeds or insects."

Pogonomyrmex marcusi Kusnezov

Marcus, 1953: "Of the larvae in nest D, 41 were 5-6 mm long, 30 were 4 mm and 11 were 2-2.4 mm. (The measurement was taken from the cervical curvature to the posterior end.) Eggs with embryos in various stages measure 1.5-2 mm. The largest larvae (6 mm) had rudiments of testes. From these data we may presume that there are four larval stages, each molt with a larva one millimeter longer. The larva of 5-6 mm belong to the worker and sexual castes, the latter having one more molt than the former.

"Certain larvae attract attention because of their broad flat shape. This rare and surprising shape is not the result of poor preservation, because it was observed while collecting. It seems that immediately after the molt the larvae are flat and after feeding acquire the normal rounded body shape.

"Figure 33 shows one of these flat larvae, which measures 3.6 mm long and 3.25 mm broad. To be noted are 12 spiracles for primordial tracheal respiration. The second segment bears two. In sagittal section the midgut is empty and consists of a simple epithelium. All the interior of the larva is composed of uniform histiogenic cells. When a rounded larva is examined one finds differentiated organs, an intestine with muscles, Malpighian tubules and especially beautiful thick tubes of salivary (or labial) glands. . . .

"Each form has its physical cause. At the molt the hard chitinous exoskeleton is ruptured, the contents of the intestine are eliminated and certain larval organs degenerate. The larva remains without the support of the exterior chitin and with an interior of rounded undifferentiated cells, actually liquid. The lack of solid tissues for support causes the larva to lie on its back on the soil like a jellyfish stranded on the beach. Thus results, I believe, the flattened form of the larva shown in figure 33. When it regenerates the intestine, new larval organs and new supporting tissues develop and the larva recovers its rounded form around the regenerated intestine, which is filled with food." (Translated from the Spanish, pp. 46 and 48.) Fig. 33*a*. shows a flat larva in ventral view; Fig. 33*b*, a normal larva in profile. Internal anatomy, pp. 48-54 and figs. 33*c*, 34, 35, 36, 37 and 40. Summary in German, p. 67.

Genus **Hylomyrma** Forel

Body hairs sparse, rather long. Of two types: (1) denticulate and slightly curved; (2) sinuous, with the apical portion hooked, simple or with a few denticles on the apical third, a few around the middle of each somite. Anchor-tipped hairs lacking. Antennae small, each with three sensilla each of which bears a rather long spinule. Head hairs few, short to long, minutely denticulate. Labrum with the breadth 1½ X length; bilobed; each lobe without spinules or hairs but with seven sensilla on and near the ventral border; posterior surface sparsely spinulose. Mandibles with the apical tooth curved medially and posteriorly; with a medial blade which has an erose border and bears one or two subapical teeth; anterior surface of the blade with a few spinules. Maxillae with the galea digitiform and bent.

Hylomyrma has been regarded as the least specialized genus in the tribe Myrmicini. It has also been considered as a subgenus of *Pogonomyrmex*. Larval characters do not support either viewpoint. It is certainly generically distinct from *Pogonomyrmex* because of its mandibular shape and spinules and because of its

hooked body hairs. It is perhaps less specialized than *Pogonomyrmex* in mandibular shape and spinules but it is more specialized in having fewer spinules on the other mouth parts and in the hooked body hairs.

Hylomyrma columbica Forel

(Pl. I, figs. 16-21)

Sexual Semipupa.—Length (through spiracles) about 3.5 mm. Leg, wing and gonopod vestiges present. Integument spinulose. Body hairs sparse, rather long and denticulate. Of two types: (1) 0.036-0.08 mm slightly curved, without alveolus and articular membrane, on every somite; (2) a few around the middle of each somite, 0.18-0.22 mm long, sinuous, with the apical portion hooked, the hooks (in preserved material) curled anteriorly, simple or with a few denticles on the apical third. Cranium subtrapezoidal in anterior view, narrowed ventrally, with the occipital corners broadly rounded. Antennae small, each with three sensilla each of which bears a rather long spinule. Head hairs few, short to long (0.054-0.09 mm), slightly curved, with very minute denticles. Labrum with the breadth 1½ X length; bilobed, with a furrow extending dorsally on the anterior surface; each lobe with seven sensilla on the anterior surface and ventral border; posterior surface of each lobe with about seven sensilla near the center; posterior surface sparsely spinulose, the spinules minute and in very short rows. Mandibles subtriangular in anterior view; apical tooth heavily sclerotized, curved medially and posteriorly; with a medial blade which has an erose border and bears one or two subapical teeth; anterior surface of the blade with a few spinules. Maxillae with the apex paraboloidal and sparsely spinulose, the spinules isolated or in short rows; palp a tall frustum with two apical (bearing a spinule each), two subapical (large and encapsulated) and one lateral (bearing a spinule) sensilla; galea digitiform, the apical half bent outward at a 25° angle, with two apical sensilla bearing a spinule each. Labium spinulose, the spinules in short transverse rows; palp a low knob with five sensilla (three bearing a spinule each and two encapsulated); an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit in a depression. No spinules seen on hypopharynx. (Material studied: two sexual semipupae from Mexico, collected by E. O. Wilson.)

Dr. Wilson has informed us (by letter) that "in captivity workers of this species captured *Drosophila* spp., *Isotoma viridis* Bourlet, and a few other small insects offered them in the food chamber, and fed them directly to the larvae."

Genus **Myrmica** Latreille

Myrmica laevinodis Nylander

Brian (1951 *a*) referred to this species, but changed the identification to *M. rubra* in 1957*b* (see below).

Myrmica rubra (Linnaeus)

Brian (1951*a*) reported that there were two batches of brood, each in a separate cycle (referred to as *M. laevinodis*, but changed to *M. rubra*, 1957*b*) and (1957*b*) he considered factors affecting these cycles. He reported (1956*b* and 1956*c*) the effects of larva-piling, "test-servicing" and the sizes of larvae in a group on larval feeding. In

1957*a* he reported that food was distributed equally to larvae of equal size, but that in larvae of mixed sizes larger larvae were fed and smaller larvae neglected.

Brian (1951*b*) reported that female larvae had to reach a certain size by the time they started hibernation in order to become queens and he suggested that "vernalisation" might also be necessary. He reported (1954) "normal" ontogenies for larvae which develop into queens and males and suggested criteria for measuring "queenness." In 1955 *a* and *b* he concluded that: (1) season at which eggs were laid, (2) the ratio of growth to development, (3) temperature during development and (4) age of attendant workers determine whether workers or queens would be produced. In 1956*a* he reported that protein food was essential through the critical third instar period for normal queen-larval growth. A summary of factors producing queens and males was given in 1957*c*.

Morley, 1953, p. 21, fig. 2c: a small crude drawing of a larva in side view. Weir, 1957: internal anatomy (referred to as subspecies *microgyna*).

Genus **Manica** Jurine

Stout; ventral profile angulate, with the apex at abdominal somite II; dorsal profile curved; diameter greatest at abdominal somite V, decreasing gradually to the anterior end (or slightly constricted at abdominal somites I and II) and more rapidly to the posterior end, which is broadly rounded. Anus posteroventral. Body hairs sparse to numerous, short to moderately long. Two types in each species; one type whip-like, the other either denticulate toward the apex or with appressed branches; anchor-tipped hairs lacking. Antennae minute, slightly elevated, each with three (rarely four) sensilla. Head hairs few to moderately numerous, short to long, mostly denticulate. Labrum short, more or less bilobed; anterior surface of each lobe with 5-10 sensilla but without hairs; ventral border of each lobe spinulose and bearing three or four sensilla; posterior surface densely spinulose and with 7-10 sensilla on each lobe. Mandibles with the apex forming a long tooth which is curved medially and slightly posteriorly; anterior surface produced mesally into a blade which bears two subapical teeth; basal half of anterior surface with numerous spinules in short rows. Maxillary and labial palps with six or seven sensilla each.

Manica mutica (Emery)

(Pl. I, figs. 1-5)

Worker Larva.—Length (through spiracles) about 5 mm. Stout; ventral profile angulate, with the apex at abdominal somite II; dorsal profile curved, diameter greatest at abdominal somite V, decreasing gradually to the anterior end (or slightly constricted at abdominal somites I and II) and more rapidly to the posterior end, which is broadly rounded. Anus posteroventral. Leg, wing and gonopod vestiges present. Segmentation indistinct. Integument with minute spinules in moderately long transverse rows on the ventral surface of the thorax and abdominal somite I. Body hairs sparse and short to moderately long. Of two types: (1) 0.078-0.19 mm long, evenly attenuated, with the base straight or slightly curved and the remainder flexible, on all somites except the prothorax and abdom-

inal somite X; (2) 0.027-0.198 mm, slightly curved, with a few denticles toward the apex, on the prothorax and the last abdominal somite. Cranium subhexagonal in anterior view, with the corners rounded. Antennae minute, slightly elevated, each with three sensilla, each of which bears a minute spinule. Head hairs few, short to long (0.027-0.14 mm), slightly curved, with a few denticles near the apex. Labrum short (breadth 1.8 X length); ventral border feebly concave; each half of anterior surface with five sensilla; each half of ventral border with four sensilla; ventral border spinulose, the spinules minute and in short rows; posterior surface densely spinulose, the spinules minute and in numerous short arcuate rows; posterior surface of each half with five isolated and two contiguous sensilla. Mandibles heavily sclerotized; subtriangular in anterior view; apex forming a long tooth which is curved medially and slightly posteriorly; anterior surface produced medially into a blade which bears two subapical teeth; basal half of anterior surface with numerous spinules in short oblique rows. Maxillae with the apex conoidal and spinulose, the spinules minute and in short arcuate rows; palp a skewed peg with two apical (with a spinule each), two subapical (one encapsulated and one bearing a spinule) and three lateral (each bearing a spinule) sensilla; galea digitiform, with two apical sensilla. Labium with the anterior surface sparsely spinulose, the spinules minute and in numerous short arcuate rows, the rows grouped into longer subtransverse rows; palp a low knob with six sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit. Hypopharynx spinulose, the spinules minute and in subtransverse rows.

Sexual Larva.—Length (through spiracles) about 7.2 mm. Similar to the worker larva except in the following details: A small concavity on the mid-ventral surface of the last abdominal somite, but no gonopod vestiges seen. Entire integument spinulose. Head transversely subelliptical. Labrum with 6-8 sensilla on each half of the anterior surface; palp a tall skewed peg with four apical and four lateral sensilla.

(Material studied: numerous larvae from Roosevelt National Memorial Park, North Dakota.)

Manica bradleyi (Wheeler)

(Pl. I, figs. 6-8)

Worker Larva.—Length (through spiracles) about 7.4 mm. Similar to *M. mutica* except as follows: No spinules seen on the integument. Body hairs numerous and moderately long. Of two types: (1) on the dorsal surface, 0.144-0.288 mm long, simple, whip-like, with long slender shaft and very fine lash; (2) on the ventral and lateral surfaces, 0.072-0.306 mm long, with heavy base and minute to long branches, the branches closely appressed so that at low magnification the hairs appear stout and simple. Anterior surface of each lobe of labrum with 10 sensilla; posterior surface with 8-10 sensilla in the center of each lobe.

Sexual Larva.—Length (through spiracles) about 8.4 mm. Similar to worker larva except in the following details: A small concavity on the midventral surface at the posterior border of abdominal somite IX, but no gonopod vestiges seen. Body hairs shorter. Ventral border of labrum with two isolated and two contiguous sensilla on each lobe. Maxillary palp with four apical and four lateral sensilla. Labial palp with a low knob with six sensilla.

(Material studied: 16 larvae from Yosemite National Park, California, collected by Dr. E. O. Wilson.)

Tribe **Pheidolini** Emery

Genus **Stenamma** Westwood

Stenamma diecki Emery

Smith, 1957, p. 134: "Brown and Wilson (unpublished observations) found the larvae of *diecki* feeding on a small dipterous larva determined by W. W. Wirth as probably an empidid, and also on what they though might be a springtail." See also p. 163.

Stenamma impar Forel

Smith, 1957, p. 153: "Miss Talbot found that it is common for the larvae to overwinter in the nest."

Genus **Aphaenogaster** Mayr

Aphaenogaster (Attomyrma) floridana M. R. Smith

Length through spiracles about 4.3 mm. Similar to *A. rudis* (Wheeler and Wheeler, 1953*b*, p. 56) except in the following details: Body hairs of only one type, short (0.036-0.072 mm), with long base and short dichotomizing tip. Cranium somewhat broader than long. Anterior surface of basal half of mandibles spinulose. (Material studied: numerous larvae from Gretna, Florida, and from Georgia, collected by Dr. P. B. Kannowski.)

Aphaenogaster (Deromyrma) sp.

Length (through spiracles) about 4.8 mm. Apparently similar to *A.* (*D.*) *inermis* (Wheeler and Wheeler, 1953*b*, p. 64). (Material studied two larvae and two semipupae, with most of the hairs lacking, collected by J. W. Chapman, 1942, Horn of Negros, Dumaguete, Philippine Islands.)

Genus **Messor** Forel

Messor barbarus aegyptiacus (Emery)

Bernard (1951*a*, pp. 93-94) mentioned this species as adapted to the dry soil of the Sahara.

Bernard (1953, p. 13) discussed the xerophilous adaptations of larvae:

"La forme externe larvaire ne paraît pas offrir de traits spéciaux aux Fourmis xérophiles, mais l'anatomie interne a souvent, sinon toujours, quelques particularités. D'après les recherches récentes de C. Athias-Henriot (1945) [1947] et de S. Valentini (1951), faites à mon laboratoire, on connaît déjà *Messor aegyptiaca, Monomorium Salomonis, Acantholepis Frauenfeldi.* Leurs larves sont relativement riches en corps gras, de nature à faciliter la rétention d'eau par les tissus. Les glandes labiales sont petites et à cellules réduites: peut-être y a-t-il économie de salive. La vésicule rectale . . . est très grande et reployée autour de l'intestin, suggérant une récupération possible de l'eau des excreta. Ces premières indications montrent l'intérêt de travaux biologiques plus poussés sur ces larves, dont la croissance en volume semble aussi modifiée."

Messor barbarus minor (E. André)

Valentini, 1951: internal anatomy.

Genus **Novomessor** Emery

When we prepared our characterization of *Novomessor* (1953*b*, p. 70) we had only damaged integuments of one species. Since we now have adequate material of this species and of two additional species, a complete revision of the generic treatment is necessary:

Body moderately stout, slightly constricted at abdominal somites I and II; diameter greatest at abdominal somites IV and V. No neck. Body hairs short, rather sparse or moderately numerous; of two or three types, shapes diverse. Cranium subhexagonal in anterior view but with the angles indistinct; as broad as long. Antennae very small. Head hairs sparse, rather short, with denticulate tip. Labrum short, bilobed; posterior surface spinulose, the spinules minute and in short arcuate rows which tend to form a reticulate pattern. Mandibles with the apex forming a long slender tooth; with two subapical teeth on the medial border. Maxillae with the apex spinulose.

Novomessor albisetosus (Mayr)

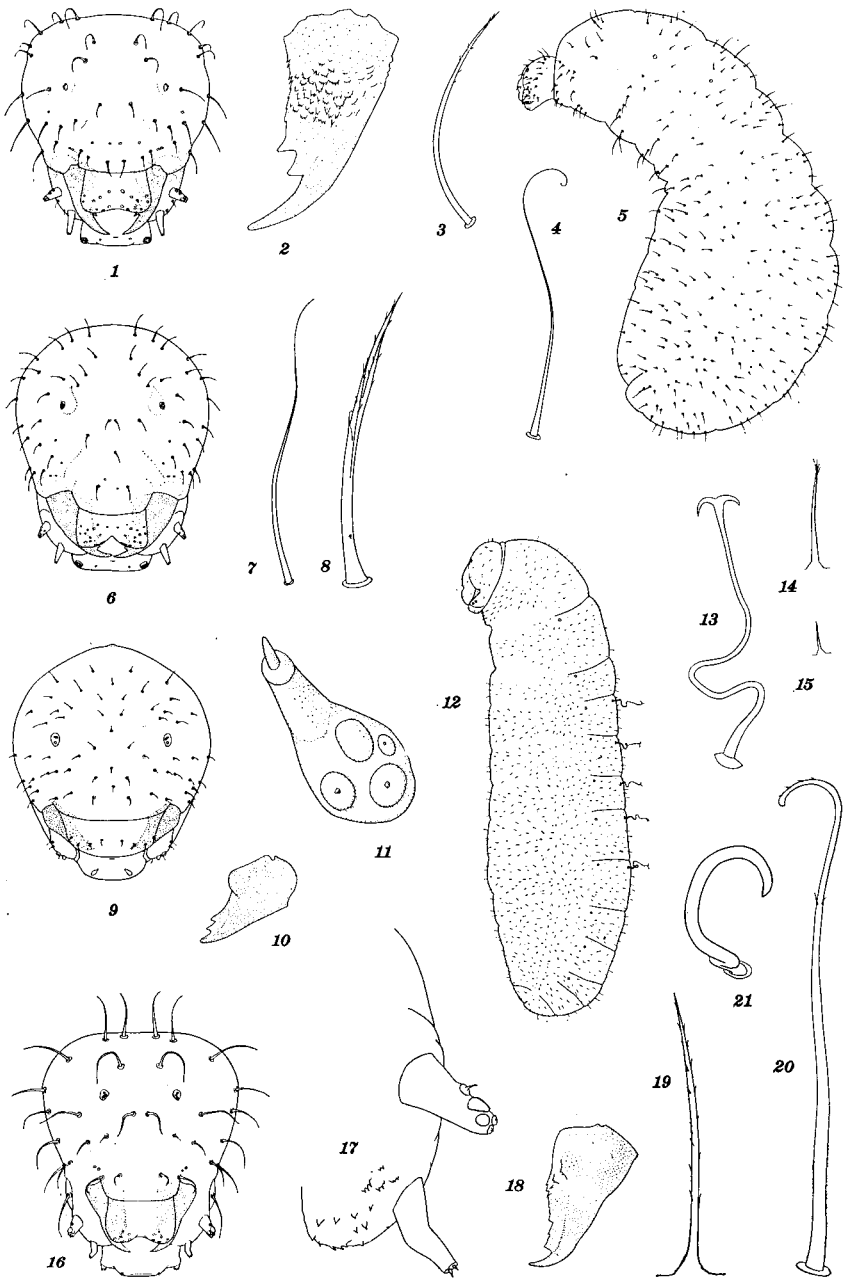
(Pl. II, fig. 1)

Length (through spiracles) about 6.6 mm. Body moderately stout; slightly constricted at the first and second abdominal somites; diameter greatest at abdominal somites IV and V; no neck. Anus posteroventral. Leg, wing and gonopod vestiges present. Spiracles small, the mesothoracic slightly larger. No spinules seen on the integument. Body hairs short and rather sparse. Of two types: (1) 0.034-0.1 mm long, slightly curved, with bifid tip, generally distributed; (2) 0.05-0.1 mm long, bifid with the tips recurved, 12-24 on each abdominal somite. Cranium subhexagonal in anterior view, as broad as long. Antennae very small, each with three sensilla each of which bears a minute spinule. Head hairs sparse, rather short (0.024-0.053 mm long), slightly curved with the tip denticulate. Labrum short, breadth twice the length; bilobed; anterior surface of each lobe with seven sensilla; ventral border of each lobe with three sensilla and a few minute spinules; posterior surface of each lobe with two isolated and a cluster of three sensilla; posterior surface spinulose, the spinules minute and in short arcuate rows, the rows forming a reticulate pattern, with a transverse trend dorsally and a longitudinal trend on and near the ventral border. Mandibles heavily sclerotized; subtriangular in anterior view; apex forming a long slender tooth which is slightly curved medially; with two conspicuous acute subapical teeth on the medial border. Maxillae small, with the apex moderately spinulose, the spinules minute and in

---

EXPLANATION OF PLATE I

Manica mutica: fig. 1, head in anterior view, X65; fig. 2, left mandible in anterior view, X214; figs. 3 and 4, two body hairs, X185; fig. 5, larva in side view, X19. *Manica bradleyi:* fig. 6, head in anterior view, X60; figs. 7 and 8, two body hairs, X176. *Xenomyrmex stolli mexicanus:* fig. 9, head in anterior view, X111; fig. 10, left mandible in anterior view, X212; fig. 11, left labial palp in anterior view, X1700; fig. 12, larva in side view, X38; figs. 13-15, three body hairs, X333. *Hylomyrma columbica:* fig. 16, head in anterior view, X96; fig. 17, left maxilla in anterior view, X427; fig. 18, left mandible in anterior view, X185; fig. 19, type 1 body hair, X432; fig. 20, type 2 body hair in side view, X432; fig. 21, type 2 body hair in end view. X432.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

very short rows; palp paxilliform and bearing four apical (two encapsulated and two bearing a spinule each) and one lateral (with a spinule) sensilla; galea digitiform with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in short arcuate rows; palp a low knob with five sensilla; opening of sericteries a short transverse slit in a depression on the ventral surface. Hypopharynx spinulose, the spinules minute and in transverse rows. (Material studied: 14 larvae from Texas, courtesy of Dr. P. B. Kannowski.)

Novomessor cockerelli (E. André)

Length (through spiracles) about 7.8 mm. Similar to *N. albisetosus* except in the following details: Body hairs of three types: (1) generally distributed, 0.02-0.078 mm long, with multifid tip, all branches in one plane; (2) 0.078-0.156 mm long, with short-bifid tip, the branches sometimes denticulate, 36 on the prothorax, 16 each on mesothorax, metathorax and abdominal somite I, six on the ventral surface of abdominal somite II, ten on X; (3) 0.078-0.117 mm long, with the tip bifid, the branches short and more or less coiled, some on all surfaces of each abdominal somite I-IX. Labrum with the anterior surface of each lobe bearing ten sensilla; posterior surface of each lobe with five isolated and a cluster of three sensilla. (Material studied: 19 larvae from Texas, courtesy of Dr. P. B. Kannowski.)

Novomessor manni Wheeler and Creighton

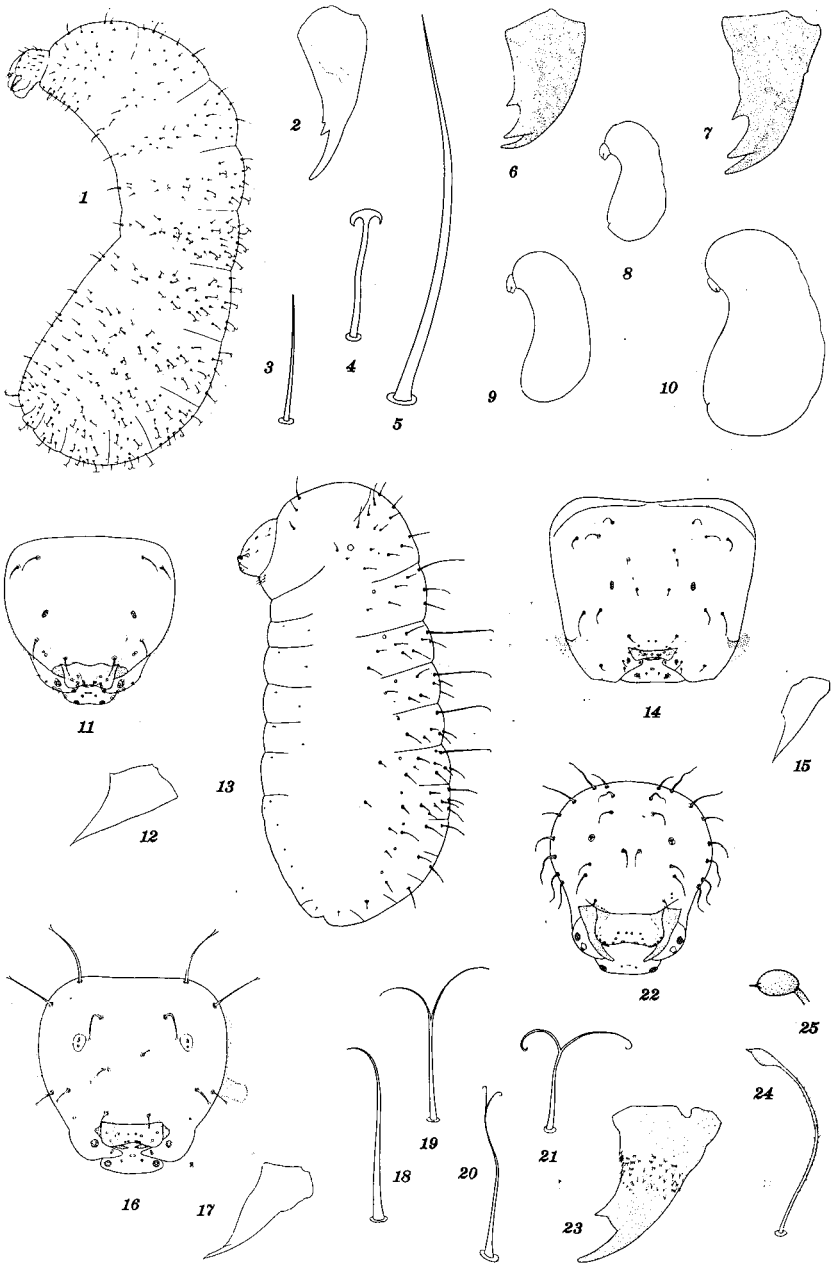
(Pl. II, figs. 2-5)

Semipupa.—Length (through spiracles) about 8 mm. Apparently similar to *N. albisetosus* except as follows: Body hairs moderately numerous. Of two types: (1) 0.078-0.27 mm long, usually simple (rarely with short-bifid tip), on all somites; (2) 0.05-0.176 mm long, stout, anchor-tipped with nearly straight shaft, four in a row across the dorsum and in a patch of 24-36 on each lateral surface of abdominal somites III-VII. Labrum with the spinules on the posterior surface much longer and in longer rows. Mandibles with the apical tooth longer and straighter, medial teeth much smaller. (Material studied: numerous semipupae from Mexico, collected by P. B. Kannowski.)

Kannowski, 1954, p. 4: "Larvae and pupae were usually found unsorted in the uppermost galleries. A peculiar feature of the larvae was noted in several nests.

EXPLANATION OF PLATE II

Novomessor albisetosus: fig. 1, larva in side view, X15. *Novomessor manni:* fig. 2, left mandible in anterior view, X116; figs. 3 and 5, simple body hairs, X217; fig. 4, anchor-tipped body hair, X217. *Monomorium (Notomyrmex) tambourinensis:* fig. 6, left mandible in anterior view, X278. *Monomorium (Notomyrmex) antarcticum:* fig. 7, left mandible in anterior view, X278; fig. 8, profile of worker larva, X7; fig. 9, profile of male larva, X7; fig. 10, profile of queen larva, X7. *Crematogaster (Orthocrema) minutissima:* fig. 11, head in anterior view, X102; fig. 12, left mandible in anterior view, X278; fig. 13, larva in side view, X38. *Crematogaster (Acrocoelia) coarctata vermiculata:* fig. 14, head in anterior view, X93; fig. 15, left mandible in anterior view, X333. *Crematogaster (Apterocrema) atitlanica:* fig. 16, head in anterior view, X118; fig. 17, left mandible in anterior view, X333. *Huberia striata:* fig. 18, type 2 body hair, X233; figs. 19-21, type 1 body hairs, X233; fig. 22, head in anterior view, X63; fig. 23, left mandible in anterior view, X214. *Rhopalothrix amoena:* fig. 24, type 3 body hair, X185; fig. 25, type 3 hair tip enlarged, X370.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Some of them were joined together side by side by hooked hairs which are present on the sides of the larvae, and were so joined that they resembled a small, open-ended, hollow sphere. Such an arrangement is probably an advantage to the workers in moving the larvae about and in keeping them together in a group.''

Genus **Pheidole** Westwood

Trabert, 1957, p. 299: brief reference to Wheeler and Wheeler, 1953*b*.

Pheidole dentigula M. R. Smith

Worker Larva.—Length (through spiracles) about 1.5 mm. Similar to *P. dentata* (Wheeler and Wheeler, 1953*b*, p. 71) except in the following details: Body hairs somewhat shorter; only two anchor-tipped hairs on the dorsum of each abdominal somite I-V. Head hairs with bifid or multifid tip. Maxillary palp with four apical and one lateral sensilla. Opening of sericteries not in a depression.

Sexual Larva.—Length (through spiracles) about 3 mm; straight length about 2.6 mm. Body subcylindrical; ventral profile straight, dorsal profile slightly curved. No body hairs or hair bases seen. Head hairs minute (about 0.005 mm). Mandibles with no denticles in the medial cavity. Maxillae without spinules. Otherwise similar to the male larvae of *P. dentata.*

(Material studied: numerous larvae from Georgia, collected by P. B. Kannowski.)

Pheidole metallescens Emery

Worker Larva.—Length (through spiracles) about 3.5 mm. Similar to *P. dentata* (Wheeler and Wheeler, 1953*b*, p. 71) except in the following details: Anchor-tipped body hairs somewhat shorter (about 0.187 mm), only two on the dorsal surface of each abdominal somite I-V. Each lobe of the labrum with three or four sensilla on the anterior surface, two on the ventral border and three on the posterior surface.

Sexual Larva.—Length (through spiracles) about 7.2 mm. Very similar to male larva of *P. dentata.* [All hairs have been broken off of our specimens.]

(Material studied: numerous larvae from Florida, collected by P. B. Kannowski.)

Pheidole morrisi Forel

Length (through spiracles) about 2.1 mm. Only two anchor-tipped hairs on the dorsum of each abdominal somite I-V. Otherwise similar to *P. dentata* (Wheeler and Wheeler, 1953*b*, p. 71). (Material studied: numerous larvae from Florida, collected by P. B. Kannowski.)

Pheidole pallidula (Nylander)

Goetsch, 1957, Fig. 5a, p. 22: a small sketch of a few larvae.
Valentini, 1951: internal anatomy.

Pheidole punctulata Mayr

Michener and Michener, 1951, p. 136, referred to feeding. (After Weber.)

Tribe **Crematogastrini** Forel

Genus **Crematogaster** Lund

Crematogaster (Acrocoelia) coarctata vermiculata Emery

(Pl. II, figs. 14 and 15)

Length (straight) about 2 mm; length through spiracles about 2.2 mm. Similar to *C.* (*A.*) *lineolata* (Wheeler and Wheeler, 1952*a*, p. 250) except in the following details: Slenderer; ends more broadly rounded. Some larvae have lateral welts smaller than and similar to *C. lineolata subopaca* type B (Wheeler and Wheeler, 1952a, p. 252). A minute midventral pocket near the posterior border of abdominal somite IX. Integument with a few minute spinules on the prothorax and abdominal somites IX and X. Head trapezoidal, narrowed ventrally. Head hairs longer (0.007-0.098 mm). Mandibles with the apex longer and slenderer. (Material studied: numerous larvae from Georgia, collected by P. B. Kannowski.)

Crematogaster (Acrocelia) rivai luctuosa Menozzi

Bernard, 1951*b*, p. 1064: "Les larves sont immobiles; celles de quelques espèces très évoluées possèdent des appendices latéraux et ventraux qui sont probablement des exsudatoires au même titre que ceux des *Pachysima.*" Fig. 965, p. 1064, third stage larva, in ventrolateral view, after Menozzi, 1930.

Crematogaster (Apterocrema) atitlanica Wheeler

(Pl. II, figs. 16 and 17)

Male Larva.—Estimated length (through spiracles) about 2 mm. Spiracles unequal in diameter; the first the largest, the remainder decreasing gradually. Integument without spinules. Body hairs of at least two types: (1) simple, 0.018-0.027 mm long, a few on the ventral surface of each somite, shorter posteriorly; (2) 0.018-0.126 mm long, with short-bifid tip, on the dorsal and lateral surfaces. Cranium subrectangular, a third broader than long; occipital border straight; occipital corners rounded. A slender sclerotized bar extends along the sides of the head just inside the genae; somewhat below the antennal level it passes out and enters the prothorax. Antennae moderately large, with two or three sensilla, each of which bears a minute spinule. Head hairs short to long (0.029-0.09 mm), with short-bifid or denticulate tip. Labrum small; short (breadth about 3 times length); bilobed due to the concavity of the ventral border; anterior surface of each lobe with three or four sensilla; ventral border of each lobe with two or three contiguous sensilla; ventral border with a few minute spinules in short arcuate rows; posterior surface of each lobe with two or three sensilla; posterior surface with a few minute spinules in short arcuate rows. Mandibles feebly sclerotized; small; apical two-thirds rather stout, sharp-pointed and slightly curved medially, sometimes with a suggestion of a medial tooth. Maxillae small, with the apex conoidal and directed medially; palp a cluster of four sensilla; galea two agglomerated sensilla. Labium small; palp a cluster of four sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit. (Material studied: One damaged integument from Tsanjuyo, Guatemala, 19-III-1935, collected by W. M. Wheeler.)

Crematogaster (Orthocrema) minutissima Mayr

(Pl. II, figs. 11-13)

Length (straight) about 1.5 mm; length through spiracles about 1.9 mm. Plump, chunky and turgid; subelliptical; diameter nearly uniform, greatest at abdominal somite IV; anterior end broadly rounded, posterior end narrowly rounded. Anus subterminal. Leg, wing and gonopod vestiges present. Spiracles unequal in size, the first the largest, the remainder decreasing gradually. Integument on the dorsa of abdominal somites VI-X with a few minute spinules in very short rows. Body hairs sparse. Of three types: (1) simple, minute (0.008-0.023 mm), most numerous on the ventral surface of the prothorax; (2) moderately long (0.047-0.102 mm), slightly curved, with short-bifid tip, on all somites, the most abundant type; (3) long (0.156-0.254 mm), anchor-tipped, with slightly curved shaft, four in a row across the dorsum of each abdominal somite I-IV. Cranium subpentagonal, a fourth broader than long, occipital border nearly straight. A slender sclerotized bar extends just inside each gena from the level of the antennae to the maxillae; at its ventral end a stouter branch passes out and enters the prothorax. Antennae minute, each with three sensilla, each of which bears a spinule. Head hairs very few, short (0.027-0.045 mm), simple or with a few minute denticles at the tip. Labrum small; short, width 2.5 times length; bilobed due to concavity of the ventral border; anterior surface of each lobe with three sensilla; ventral and ventrolateral borders with a few minute spinules; ventral border with three sensilla on each lobe; posterior surface with a few spinules in short transverse rows and with four sensilla on each lobe. Mandibles small and moderately sclerotized; subtriangular, the apex very acute. Maxillae with the apex paraboloidal; palp a low knob with five sensilla; galea represented by two agglomerated sensilla. Labium small, without spinules; palp a cluster of five sensilla; a minute sensillum between each palp and the opening of the sericteries; the latter a short transverse slit on the anterior surface. Hypopharynx without spinules. (Material studied: numerous larvae from Georgia, collected by P. B. Kannowski.)

Tribe **Myrmicariini** Forel

Genus **Myrmicaria** Saunders

Myrmicaria eumenoides opaciventris Emery

Wheeler and Wheeler, 1953*a*, fig. 12, p. 187: the mesothoracic spiracle was omitted from the drawing.

Tribe **Solenopsidini** Forel

Genus **Huberia** Forel

Body hairs sparse and short. Of two types: (1) bifid, with the branches short to long, simple or recurved, generally distributed; (2) simple and slightly curved, a few on the ventral surface. No anchor-tipped hairs. Antennae minute. Head hairs few, moderately long, simple and flexible. Labrum short, broad and bilobed. Mandibles subtriangular in anterior view; of two parts, a stout sickle-shaped body and a narrow medial blade; apex forming a long slender curved tooth; blade bearing a single conspicuous medial tooth; anterior surface with a band of spinules across the middle. Maxillary palp a low irregular elevation; galea a frustum. Labial palp represented by a cluster of five sensilla. Spinules on the posterior surface of the labrum, the anterior surface of the mandibles and on the maxillae, and hypopharynx.

Huberia striata (F. Smith)

(Pl. II, figs. 18-23)

Worker Semipupa.—Length (through spiracles) about 4.6 mm. Spiracles small. Integument without spinules. Body hairs sparse and short. Of two types (1) 0.050-0.114 mm long, bifid, the branches short to long and simple or recurved, on all somites; (2) 0.05-0.11 mm long, simple and slightly curved, a few on the ventral surface of each thoracic somite and abdominal somites I-III. Cranium transversely subelliptical in anterior view, a fourth broader than long. Antennae minute, each with three sensilla, each of which bears a spinule. Head hairs few, moderately long (0.045-0.09 mm), simple and flexible. Labrum bilobed; short (breadth 2.3 X length); anterior surface of each lobe with five or six sensilla; ventral border of each lobe with four isolated and two contiguous sensilla; posterior surface of each lobe with three or four isolated and three contiguous sensilla; posterior surface spinulose, the spinules in moderately long subtransverse rows. Mandibles with the apical half heavily sclerotized; subtriangular in anterior view; of two parts—a stout sickle-shaped body and a narrow medial blade; apex forming a long slender curved tooth; blade bearing a single conspicuous medial tooth; anterior surface spinulose in a band across the middle, the spinules coarse and isolated or fine and in short rows. Maxillae with the apex paraboloidal and spinulose, the spinules minute and in short arcuate rows; palp a low irregular elevation with five sensilla (two encapsulated and three bearing a spinule each); galea a frustum bearing two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in short arcuate subtransverse rows; each palp represented by a cluster of five sensilla (two encapsulated and three bearing a spinule each); an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit on the anterior surface. Hypopharynx densely spinulose, the spinules minute and in short subtransverse rows; near the pharynx the rows are sublongitudinal.

Male (?) *Larva.*—Length (through spiracles) about 7.25 mm. Stout; thorax slightly attenuated and curved ventrally but not differentiated into a neck; abdomen inflated, diameter greatest at abdominal somite VI. Leg, wing and gonopod vestiges present. Similar to worker semipupa except as follows: Integument sparsely spinulose, the spinules minute and in arcuate rows. Body hairs longer. Posterior surface of labrum with a median dorsal patch of minute spinules, the spinules in short arcuate rows, the rows forming a reticulate pattern. Mandible with two subapical teeth and with spinules on the anterior, medial and posterior surfaces. Maxillae without spinules.

(Material studied: two worker semipupae and six male (?) larvae and semipupae from New Zealand, collected by E. A. Plank, courtesy of Dr. W. L. Brown.)

Genus **Monomorium** Mayr

Monomorium (Equestrimessor) n. sp.

Bernard (1951*a*, p. 93) mentioned this species as adapted to the dry soil of the Sahara.

Monomorium (Monomorium) minimum (Buckley)

The United States Department of Agriculture Bulletin No. 28 (Anon., 1953) has repeated the time-honored figure used by Back, *et al.*, which includes a larva in side view.

Monomorium (Monomorium) pharaonis (Linnaeus)

Hall and Smith (1953, p. 133) stated that the worker-larvae period is 17 days; sexual 21 days. Their discussion (pp. 133-134) of caste determination is summarized (p. 135) as follows: "There is a nutritional difference between larvae destined to be workers and those destined to be sexuals. This is apparent by a darkening of the gut contents, this darkening commencing when the worker larva is 9-11 days old and when the sexual larva is 14-17 days old. Explanations of this darkening phenomenon are discussed. In *M. pharaonis* (L.) it seems probable that caste determination is trophogenic—the difference between worker and sexual seems to be due to generous feeding of the sexual larvae for a further period of 6-10 days."

Subgenus **Notomyrmex** Emery

The following revises our treatment of the subgenus, 1955*b*, p. 122: Stout; prothorax (or prothorax and mesothorax) bent ventrally at right angles to form a very short stout neck; rest of body straight. Body hairs mostly bifid (in *M. antarcticum* a few anchor-tipped and a few with the tip denticulate). Antennae minute. Head hairs bifid or with bifid tip. Posterior surface of labrum sparsely spinulose, the spinules isolated. Mandibles of two parts, a slender sickle-shaped body and a blade projecting medially; medial border of blade with two sharp teeth. Maxillae with the apex spinulose; palp a short peg; galea a low elevation or a short peg.

Monomorium (Notomyrmex) antarcticum (F. Smith)

(Pl. II, figs. 7-10)

Worker Larva.—Length (through spiracles) about 3.3 mm; straight length about 2.5 mm. Stout; prothorax and mesothorax bent ventrally to form a very short stout neck; remainder of body straight; ends rounded; diameter greatest at the fourth and fifth abdominal somites; dorsal profile C-shaped; ventral profile sinuate. Anus posteroventral. Segmentation indistinct. Spiracles small, the first larger than the others. Integument sparsely spinulose, the spinules minute and widely spaced. Body hairs rather short and moderately numerous. Of three types: (1) short (0.054-0.13 mm), bifid, with flexible shaft and long flexible branches, the tip of each branch with a single or double hook, the most abundant type; (2) moderately long (about 0.13 mm), anchor-tipped with tortuous shaft, a few on the dorsal surface; (3) short to moderately long (0.027-0.13 mm), nearly straight, with frayed tip, a few on the ventral surface of the thorax and abdominal somites I-IV. Head subcordate. Antennae minute, each with three sensilla, each of which bears a minute spinule. Head hairs few, rather short to rather long (0.03-0.06 mm), curved, with short-bifid tip. Labrum distinctly bilobed; breadth twice the length; anterior surface of each lobe with five or six sensilla; ventral border of each lobe spinulose and with one isolated and two contiguous sensilla; posterior surface of each lobe with three or four isolated and a cluster of three contiguous sensilla; posterior surface spinulose, the spinules rather coarse and isolated. Mandibles heavily sclerotized; subtriangular in anterior view; of two parts—a slender

sickle-shaped body and a medial blade bearing two large subapical teeth. Maxillae with the apex paraboloidal and spinulose; the spinules small and isolated apically, minute and in short transverse rows dorsally; palp a short frustum with one subapical and four apical sensilla; galea a short peg with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in short arcuate rows; each palp a low elevation with five sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a short transverse slit. No spinules on hypopharynx.

Mature Queen Larva.—Length (through spiracles) about 5.5 mm; straight length about 3.8 mm. Body much stouter and head relatively much smaller; no neck. Otherwise similar to worker larva.

Mature Male Larva.—Length (through spiracles) about 3.7 mm. Very similar to worker larva.

Immature Queen Larva.—See first paragraph of our description, 1955*b*, p. 123 and Pl. I, figs. 16-19 and 21.

Young Sexual Larva.—See second paragraph of our description, 1955*b*, p. 123 and Pl. I, fig. 20.

Revision based on numerous larvae from New Zealand, courtesy of Dr. W. L. Brown.

Monomorium (Notomyrmex) tambourinensis Forel

(Pl. II, fig. 6)

Length (through spiracles) about 1.9 mm; straight length about 1.6 mm. Stout; thorax bent ventrally at right angles to form a very short stout neck; remainder of body straight; ends rounded; diameter greatest at the fourth abdominal somite; dorsal profile C-shaped; ventral profile nearly straight. Anus ventral. Leg and gonopod vestiges present. Segmentation indistinct. Spiracles small, the first larger than the others. Integument of the ventral surface with minute spinules in short subtransverse rows. Body hairs short and numerous. Of two types: (1) about 0.03 mm long, bifid with long branches, without alveolus and articular membrane, on every somite, the most numerous type; (2) about 0.036 mm long, bifid, with the branches long and attenuated, a few on each somite but most numerous on the ventral surface of the prothorax, with alveolus and articular membrane. Head moderately large; cranium subhexagonal, length equal to breadth; the occipital border broadly rounded. Antennae minute, each with three sensila, each of which bears a spinule. Head hairs moderately numerous and moderately long (0.036-0.048 mm), bifid, the branches long and extremely attenuated. Labrum small and short (breadth twice the length); bilobed; anterior surface of each lobe with six sensilla; ventral border of each lobe with one isolated and two contiguous sensilla; ventral border spinulose, the spinules minute and isolated; posterior surface of each lobe with three isolated and three contiguous sensilla; posterior surface sparsely spinulose, the spinules minute and isolated. Mandibles heavily sclerotized; of two parts—a sickle-shaped body with the apex curved posteriorly and a blade arising from the anterior surface, extending medially and bearing two subapical teeth. Maxillae with the apex paraboloidal and bearing a few minute spinules in arcuate rows; palp a short peg with one lateral and four apical sensilla; galea paxilliform, with two apical sensilla. Labium with the anterior surface sparsely spinulose, the spinules minute and isolated or in short arcuate rows;

each palp a low knob with five sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a moderately wide slit on the ventral border. Hypopharynx without spinules. (Material studied: eight larvae from Queensland, collected by W. L. Brown.)

Although this species has been placed in the subgenus *Notomyrmex*, its larvae are subgenerically distinct from *Monomorium*, *Notomyrmex* and *Xeromyrmex*.

Monomorium (Parholcomyrmex) gracillimum (F. Smith)

Bernard, 1951*a*, p. 94: "Deux formes plus steppiques que sahariennes, *Cataglyphis albicans* et *Monomorium gracillimum*, toutes deux probablement originaires d'Asie centrale, sont curieuses par la forte taille des larves néonates issues de l'oeuf. Il en résulte une croissance totale en volume très faible: les larves au 5e stade sont à peine 7 ou 8 fois plus grosses qu'à leur naissance, tandis que celles des, autres Fourmis ont de 21 à 330 pour le même rapport. C'est une adaptation à la sécheresse, une grosse larve néonate ayant une surface plus faible par rapport à son volume, d'où moindre évaporation."

Monomorium (Xeromyrmex) ajjer Bernard

Valentini, 1951, p. 266: "Les larves [des *Monomorium salomonis* et *M. ajjer*], quoique très semblables par leur adaptation à la sécheresse, présentent quelques faibles différences. Toutes sont arrondies, courtes, massives." Internal anatomy, pp. 266-268.

Monomorium (Xeromyrmex) salomonis (Linnaeus)

Bernard (1951*a*, p. 93) mentioned this species as adapted to the dry soil of the Sahara.

Bernard, 1953, p. 13: see above under *Messor aegyptiacus*.

Valentini, 1951, pp. 266-268: see above under *Monomorium ajjer*.

Genus **Epixenus** Emery

Epixenus algericus Bernard

Bernard, 1955, p. 277-279: "Je dispose jusqu'à présent de deux séries de larves d'*Epixenus*, prises en mai 1955 dans les nids de la forêt de Baïnem: 3 grosses larves de 1 mm, 7 à 1 mm, 9; 12 larves de 1 mm, 15 à 1 mm, 30. Par comparaison avec *Monomorium salomonis*, qui a cinq stades larvaires comme la plupart des Fourmis, il est probable que les petites larves représentent le stade 2 et les grosses le stade 3. A part la taille, leurs morphologies sont très semblables: Tête bien différenciée, au moins autant que chez une larve de *Monomorium*, avec mandibules jaunes très visibles. Corps blanc au stade 2, jaunâtre ou brunâtre au stade 3. Les 3 segments thoraciques ont leur limites peu distinctes sur la face dorsale et très difficiles à voir ventralement. Les dix segments abdominaux ont leurs séparations bien nettes dorsalement et ventralement, mais non prolongées sur les côtés, sauf à la bordure du pygidium. Tous les segments et la tête portent de nombreux poils courts, dressés et plus ou moins incurvés. Seule la région des pièces buccales est peu poilue, avec quelques poils isolés rectilignes trois fois plus courts que les autres. Presque tous les poils du corps et du dessus de la tête sont courts, bifurqués, à branches de la fourche incurvées. Cela rappelle beaucoup *M. salomonis*, mais, chez ce dernier, il y a en plus un cercle de grands poils, rectilignes, en avant

du prothorax. Ainsi faites, ces larves diffèrent notablement de celles des *Monomorium* déjà connus (*M. salomonis* (L.) et *gracillimum* Sm.) par leur corps moins cylindrique, bien plus poilu, les limites des segments beaucoup mieux indiquées, surtout pour les segments abdominaux 4 à 10. Le bord antérieur du prothorax ne porte pas de couronne de grands poils comme chez *Monomorium*. Les types larvaires les plus voisins seraient ceux de *Leptothorax acervorum* Nyl. . . . et de *Pheidole dentata* Mayr. . . . Encore ce *Pheidole* et ce *Leptothorax* ont-ils des poils larvaires plus longs et plus variés que notre *Epixenus*. En somme, la larve *d'E. algiricus* est moins évoluée, moins simplifiée extérieurement que celles des *Monomorium*, ce qui correspond aux caractères des adultes, où la reine surtout est moins comprimée et moins différente des ouvrières que chez *Monomorium*. Le genre *Epixenus* est donc, à divers égards, plus primitif que son proche parent *Monomorium*. Si les ouvrières amènent à le rapprocher étroitement de *Monomorium*, les larves s'éloignent de la tribu des *Solenopsidini* et peuvent être comparées à celles des *Leptothoracini*, sauf pour la pilosité.'' Fig. 2, p. 278, an immature larva in side view; mouth parts and body hairs enlarged.

We can not agree, however, that the larva of *Epixenus* differs notably from the larvae of *Monomorium* which we have studied (*M. pharaonis, floricola, antarcticum, tambourinensis* and two undetermined species near *minimum;* we have not seen *M. salomonis* or *gracillimum*.) *Epixenus* lacks the anchor-tipped hairs found in *Pheidole* and *Leptothorax* and has hairs similar to *Monomorium* (except *M.* (*Notomyrmex*) *antarcticum*). *Epixenus* apparently lacks the distinct teeth and denticles found on the mandibles of *Pheidole dentata*. In fact, Bernard's figures suggest that the larva of *Epixenus* is quite similar to the larva of *Monomorium*.

Genus **Xenomyrmex** Forel

Straight and subcylindrical. Head anteroventral. Body hairs short and moderately numerous. Of two types: (1) short, simple or with a few denticles, on all somites; (2) moderately long, anchor-tipped with sinuous shaft, four in a row across the dorsum of each abdominal somite I-V. Cranium subcircular in anterior view. Antennae small. Head hairs moderately numerous, short and simple. Labrum with the ventral border convex. Mandibles small; apical third of two parts—a curved body ending in a short apical tooth and a small blade arising from the anterior surface, directed medially and produced into two teeth. Maxillae rather small, appearing adnate; palp and galea very small, the former bearing only three sensilla. Labial palp a very small projection, which is pear-shaped in anterior view. No spinules on mouth parts.

''There seems to be little doubt . . . that they form their small colonies in the cavities of twigs. The structure of the female shows a marked adaptation to such a type of habitat. The slender thorax and long, narrow abdomen of the Xenomyrmex female are strikingly similar to those of the females of certain twig-dwelling species of Solenopsis (*picta* etc.). To a lesser extent, these modifications are shown by the worker and male'' (Creighton, 1950, Bull. Mus. Comp. Zool. Harvard Coll. 104: 224). The larva of *Xenomyrmex* also shows a striking convergent similarity to the larvae of other ants which inhabit plant cavities. The body is elongate, straight and subcylindrical and the hairs are short. ''Both of these characters are

possibly adaptations to life in plant cavities, particularly tubular cavities of small bore. A long larva parked parallel and close to the wall would be less of a traffic hazard than a shorter larva parked crosswise or obliquely. These same characters are to be found also in the larvae of other ants which inhabit plant cavities, notably *Azteca, Camponotus, Crematogaster, Leptothorax,* and the Pseudomyrmecinae." (Wheeler and Wheeler, 1954*b*, p. 149.)

Xenomyrmex floridanus skwarrae Wheeler

Creighton, 1957, p. 13: "When termites were fed to them the *skwarrae* workers not only lapped up the body fluids of the termites but cut their tissues into small pieces which they thrust into the mouths of the larvae. This was followed by extensive chewing and salivation on the part of the larvae. As a rule the copious salivary secretion of the larva formed a bubbly mass above its jaws. When this happened the worker would often take away the piece of termite and give it to another larva."

Xenomyrmex stolli mexicanus Wheeler

(Pl. I, figs. 9-15)

Length (through spiracles) about 1.8 mm; straight length about 1.7 mm. Elongate, straight, subcylindrical; diameter greatest at abdominal somites IV and V; decreasing slightly to the anterior end and more rapidly to the posterior end, which is narrowly rounded; anterior end formed from the dorsum of the prothorax. Head anteroventral. Anus posteroventral. Leg, wing and gonopod vestiges present. Spiracles small, decreasing slightly posteriorly. Integument of the dorsal surface of abdominal somites VIII-X spinulose, the spinules isolated or in short rows. Body hairs short and moderately numerous. Of two types: (1) short (0.01-0.033 mm), simple or with a few denticles, on all somites, a few of the longest with alveolus and articular membrance; (2) moderately long (about 0.15 mm), anchor-tipped, with sinuous shaft, four in a row across the dorsum of each abdominal somite I-V. Head moderately large; cranium subcircular in anterior view. Antennae small, each with three sensilla each of which bears a minute spinule. Head hairs moderately numerous, short (0.01-0.02 mm), simple and nearly straight. Labrum short, breadth 2.5 times the length; anterior surface with eight minute hairs; ventral border convex and bearing one isolated and three contiguous sensilla on each half; posterior surface with four or five sensilla on each half; without spinules. Mandibles small, with the apical third heavily sclerotized and composed of two parts—a curved body ending in a short apical tooth and a small blade arising from the anterior surface, directed medially and produced into two teeth. Maxillae rather small, appearing adnate; palp a very small peg with three sensilla; galea a very small peg with two sensilla. Labial palp a very small projection, which is pear-shaped in anterior view, with one apical (bearing a spinule) and four basal (one encapsulated and three bearing a spinule each) sensilla; opening of sericteries a very small slit on the anterior surface. Hypopharynx without spinules. (Material studied: four larvae from a colony in an orchid pseudobulb from San Luis Potosí, Mexico, courtesy of Dr. W. S. Creighton.)

Genus **Allomerus** Mayr

Allomerus decemarticulatus octoarticulatus Mayr

Bernard, 1951*b*, p. 1019: "Il est difficile de reconnaître les larves de futurs sexués autrement que par leur taille. Cependant, certain genres ont, après la 3e

mue, de remarquables différenciations morphologiques, séparant nettement les reproducteurs des autres castes. Tel est le Myrmicide tropical *Allomerus octoarticulatus*, d'après G. C. Wheeler (fig. 936 [= Wheeler, 1935, pl. VIII, figs. 4 and 6]): les larves banales ont des segments convexes, à poils flexueux courts, et cela se maintient jusqu'à la nymphose chez l'ouvrière. Les larves sexuées acquièrent, après une mue critique, des segments plus cylindriques et sans poils, sauf des soies géantes sur la face ventrale de l'abdomen. Semblables changements existent certainement ailleurs . . . et présentent un grand intérêt pour l'origine des castes.''

Trabert, 1957, pp. 299 and 300: brief reference to G. C. Wheeler, 1935.

Genus **Solenopsis** Westwood

Michener and Michener (1951, p. 234): ''One species [of *Microdon*] is reported to eat the larvae of its host, *Solenopsis*, the fire ant.''

Solenopsis (Solenopsis) saevissima (F. Smith)

Wilson, 1958, p. 40: a photograph of sexual [queen?] larvae. Repeated by Wilson and Brown, 1958, p. 214.

Anonymous, 1954, p. 3: ''In 8 to 12 days the eggs hatch into larvae. When the larvae appear, they are ready to start feeding. They are helpless, dirty-white grubs, and can hardly move. They depend on the queen and the workers. The queen feeds her first larvae food that is stored in her own body. Workers feed larvae of subsequent broods.'' Life cycle: egg 8-12 days; worker larvae 6-12 days; pupa 9-16 days. Photograph of larva in side view, on page 4. This is referred to subspecies *richteri*. The above information is used in Anonymous, 1958.

Solenopsis (Diplorhoptrum) fugax (Latreille)

According to Trabert (1957, pp. 300-301) both sexes have 22-27 head hairs. Those of the queen are somewhat the longer. In the queen only the tips of the hairs are branched (2 to 4 fine branches). In the male on the dorsal half of the head the hairs are similar to body hairs—deeply bifid with the branches strongly divergent; sometimes the branches are bifid. The hairs on the ventral half of the head are also bifid but with the shaft longer and the branches relatively shorter. Both clypeal hairs have multifid tip. The mandible of the queen has an apical and two medial teeth. The mandible of the male has a sharp apex and a vestigial medial tooth. Fig. 1, p. 300, head hairs of queen and male compared; Fig. 2, p. 301, mandibles of queen and male.

Solenopsis (Diplorhoptrum) pergandei Forel

Worker Larva.—Length (through spiracles) 1.7 mm; straight length about 1.35 mm. Similar to *S. geminata* (Fabricius) (Wheeler and Wheeler, 1955*b*, p. 132) except in the following details: Integument of ventral surface of thorax and dorsum of posterior somites sparsely spinulose. Body hairs of two types: (1) 0.024-0.03 mm long, with nearly straight bifid tip, a few on the ventral surface of each thoracic somite; (2) elsewhere the hairs are bifid, 0.03-0.04 mm long, with the base about half the length, the branches more or less perpendicular to the base, the tips recurved; hairs on ventral surface with alveolus and articular membrane. Genae bulging. Head hairs much shorter (0.02-0.04 mm long). Maxillary and labial palps each with five sensilla (two encapsulated and three bearing a spinule each).

Sexual Larva.—Similar to those of *S. molesta* (Say) (Wheeler and Wheeler, 1955*b*, p. 134) except as follows: Body hairs of one type, 0.048-0.096 mm, bifid, with very short base and long straight branches; no hairs on the dorsum of prothorax and mesothorax and none on the entire ventral surface. No head hairs.

(Material studied: numerous larvae from Georgia, collected by P. B. Kannowski.)

Solenopsis (Diplorhoptrum) picta Emery

Length (through spiracles) about 1.5 mm; straight length 1.2 mm. Similar to *S. geminata* (Wheeler and Wheeler, 1955*b*, p. 132) except as follows: Ventral surface of thorax sparsely spinulose. Body hairs of three types: (1) 0.01-0.015 mm long, simple, mostly with alveolus and articular membrane, about 12 on the ventral surface of each thoracic somite and abdominal somite I; (2) 0.008-0.015 mm, with bifid tip, without alveolus and articular membrane, on all somites; (3) 0.02-0.03 mm long, with slightly curved shaft and single hook, on the dorsum of the thorax. Each lobe of the labrum with four sensilla on the anterior surface, three on the ventral border and five on the posterior surface; no spinules. Maxillary palp a slight elevation with four sensilla. Labium without spinules; palp a cluster of four sensilla. (Material studied: numerous larvae from Florida, collected by P. B. Kannowski.)

Solenopsis (Euophthalma) globularia littoralis Creighton

Length (through spiracles) about 2.0 mm; straight length about 1.6 mm. Generally similar to *S. geminata* (Wheeler and Wheeler, 1955*b*, p. 132) except in the following details: Integument of ventral surface of thorax with minute spinules in subtransverse rows. Body hairs of type (1) 0.015-0.03 mm long, with simple or denticulate tip, about ten on the ventral surface of each thoracic somite and abdominal somites I and II; (2) elsewhere the hairs are 0.015-0.025 mm long, the base about half the length, the branches more or less perpendicular to the base. Maxillary and labial palps each with five sensilla (two encapsulated and three bearing a spinule each). (Material studied: numerous larvae from Florida, collected by P. B. Kannowski.)

Tribe **Pheidologetini** Emery

Genus **Paedalgus** Forel

Paedalgus termitolestes Wheeler

Bernard, 1951*b*, p. 1065: "Les ouvrières, aveugles ou presque, pillent la termitière et nourrissent d'énormes larves de femelles. Par exemple, la larve femelle âgée . . . est obèse, à pièces buccales réduites, mais à glandes salivaires labiales hypertrophiées: comme les nymphes sont nues, le rôle de ces glandes dans la trophallaxie n'est guère douteux. Les poils crochus maintiennent les larves accrochées entre elles par paquets." Fig. 966, larva in side view, after W. M. Wheeler.

Tribe **Myrmecinini** Ashmead

Genus **Podomyrma** F. Smith

Podomyrma sp.

Immature Larva.—Length (through spiracles) about 3 mm. Generally similar to *P. adelaidae* (F. Smith) (Wheeler and Wheeler, 1954*d*, p. 127) but differing in

the following details: Body hairs: (1) moderately long (about 0.24 mm), anchor-tipped, with tortuous shaft, 2-10 in a row across the dorsum of the metathorax and each abdominal somite I-VIII (two may be present on each abdominal somite IX and X); (2) all other hairs very short (0.012-0.06 mm) with short-bifid to multifid tip, on all somites, mostly without alveolus and articular membrane. Antennae small. Head hairs half as numerous and shorter (0.01-0.036 mm long), with bifid or multifid tip. Labrum without spinules except a few on the lateral borders; anterior surface of each lobe of labrum with eight sensilla. Mandibles stouter, with several denticles near the middle of the medial surface. Maxillary palp a slight elevation with five sensilla. Labium without spinules. (Material studied: numerous larvae from Sherbrooke For., Dandenong Ra., Victoria, Australia, 8-IX-1951, collected by W. L. Brown).

Genus **Atopula** Emery

Atopula hortensis Bernard

Valentini, 1951, pp. 269-271; internal anatomy.

Tribe **Leptothoracini** Emery

Genus **Leptothorax** Mayr

Subgenus **Dichothorax** Emery

Like *Myrafant* as amended below.

Leptothorax (Dichothorax) pergandei Emery

Length (through spiracles) about 3.6 mm. Similar to *L.* (*M.*) *ambiguus* Emery (Wheeler and Wheeler, 1955*a*, p. 22) except in the following characters: Body hairs of two types: (1) short (0.02-0.13 mm), longest dorsally, with short-bifid or short-multifid tip; (2) long (about 0.26 mm), anchor-tipped, with tortuous shaft, four in a row across the dorsum of each abdominal somite I-IV, two on V. Head hairs short (0.032-0.057 mm), with short-bifid or denticulate tip. Anterior surface of labrum with six minute hairs. Mandibles with two sharp-pointed subapical teeth. Maxillary palp a cluster of five sensilla. Labial palp a cluster of four or five sensilla. (Material studied: numerous larvae from New Jersey, courtesy of Dr. W. L. Brown).

Subgenus **Myrafant** M. R. Smith

Our previous characterization of this subgenus (1955*a*, p. 22) must now be amended to accommodate two additional species: Body hairs sparse. Of two or three types, including anchor-tipped.

Leptothorax (Myrafant) schaumi Roger

Length (through spiracles) about 1.7 mm. Similar to *L.* (*M.*) *ambiguus* (Wheeler and Wheeler, 1955*a*, p. 22) except in the following details: Integument without spinules. Body hairs sparse. Of two types: (1) short (0.009-0.117 mm), slightly curved, with denticulate tip, on every somite; (2) moderately long (about 0.144 mm), anchor-tipped, with tortuous shaft, four in a row across the dorsum of each abdominal somite I-V, two on VI. Head hairs short (0.005-0.012 mm), with multifid tip. Labial palp represented by a cluster of five sensilla. (Material studied: a dozen larvae from Georgia, collected by P. B. Kannowski.)

Leptothorax (Myrafant) texanus Wheeler

Mature Larva.—Length (through spiracles) about 3 mm. Similar to *L.* (*M.*) *ambiguus* (Wheeler and Wheeler, 1955*a*, p. 22) except in the following characters: Integument without spinules. Body hairs of two types. (1) short (0.024-0.168 mm), longest dorsally, with short-bifid tip, on every somite; (2) long (about 0.24 mm), four in a row across the dorsum of each abdominal somite I-III, anchor-tipped, with tortuous shaft. Head hairs short (0.009-0.024 mm), with short-bifid tip. Anterior surface of labrum with seven minute hairs; posterior surface with eight sensilla. Mandibles with two large subapical teeth on medial blade. Maxillary palp with four or five sensilla. Labial palp with five sensilla.

Just-Hatched Larva.—Similar to *L.* (*M.*) *ambiguus* (Wheeler and Wheeler, 1955*a*, p. 23).

Material studied: numerous larvae from Georgia, collected by P. B. Kannowski.

Leptothorax (Temnothorax) arenarius Santschi

Bernard, 1951*a*, pp. 93-94: "La forme externe et la pilosité ne sont pas sensiblement modifiées par rapport aux espèces hygrophiles des mêmes genres. Il n'y a pas lieu de retenir les déductions de Santschi (1908), basées sur *Leptothorax arenarius* des oueds tunisiens, selon lesquelles des poils crochus aideraient les larves à se maintenir dans le sable croulant. D'une part, *Cataglyphis bombycina*, éminemment sabulicole, a des poils simples et courts; d'autre part, une foule de *Leptothorax* et de *Crematogaster* habitant les roches lisses ont des poils crochus."

Genus **Macromischa** Roger

Our previous characterization of this genus (1955*a*, p. 17) needs revision as to hairs: Body hairs sparse to moderately numerous; of two or three types including short and spike-like, short to moderately long with multifid or denticulate tip and anchor-tipped. Head hairs few or moderately numerous and short or long.

Marcomischa manni Wheeler

Length (through spiracles) about 3.7 mm. Similar to *M. wheeleri* Mann (Wheeler and Wheeler, 1955*a*, p. 18) except in the following details: First spiracle not much larger than the others. Apparently without spinules on the integument. Body hairs moderately numerous. Of two types: (1) short to moderately long (0.018-0.19 mm), with multifid tip, generally distributed; (2) long (about 0.4 mm), anchor-tipped, with tortuous shaft, four in a row across the dorsum of the metathorax and each abdominal somite I-VI. Head small. Head hairs moderately numerous, longer (0.018-0.084 mm). Anterior surface of labrum with 12 short hairs; posterior surface with 10 isolated and two clusters of three sensilla each. Maxillary palp a cluster of five sensilla. (Material studied: nine larvae from Cuba, collected by E. O. Wilson, courtesy of Dr. W. L. Brown.)

Tribe **Tetramoriini** Emery

Genus **Tetramorium** Mayr

Tetramorium caespitum (Linnaeus)

According to Trabert (1957, pp. 301-303) the body hairs of the male are dendritic with the branches only slightly divergent. The queen body hairs have strongly divergent branches. Each sex has a few hairs intermediate between these

two types. There are usually 24 hairs on the head. The head hairs of the queen are notably longer than those of the male and are bifid or multifid at the tip. Those of the male have the tip frayed into many more branches. In the male the maxillary palp and galea are stout and the galea is the shorter; in the queen they are more slender and the galea is longer than the palp. Fig. 3, p. 302, body hairs of male and queen; Fig. 4, p. 302, head hairs of male and queen compared; Fig. 5, p. 303, maxillary palps and galeae of male and queen.

Tribe **Basicerotini** Brown

Genus **Rhopalothrix** Mayr

Rhopalothrix amoena Mann

(Pl. II, figs. 24 and 25)

Immature Larva.—Length about 1.6 mm. Generally similar to *R. gravis* Mann (Wheeler and Wheeler, 1954*a*, p. 117) except in the following details: Body hairs of two types: (1) slender, flexible, denticulate, short to moderately long (0.048-0.192 mm), on all surfaces of all somites; (2) stout, of nearly uniform diameter, sinuous, long (about 0.17 mm), with denticulate shaft and a minute apical hook arising from a spoonshaped or subfusiform knob. Cranium subcircular. Head hairs moderately numerous, long (0.024-0.096 mm). Labrum wider (breadth three times the length); posterior surface of each lobe with two contiguous sensilla. (Material studied: two immature larvae from the Chiriqui Mts., Panama, collected by F. M. Gaige, determined by W. L. Brown.)

Rhopalothrix biroi Szabó

Wilson, 1956, p. 22-23: "If any generalization is to be made about food preference, it is probably safest to say that this species of *Rhopalothrix* accepts a wide variety of soft-bodied arthropods and rejects other animals that are either hard-bodied or possess repugnant odors . . . Captured animals were either left on the brood chamber apart from the larvae, or else placed immediately among the larvae, which fed on it directly, ponerine fashion. The adults fed separately or simultaneously with the larvae on the same animal . . . The workers were very solicitous of the brood, washing it and moving it about constantly. They were in fact more attentive in this way than any dacetine genera I have studied."

Tribe **Dacetini** Forel

Genus **Epopostruma** Forel

Epopostruma sp.

Length (through spiracles) about 3.5 mm. Indistinguishable from *E.* sp. which we have described, 1954*a*, p. 128. (Material studied: four larvae from Ferntree Gully, Dandenong Ra., Victoria, Australia, 8-X-1951, W. L. Brown coll. et det.)

Genus **Strumigenys** F. Smith

Our previous description (1954*a*, p. 135) should be amended to read as follows: Short and stout; prothorax directed ventrally; dorsal profile C-shaped, ventral feebly sinuate; diameter of body increasing gradually from anterior end to

abdominal somite V, then decreasing to posterior end. Segmentation indistinct. Body hairs moderately numerous and short to moderately long. Of three types: (1) on the ventral surface, few, denticulate, flexible; (2) bifid, with the branches denticulate; (3) anchor-tipped, with tortuous shaft, two or four in a row across the dorsum of each abdominal somite I-IV or I-V. Antennae small to moderately large, with only two sensilla each. Head hairs short to moderately long, flexible and denticulate. Maxillary palp a low elevation bearing four sensilla. Labium with a pair of mammiform ventrolateral lobes, each bearing a palp which is a low elevation with four or five sensilla.

Strumigenys biolleyi Forel

Length (through spiracles) about 2.7 mm. Similar to *S. louisianae* Roger (Wheeler and Wheeler, 1954*a*, p. 136) except in the following details: Anchor-tipped hairs longer (about 0.26 mm long), on abdominal somites I-IV. Middle of occipital border straight. Antennae moderately large. Labrum narrower (breadth 1.8 times length); anterior surface of each lobe with four sensilla; posterior surface of each lobe with three isolated and three contiguous sensilla. Labial palp with five sensilla. (Material studied: four larvae from Panama, collected by F. M. Gaige, det. W. L. Brown.)

Strumigenys godmani Forel

Worker Larva.—Length (through spiracles) about 3.6 mm. Similar to *S. louisianae* (Wheeler and Wheeler, 1954*a*, p. 136) except in the following details: Body hairs longer: (1) 0.072-0.144 mm long; (2) 0.11-0.2 mm long; (3) about 0.3 mm long, two on the dorsum of each abdominal somite I-IV. Antennae moderately large. Subapical tooth of mandible smaller.

Just-Hatched Larva.—Length (through spiracles) about 0.8 mm. Body shape very similar to very young larva of *Smithistruma nigrescens* (Wheeler) (Wheeler and Wheeler, 1954*a*, p. 144). Otherwise similar to mature larva of *godmani* except in the following details: Body hairs sparse; (1) 0.051-0.15 mm long; (2) shorter (0.012-0.036 mm long), very few on lateral surfaces only; (3) shorter (about 0.2 mm long). Head hairs much longer (0.018-0.072 mm long). Mandibular teeth shorter and with sharper points.

(Material studied: 12 larvae from Panama, coll. F. M. Gaige, det. W. L. Brown.)

Strumigenys loriae Emery

Wilson and Brown, 1956, p. 451: In mixed nests, the larvae of *Strumigenys loriae* were mixed with the brood of *Kyidris yaleogyna* Wilson and Brown or *K. media* Wilson and Brown. Both species of workers fed and cared for the mixed brood but the *Kyidris* workers were reported to be "ineffectual."

Strumigenys n. sp.

Worker Larva.—Length (through spiracles) about 2.4 mm. Similar to *S. louisianae* (Wheeler and Wheeler, 1954*a*, p. 136) except in the following details: Body hairs of type 2 shorter (0.048-0.072 mm); type 3 about 0.15 mm long, two on the dorsum of each abdominal somite I-V. Head hairs shorter (0.014-0.096 mm long). Antennae moderately large. Mandible with the medial teeth larger, the proximal tooth directed medially. Labium not bilobed; palp with five sensilla.

Male Larva.—Length (through spiracles) about 3.3 mm. Similar to the worker larva except in the following details: A minute midventral pocket on the ninth abdominal somite. Body hairs sparse; longer: (1) 0.1-0.2 mm long; (2) 0.065-0.15 mm long; (3) about 0.23 mm long, four in a row across the dorsum of each abdominal somite I-V. Labium bilobed.

(Material studied: numerous worker larvae and male semipupae, from Progresso, Chiriqui Mts., Panama, 15-IV-1923, F. M. Gaige, #332; det. W. L. Brown.)

Strumigenys sp. (**szalayi** group)

Mature Larva.—Length (through spiracles) about 2.3 mm. Similar to *S. louisianae* (Wheeler and Wheeler, 1954*a*, p. 136) except in the following details: Anterior end more swollen dorsally; posterior end slenderer. Head relatively larger. Body hairs (1) 0.042-0.12 mm long, on the ventral surface of the thorax and abdominal somites I-VIII; (2) 0.072-0.096 mm long; (3) about 0.23 mm long. Head hairs shorter (0.012-0.072 mm long). Antennae moderately large. Medial teeth of mandible directed anteromedially. Labial palp with five sensilla.

Very Young Larva.—Shape similar to that of *Smithistruma nigrescens* (Wheeler); otherwise similar to the mature larva.

(Material studied: a dozen larvae from Baliem, Dutch New Guinea, 14-XII-1938, 1600 m, L. J. Toxopeus; det. W. L. Brown.)

Strumigenys sp.

Length (through spiracles) about 3.2 mm. Similar to *S. louisianae* (Wheeler and Wheeler, 1954*a*, p. 136) except in the following details: Body hairs sparse; (1) longer (0.054-0.144 mm long); (2) 0.084-0.12 mm long; (3) longer (about 0.2 mm long). Head hairs shorter (0.024-0.1 mm long). All mandibular teeth round-pointed and blunt. (Material studied: numerous larvae from Chiriqui Mts., Panama, 19-V-1923, F. M. Gaige, #497; det. W. L. Brown.)

Genus **Smithistruma** Brown

Smithistruma alberti (Forel)

Similar to *S. talpa* (Weber) (Wheeler and Wheeler, 1954*a*, p. 141) except in the following details: Body hairs: (1) 0.036-0.072 mm long; (2) 0.06-0.12 mm long; (3) about 0.18 mm long, four in a row across the dorsum of each abdominal somite I-V. Each labial palp with five sensilla. (Material studied: two damaged larvae from Panama, coll. F. M. Gaige; det. W. L. Brown.)

Tribe **Attini** F. Smith

Bischoff, 1927, p. 384: "Bei den pilzzüchtenden Attinen bilden die kultivierten Pilzkohlrabi die wichtigste Brutnahrung."

Weber, 1956*b*, p. 605: Ant saliva may possibly promote the growth of mycelia. "This would account for the covering of mycelium that a well-licked larva may develop."

Weber, 1958, p. 463: "The care of the brood is similar among the attines. The brood is kept in the cells of the gardens, except in *Cyphomyrmex rimosus* where the brood is roughly segregated from the garden and in piles according to size.

"It is significant and striking that the brood in all genera known is commonly coated with the mycelium of the fungus. In *Cyphomyrmex rimosus*, where the

fungus is cultivated in the form of masses of yeast-like cells, the brood is covered with filamentous hyphae as in the other attines. This mycelial covering may be so dense as to completely obscure the larvae and pupae. The eggs may bear less numerous tufts of the mycelium. The mycelium is planted by the ants on the brood integument as they similarly plant the substrate. For this reason, and apparently because of changing luxuriantness of the fungus in the garden and feeding habits, the brood within a colony may vary in the completeness of its mycelial coat from day to day. The hairy larvae of *Acromyrmex octospinosus* may lack a fungus coat. All stages of brood among attines are frequently licked by the workers. The saliva as added may be nutritive for the fungus and of course the latter may be food for the adults.

"Larvae are fed by the worker bringing in masses of the fungus and placing them on the mouthparts, where the larva takes over and manipulates the fungus so that it can imbibe the contents of the rasped or punctured cells. It usually rests on its dorsal or lateral surfaces with mouthparts directed outward and frequently embedded in the garden as so much substrate, being held in place by its hairs or by a mesh of mycelium."

Genus **Cyphomyrmex** Mayr

Cyphomyrmex rimosus Spinola

Weber, 1958, p. 463: See above under tribe Attini.

Cyphomyrmex rimosus minutus Mayr

Weber, 1955: "The brood is kept separate from the garden and is segregated according to size; large larvae may be mingled with pupae. The brood is usually enveloped in a mycelium that differs from that in other attines in being almost granular in superficial appearance, consisting of dense masses or tufts that are always connected by ordinary hyphal strands. Under a 32X binocular the tufts show as a more concentrated form of bromatia than in other attine species . . . Eggs and the smallest larvae as well as larger brood may be covered with the mycelium. The position and frequency of the tufts indicate that they sometimes may be planted by the workers. Larvae are fed as in other attines by placing the fungus on the mouthparts. In this species the fungus fed to the larvae seems to consist only of the cheese-like bromatia. As the larva feeds, the mouthparts go in and out like pistons while the bromatium is rasped and the juices imbibed" (p. 277-278). Fig. 1, photograph of nest in Petri dish, showing larvae.

Genus **Sericomyrmex** Mayr

See *Trachymyrmex wheeleri* (below).

Genus **Trachymyrmex** Forel

Trachymyrmex septentrionalis (McCook)

Weber (1956*a*, p. 156) described two young larvae (1.5 and 1.0 mm long) as "smooth and shiny." Two days later the smaller larva had a scanty covering of hyphae.

Trachymyrmex wheeleri (Weber)

G. C. Wheeler described (1948, 670-671, Pl. II, figs. 9-13) the larva of this species as *Sericomyrmex wheeleri*. Weber has transferred the species to *Trachymyrmex* (*Entom. News* 69: 54. 1958).

Trachymyrmex sp.

Michener and Michener (1951, Fig. 90, opposite p. 208): photograph of larvae on a fungus garden.

Genus **Acromyrmex** Mayr

Morley (1953, p. 21, fig. 2a) reproduced G. C. Wheeler's 1943 figure of *Eciton* (*E.*) *hamatum* head in anterior view erroneously under this genus.

Acromyrmex octospinosus (Reich)

Weber, 1958, p. 463: "The hairy larvae . . . may lack a fungus coat."

Genus **Atta** Fabricius

Brun (1924, p. 95) made a brief mention of sex determination in *Atta*.

Steinhaus (1949, p. 96): "The larvae hatching from the eggs eat the fungus" in the nest of a colony-founding queen. This is contrary to the observations of Huber (1905, translation 1907), W. M. Wheeler (1907 and later), Forel (1923), etc. (See references: G. C. Wheeler, 1948, pp. 676-683). See also Michener and Michener, 1951, p. 166.

Atta insularis Guérin

Bruner and Barry (1949, p. 140) reported that in an incipient colony the life cycle was: egg 15 to 16 days; larva 9 to 22 days (average 17); pupa 11 to 15 days (average 14). (English summary, p. 151.)

Atta sexdens (Linnaeus)

Brun (1924, p. 90) reviewed Huber's (1905) account of colony-founding. Also he referred (p. 37) to Goeldi's conclusions on caste determination: "Ein weiteres Argument für die trophogene Theorie hat neuerdings Göldi durch eine interessante Beobachtung bei der südamerikanischen Pilzzüchterin *Atta sexdens* geliefert. Er fand nämlich in den Brutkammern der Nester dieser Ameisen eigentümliche Knäuel, die sich bei näherer Untersuchung aus etwa einem Dutzend kleinster Arbeiter zusammengesetzt erwiesen, welche je eine grosse männliche oder weibliche Larvae vollständing bedeckten. Diese 'Ammen' schienen in eine Art lethargischen Schlaf versunken und hafteten so fest an ihrer Unterlage, dass sie sich sogar in Spiritus nicht von derselben loslösten. Göldi glaubt, in diesen Brutknäueln 'das biologische Äquivalent der verbesserten Aufzuchtbedingungen (Raum, Futter in qualitativer und quantitativer Hinsicht) erblicken zu dürfen, welche im Bienenhaushalte von den Arbeitsbienen den Geschlechtsindividuen (Weisel and Drohnen) geboten werden (Göldi 1916)." We have been unable to find any article by Goeldi dated 1916, nor any other reference to such an article.

Eidmann, 1935: "Die kleine Larve verlässt durch ein seitlich genagtes Loch die Eischale" (p. 197). "Die Larve von *A. sexdens* ist wie alle Ameisenlarven eine bein- und augenlose Made. Am Abdomen lassen sich 10 Segmente unterscheiden, die besonders bei den Junglarven gut ausgeprägt sind, so dass die Larve insgesamt 13 Segmente zählt. Die Larven sind holopneustisch, d. h. sie haben die normale Zahl von 10 Stigmen, von denen 2 dem Thorax (Meso- und Metathorax), der Rest den ersten 8 Abdominalsegmenten angehört. Die Junglarve ist ziemlich gleichmässig ventral eingekrümmt und von gelblicher Färbung. Der Kopf ist relativ gross und beborstet, die Kopfkapsel schwach chitinisiert. Die Antennen sind angedeutet durch warzenförmige Erhebungen, auf welchen sich 2 Sinneshöcker

erkennen lassen. Die Mandibeln sind relativ gross und auf ihrer Aussenseite dicht bedornt. Sie haben einen schwach gezähnten Kaurand. Der Körper der Junglarve ist mit äusserst feinen, teilweise gruppenartig beieinander stehenden Dörnchen bedeckt. Behaart ist ausser dem Kopf nur das letzte Segment in der Umgebung des Afters, sowie die Ventralseite des Pro- und Mesothorax, die eine dichte bürstenartige Beborstung aufweist, welche wohl mit der Nahrungsaufnahme in Zusammenhang stehen dürfte. Von der Verpuppung gehen an der Larve eine Reihe von Veränderungen vor sich, und diese wird zur Präpuppe. An ihr fällt der relativ sehr kleine Kopf auf, welcher wie ein kleines Anhängsel vorn an dem buckelförmig aufgetriebenen Prothorax sitzt. Letzterer enthält in diesem Stadium die Anlage des mächtigen Puppenkopfes, der die Auftreibung verursacht. Die Haut ist in diesem Stadium prall ausgedehnt, die Segmentierung daher besonders in der Abdominalregion kaum kenntlich. Die Behaarung ist spärlich und kurz und beschränkt sich auf den Kopf, den Prothorax und die letzten Abdominalsegmente'' (p. 198-199). Figure 6, p. 198, young larva and semipupa in side view. At the end of September eggs, young larvae and mature larvae were in the nest but middle-sized larvae and the larvae and pupae of the sexual forms were absent (p. 195).

LITERATURE CITED

(*Supplementary bibliography for the ant larvae of the subfamily Myrmicinae.*)

[Anonymous.] 1953. Ants in the home and garden. How to control them. U. S. Dept. Agric. Home and Garden Bull. No. 28, 8 pp., illus. (Revised 1957).

[Anonymous.] 1954. The imported fire ant. How to control it. U. S. Dept. Agric. Leaflet No. 350, 8 pp., illus.

[Anonymous.] 1958. Making the fire ant ''holler uncle.'' Co-op Grain Quarterly 16: 26-30, illus.

Athias-Henriot, C. 1947. Recherches sur les larves de quelques fourmis d'Algérie. Bull. Biol. France Belgique 81: 247-272, 5 figs.

Barnes, O. L. and N. J. Nerney, 1953. The red harvester ant and how to subdue it. U. S. Dept. Agric. Farmers' Bull. No. 1668, 11 pp., 5 figs.

Bernard, F. 1951*a*. Adaptations au milieu chez les fourmis sahariennes. Bull. Soc. Hist. Nat. Toulouse 86: 88-96.

————. 1951*b*. Super-famille des Formicoidea. Traité de zoologie, Tome X, Fasc. II: 997-1104, 74 figs.

————. 1953. Les fourmis du Tassili des Ajjer. Inst. Rech. Sahariennes Univ. d'Alger., 132 pp., 6 pls., 16 text figs.

————. 1955. Morphologie et comportement des fourmis lestobiotiques du genre *Epixenus* Emery. Insectes Sociaux 2: 273-283, 2 figs.

Bischoff, H. 1927. Biologie der Hymenopteren. Berlin: Julius Springer. viii + 598 pp., 244 figs.

Brian, M. V. 1951*a*. Summer population changes in colonies of the ant *Myrmica*. Phys. Comp. et Oecol. 2: 248-262, illus.

————. 1951*b*. Caste determination in a myrmicine ant. Experientia 7: 182.

————. 1954. Studies of caste differentiation in *Myrmica rubra* L. 1. The growth of queens and males. Insectes Sociaux 1: 101-122, 3 figs.

————. 1955*a*. Studies of caste differentiation in *Myrmica rubra* L. 2. The growth of workers and intercastes. Insectes Sociaux 2: 1-34, 5 figs.

Brian, M. V. 1955*b*. Studies of caste differentiation in *Myrmica rubra* L. 3. Larval dormancy, winter size and vernalisation. Insectes Sociaux 2: 85-114, 5 figs.

————. 1956*a*. Studies of caste differentiation in *Myrmica rubra* L. 4. Controlled larval nutrition. Insectes Sociaux 3: 369-394, 3 figs.

————. 1956*b*. Group form and causes of working inefficiency in the ant *Myrmica rubra* L. Physiol. Zool. 29: 173-194, 2 figs.

————. 1956*c*. Inefficiency in brood-rearing in the ant *Myrmica rubra* L. Insectes Sociaux 3: 71-74.

————. 1957*a*. Food distribution and larval size in cultures of the ant *Myrmica rubra* L. Phys. Comp. et Oecol. 4: 329-345, 3 figs.

————. 1957*b*. Serial organization of brood in *Myrmica*. Insectes Sociaux 4: 191-210.

————. 1957*c*. Caste determination in social insects. Ann. Rev. Entom. 2: 107-120.

Brun, R. 1924. Das Leben der Ameisen. Leipzig & Berlin: B. G. Teubner. 211 pp., 60 figs.

Bruner, S. C. & F. V. Barry. 1949. Observaciones sobre la biología de la bibijagua. Mem. Soc. Cubana Hist. Nat. 19: 135-154, 2 pls.

Creighton, W. S. 1957. A study of the genus *Xenomyrmex*. Amer. Mus. Novitates No. 1843, 14 pp.

Eidmann, H. 1935. Zur Kenntnis der Blattschneiderameise *Atta sexdens* L., inbesondere ihrer Oekologie. Zeitschr. angew. Entom. 22: 185-241, 25 figs.; 385-436, 45 figs.

Goetsch, W. 1957. The ants. Ann Arbor: University of Michigan Press. 169 pp., 85 figs.

Hall, D. W. and I. C. Smith. 1953. Atypical forms of the wingless worker and the winged female in *Monomorium pharaonis* (L.). Evolution 7: 127-135, 18 figs.

Kannowski, P. B. 1954. Notes on the ant *Novomessor manni* Wheeler and Creighton. Occ. Papers Mus. Zool. Univ. Michigan No. 556, 6 pp.

Marcus, H. 1953. Estudios mirmecológicos. Folio Universitaria (Cochabamba, Bolivia) No. 6: 17-68, 52 figs.

Michener, C. D. and M. H. Michener. 1951. American social insects. New York: D. Van Nostrand Co., Inc. xiv + 267 pp., 109 figs.

Morley, D. W. 1953. Ants. London: Collins. xii + 179 pp., illus.

Smith, M. R. 1957. Revision of the genus *Stenamma* Westwood in America north of Mexico. Amer. Midland Nat. 57: 133-174, 16 figs., 1 map.

Steinhaus, E. A. 1949. Principles of insect pathology. New York: McGraw-Hill Book Co., Inc. xi + 757 pp., 219 figs.

Trabert, C. 1957. Ueber sekundäre Geschlechtsmerkmale bei einigen Ameisenlarven. Insectes Sociaux 4: 299-304, 5 figs.

Valentini, S. 1951. Sur l'adaptation des larves de Formicoidea. Ann. Sci. Nat., Zool. Ser. 11: 249-276, 30 figs.

Weber, N. A. 1955. Fungus-growing ants and their fungi: *Cyphomyrmex rimosus minutus* Mayr. Jour. Washington Acad. Sci. 45: 275-281, 2 figs.

————. 1956*a*. Fungus-growing ants and their fungi: *Trachymyrmex septentrionalis*. Ecology 37: 150-161, 4 figs.

————. 1956*b*. Treatment of substrate by fungus-growing ants. Anat. Rec. 125: 604-605.

Weber, N. A. 1958. Evolution in fungus-growing ants. Proc. 10th Intern. Congr. Entom. (1956) 2: 459-473, 12 figs.

Weir, J. S. 1957. The functional anatomy of the mid-gut of larvae of the ant, *Myrmica*. Quart. Jour. Micr. Sci. 98: 499-506, 1 pl., 1 text fig.

Wheeler, G. C. 1935. The larvae of *Allomerus*. Psyche 42: 92-98, 2 pls., 1 text fig.

————. 1943. The larvae of the army ants. Ann. Entom. Soc. Amer. 36: 319-332, 2 pls., 2 text figs.

————. 1948. The larvae of the fungus-growing ants. Amer. Midland Nat. 40: 664-689, 3 pls., 3 text figs.

Wheeler, G. C. and J. Wheeler, 1952*a*. The ant larvae of the myrmicine tribe Crematogastrini. Jour. Washington Acad. Sci. 42: 248-262, 5 figs.

————. 1952*b*. The ant larvae of the myrmicine tribe Myrmicini. Psyche 59: 105-125, 1 pl., 1 text fig.

————. 1953*a*. The ant larvae of the myrmicine tribes Melissotarsini, Metaponini, Myrmicariini, and Cardiocondylini. Jour. Washington Acad. Sci. 43: 185-189, 20 figs.

————. 1953*b*. The ant larvae of the myrmicine tribe Pheidolini. Proc. Entom. Soc. Washington 55: 49-84, 3 pls.

————. 1953*c*. The ant larvae of the myrmicine tribe Pheidologetini. Psyche 60: 129-147, 1 pl., 1 text fig.

————. 1954*a*. The ant larvae of the myrmicine tribes Basicerotini and Dacetini. Psyche 61: 111-145, 5 pls.

————. 1954*b*. The ant larvae of the myrmicine tribes Cataulacini and Cephalotini. Jour. Washington Acad. Sci. 44: 149-157, 46 figs.

————. 1954*c*. The ant larvae of the myrmicine tribes Meranoplini, Ochetomyrmicini and Tetramoriini. Amer. Midland Nat. 52: 443-452, 1 pl.

————. 1954*d*. The ant larvae of the myrmicine tribe Myrmecinini. Proc. Entom. Soc. Washington 56: 126-138, 2 pls.

————. 1955*a*. The ant larvae of the myrmicine tribe Leptothoracini. Ann. Entom. Soc. Amer. 48: 17-29, 1 pl., 1 text fig.

————. 1955*b*. The ant larvae of the myrmicine tribe Solenopsidini. Amer. Midland Nat. 54: 119-141, 3 pls., 1 text fig.

————. 1956. *Veromessor lobognathus* in North Dakota. Pysche 63: 140-145, 2 figs.

————. 1957. The larva of the ant genus *Dacetinops* Brown and Wilson. Breviora Mus. Comp. Zool. (Harvard) No. 78, 4 pp., 1 fig.

Wheeler, W. M. 1907. On certain modified hairs peculiar to the ants of arid regions. Biol. Bull. 13: 185-202, 14 figs.

Wilson, E. O. 1956. Feeding behavior in the ant *Rhopalothrix biroi* Szabó. Psyche 63: 21-23.

————. 1958. The fire ant. Sci. Amer. 198 (3): 36-41, illus.

Wilson, E. O. and W. L. Brown. 1956. New parasitic ants of the genus *Kyidris* with notes on ecology and behavior. Insectes Sociaux 3: 439-454, 5 figs.

————. 1958. Recent changes in the introduced population of the fire ant *Solenopsis saevissima* (Fr. Smith). Evolution 12: 211-218, 3 figs.