

ENTOMOLOGY.—*The ant larvae of the myrmicine tribe Crematogastrini.*¹ GEORGE C. WHEELER and JEANETTE WHEELER, University of North Dakota. (Communicated by C. F. W. Muesebeck.)

The late Dr. W. M. Wheeler could often predict by merely looking at a stone or log what kinds of ants would be found under (or in) it. In the summer of 1924 when he and I were collecting on Barro Colorado Island, he selected a certain log as promising. But this time he had made a mistake, for as soon as we opened it he exclaimed, "Just another one of those nasty little *Crematogasters*!" I was startled—almost shocked—that one of the world's foremost myrmecologists should speak thus disrespectfully of any ant. It was practically blasphemy—myrmecoblasphemy, that is.

To be sure, it was merely an *obiter dictum*. Nevertheless it did seem to express Dr. Wheeler's general attitude toward this genus. In his introduction to the *Ants of*

*the Belgian Congo*² he said:

At my request, Dr. F. Santschi kindly undertook to work up the species of *Crematogaster*, a genus to which he has given much attention. A glance at my catalog of the Ethiopian species will show why I despaired of adequately handling the Congo material of the group. I might have attempted it, if the *Crematogaster* portion of Mr. George Arnold's monograph of the Rhodesian ants had appeared, but the World War had stopped the publication of this important work, so that even in making my catalog I had nothing to rely on except the confused mess in the existing literature. Mr. Arnold nevertheless sent me some valuable comments on several of the species, together with the following remarks on the genus as a whole: "The genus *Crematogaster* is perhaps the most troublesome of all, and for this there are several reasons. First of all, it is a very large genus, so large that authors get lost in the vast number of described forms and of their collections. Secondly, the species of this genus in Africa are exceptionally liable to minute variations in all

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² Bull. Amer. Mus. Nat. Hist. 45: 7-8. 1922.

directions even over a very small area. . . ., and even within the limits of the same nest. . . . Thirdly, in the separation of species and varieties, too much emphasis has been placed on unreliable characters. . . . Lastly, a good deal of confusion is due to sheer carelessness and contempt for exact methods."

This same distaste for *Crematogaster* seems to be rather general among myrmecologists. I have certainly shared it when collecting in Oklahoma, Texas, and Central America, where it is one of the commonest genera.³ And now the study of the larvae has strengthened my distaste.—G. C. WHEELER.

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Tribe CREMATOGASTRINI Forel

The tribe Crematogastrini comprises a single genus. But what a genus! Emery in his *Genera insectorum* listed 274 species, which make it the fourth largest genus of ants. These species are grouped in 11 subgenera; many of them have numerous subspecies and varieties. But all this is merely small-scale diversity. The genus as a whole—both adults and larvae—is remarkably homogeneous and easily recognized at a glance.

But as soon as one steps inside the genus, all is confusion. It is not possible to characterize larval subgenera (at least with the material at hand), for the differences within a subgenus may exceed those between subgenera. In fact, the differences within a single nest may surpass those between subgenera.

This brings us to the most remarkable discovery in this study: the apparent dimorphism of the larvae of *Crematogaster lineolata subopaca*, which is fully described below and illustrated on the plates. It is certainly tempting to speculate on the cause of this phenomenon—dimorphic queens, social parasitism, genetic segregation after hybridization, etc. But we resist temptation and simply state that we do not have enough facts even for a tentative hypothesis.

Genus *Crematogaster* Lund

Plump, chunky, and straight; practically immobile; subellipsoidal or subcylindrical; ends

³ In North Dakota the picture is entirely different: *Crematogaster* is rare in the southern half of the State and apparently absent in the northern half.

rounded; anterior end formed by the dorsum of the prothorax; head flattened against the ventral surface near the anterior end; no neck. Anus posteroventral. Leg vestiges present. Segmentation indistinct. Spiracles unequal in diameter, the first (i.e., mesothoracic) much the largest, the remainder small and diminishing progressively toward the posterior end. Body hairs sparse; uncinat hairs short to moderately long; other hairs minute to short. Seven types of body hairs occur in the genus: (1) simple; (2) with the tips bifid; (3) with the tips multifid; (4) with the tips frayed; (5) with the apical portion denticulate; (6) with the apical portion broad, flat and denticulate; (7) uncinat hairs, with a heavy, nearly straight shaft and a stout anchor-like tip, restricted to the dorsal surface of abdominal somites I-V or I-VI and arranged in transverse rows of 3-8 hairs, one row on each somite. A species may have two, three or four of these types; the majority have three types. Head with the dorsal and dorsolateral regions thin and depressed; mouth parts small; from each gena a sclerotized band (which is a continuation of the internal skeleton) passes out of the head and enters the prothorax. Antennae small or minute; each with 1-4 (usually 2 or 3) sensilla. Head hairs sparse; minute to short; usually shorter than body hairs; mostly simple. Labrum very small and short; breadth 3-4X length; subtrapezoidal or subrectangular; ventral border concave; anterior surface with 1-4 isolated and two agglomerated sensilla on each half; posterior surface with 4-8 sensilla, but without spinules. Mandibles very small [ratio of head width to mandible length = 4.3 to 9.4 (average 6.7)]; short [ratio of mandible length to width at base = 1.3 to 2 (average 1.5)]; base inflated and feebly sclerotized; apex moderately sclerotized, narrowed to a sharp point and slightly curved medially; no medial teeth; no spinules. Maxillae small; apex paraboloidal and directed medially; without spinules; palp represented by a cluster of three or four agglomerated sensilla; galea represented by two agglomerated sensilla. Labium small; without spinules; palp represented by a cluster of four agglomerated sensilla; a minute sensillum between each palp and the opening of the sericteries; the latter a short transverse slit. Palps and galea never paxilliform. No spinules seen on the hypopharynx.

To most of the characters in the foregoing definition there are exceptions. Nevertheless the

larvae of *Crematogaster*—like their adults—constitute a well defined and homogeneous group. They are readily distinguished from the larvae of other tribes by the shape of the body; the position of the head; the variation in the size of the spiracles of different somites; the paucity and small size of the hairs (except the few uncinata hairs); the depressed dorsal and dorsolateral regions of the head; the sclerotized band emerging from each gena; the reduction of the mouthparts; the reduction of the palps and galea to clusters of sensilla; the lack of spinules on the mouth parts. None of these characters would alone serve to differentiate the larvae from those of all other genera, but as a group they define the genus and tribe very well.

The larvae of *Crematogaster* closely resemble the larvae of the subfamily Dolichoderinae in all the above characters, but they may be differentiated as follows: In the latter the first abdominal spiracle is the largest; uncinata hairs lacking (or, when present, with only one hook); dorsal and dorsolateral regions of the head not depressed (except in *Dolichoderus*); no sclerotized band emerging from each gena; spinules present on the mouth parts. The dolichoderine *Azteca* is the genus most easily confused with *Crematogaster*; in fact, it can be distinguished only by the presence of spinules on its mouth parts and by the shape of its uncinata hairs, which are spirally coiled and have only one hook.

Also like the Dolichoderinae, the larvae of the Crematogastrini are a highly specialized group and both groups are specialized mostly through reductions and losses rather than by elaborations: body length is reduced; mobility is almost lost; hairs are few, short and simple (except the few uncinata hairs); mouth parts are reduced—almost vestigial; the trophorhinium is lacking; palps and galea are merely clusters of sensilla.

In this article we describe the larvae of 11 species representing four subgenera. References from the literature are cited for additional species, making the total considered 16 species in five subgenera.

Athias-Henriot (1947, p. 253) characterized the larvae of this genus as “évolués, simples, . . . reliant [les Myrmicines] aux [Dolichoderinés].”

Bristowe, 1932: “The nests of a species of *Crematogaster* (called Mott dam) are collected on account of their grubs which are eaten in a curry in the Hua Hin district.”

Gantes, 1949: “Larves immobiles” (p. 84). “La croissance est forte au stade IV et elle est ralentie au stade V, mais ce ralentissement est très faible” (p. 85). “Chez *Crematogaster* les poils à double crochet sont plus longs au stade IV qu’au stade V. Donc, l’accrochage mutuel, important pour le transport des larves par les ♀, est surtout possible aux stades jeunes, II à IV” (p. 87). “Larves très évoluées comme *Crematogaster* . . . Ces larves sont immobiles, ont des mandibules minuscules” (p. 88).

Stärcke, 1948, p. 28: “Body still more swollen, of a short oval or nearly globose shape, with a small head projecting on the ventral side.”

Crematogaster (Acrocoelia) *lineolata* Say

Fig. 1 (1-4)

Plump, chunky, and turgid; straight and sub-ellipsoidal; diameter greatest at abdominal somite II; ends round-pointed; anterior end formed from the dorsal portion of the prothorax. Head flattened against the ventral surface near the anterior end; no neck. Anus posteroventral. Leg, wing, and gonopod vestiges present. Approximately a third of the larvae have one, two, or three abdominal leg vestiges (?) on somites I-III, which are larger and more conspicuous than those on the thorax. Segmentation indistinct. Spiracles unequal in size; the first much the largest, the remainder diminishing gradually. Integument of the posterior somites with a few spinules which are either isolated or in short transverse rows. In addition, approximately half the larvae have on each lateral surface of most somites a dorsoventrally elongate patch of minute, stout spinules. Body hairs sparse, somewhat more abundant on the prothorax. Of two types: (1) simple, slightly curved, 0.009-0.036 mm, the most numerous type; (2) a row of four to six nearly straight 2-hooked uncinata hairs on the dorsal surface of each abdominal somite I-VI, about 0.14 mm long. Head moderately large; subtrapezoidal or subcordate in anterior view; narrowed ventrally; about as long as broad; extensive dorsolateral portions thin and depressed; mouth parts small. Inside the head just above the level of the mouth parts there is a slender transverse sclerotic bar; at each end of this bar a large sclerotized lobe is exposed on the surface and extends outward into the prothorax; a slender branch of the lobe extends upward inside the gena and at its end protrudes laterally for a short distance. Antennae

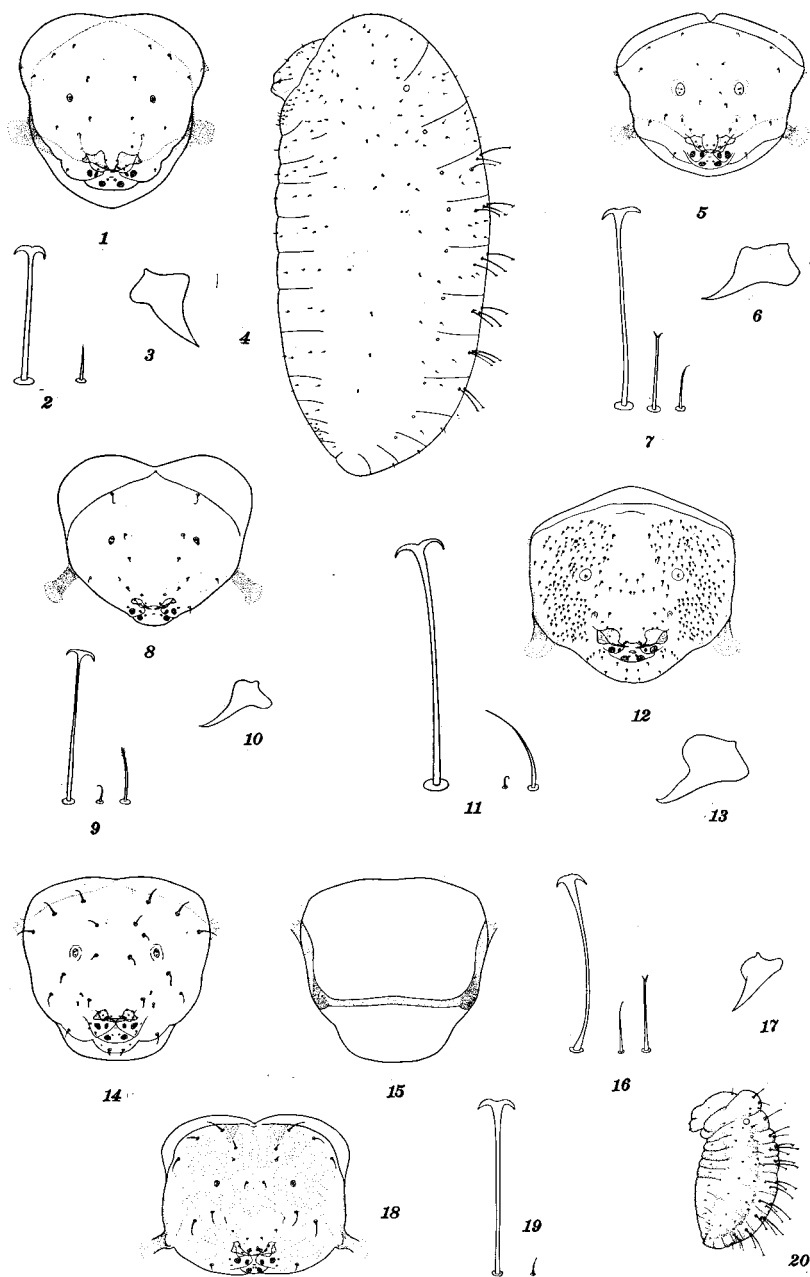


FIG. 1.—*Crematogaster (Acrocoelia) lineolata* Say: 1, Head in anterior view, $\times 76$; 2, two body hairs, $\times 185$; 3, right mandible in anterior view, $\times 216$; 4, larva in side view, $\times 32$. 5–7, *C. (A.) laeviuscula* Mayr: 5, Head in anterior view, $\times 60$; 6, left mandible in anterior view, $\times 216$; 7, three body hairs, $\times 185$. 8–10, *C. (A.) menileki proserpina* Santschi: 8, Head in anterior view, $\times 86$; 9, three body hairs, $\times 185$; 10, left mandible in anterior view, $\times 216$. 11–13, *C. (A.) auberti sordida* Forel: 11, Three body hairs, $\times 185$; 12, head in anterior view, $\times 76$; 13, left mandible in anterior view, $\times 216$. 14–20, *C. (A.) lineolata subopaca* Emery: 14, Head of type A in anterior view, $\times 76$; 15, head of type A in posterior view to show chitinated bar, $\times 76$; 16, three body hairs of type A, $\times 185$; 17, left mandible of type A in anterior view, $\times 216$; 18, head of type B in anterior view, $\times 76$; 19, two body hairs of type B, $\times 185$; 20, very young larva in side view, $\times 32$.

minute, each with three (rarely two or one) sensilla. Head hairs sparse, very short (0.009–0.035 mm), simple and slightly curved. Labrum very small; short (length one-third the width); subtrapezoidal in anterior view; narrowed ventrally; ventral border feebly to moderately concave; anterior surface of each half with two or three isolated sensilla and two agglomerated sensilla near the ventral border; posterior surface with four scattered sensilla. Mandibles very small; apical two-thirds rather stout, sharp-pointed, slightly curved medially, moderately sclerotized; basal one-third feebly sclerotized and inflated. Maxillae small; apex paraboloidal and directed medially; palp a cluster of four sensilla; galea two agglomerated sensilla. Labium small; palp a cluster of four sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit.

QUEEN: Similar to worker, except that the body is relatively more voluminous and the head and hairs relatively smaller.

(Material studied: Numerous larvae from six nests collected in Michigan, New Hampshire, New Jersey, and New York.)

***Crematogaster (Acrocoelia) lineolata*
subopaca Emery**

Figs. 1 (14–20), 2

WORKER TYPE A: Plump, chunky, and turgid; straight and subcylindrical, with the dorsal and ventral profiles nearly straight and moderately long, while in ventral view there is a slight constriction at abdominal somites I and II; ends round-pointed, the posterior end more narrowly so; anterior end formed from the dorsal portion of the prothorax. Head thin and flattened against the ventral surface near the anterior end; no neck. Anus posteroventral. Leg, wing and gonopod vestiges present; abdominal leg vestiges (?) very rarely present. Segmentation indistinct. Spiracles unequal in size, the first much the largest, the remainder diminishing gradually. Integument of abdominal somites VI–X spinulose, the spinules minute and isolated or in short transverse rows. Body hairs sparse, somewhat more abundant on the prothorax. Of three types: (1) simple, very short (about 0.027 mm on the ventral surface to 0.045 mm on the dorsal surface), the most abundant type; (2) with the tip bifid, about 0.045 mm long, a few on the dorsal surface of each

somite; (3) nearly straight 2-hooked uncinate hairs, moderately long (about 0.14 mm), six to eight in a row across the dorsal surface of each abdominal somite I–VI. Head subtrapezoidal in anterior view; narrowed below; slightly broader than long; dorsolateral regions thin and depressed; mouth parts small. Inside the head, just above the level of the mouth parts, there is a slender transverse sclerotic bar; each end of the bar turns upward and continues inside the gena; it finally becomes external near the dorsal corner of the cranium and extends laterally a short distance onto the prothorax. Antennae minute, each with three (rarely two) minute sensilla. Head hairs sparse, short (0.009–0.035 mm), simple and slightly curved. Labrum very small, short (length one-fourth the width), subtrapezoidal, narrowed ventrally; ventral border feebly concave; anterior surface of each half with four isolated sensilla and with two agglomerated sensilla near the ventral border; posterior surface with three sensilla on each half. Mandibles very small; apical two-thirds slender, sharp-pointed, slightly curved medially, moderately sclerotized; basal third feebly sclerotized and widely inflated. Maxillae small; apex paraboloidal and directed medially; palp represented by a cluster of four sensilla; galea represented by a cluster of two agglomerated sensilla. Labium small; palp represented by a cluster of four sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit between the tips of the maxillae.

WORKER TYPE B: Plump and chunky; straight and subcylindrical; not constricted at the middle; ends round-pointed; anterior end formed from the dorsal portion of the prothorax. Head thin and flattened against the ventral surface near the anterior end; no neck. Anus posteroventral. Leg and wing vestiges present. Abdominal leg vestiges (?) on somites I–III are much larger and more conspicuous than those on the thorax; in alcoholic material they are brown and can be readily seen at a low magnification; typically three pairs are present but the number may vary from zero to six vestiges. Ten differentiated somites. Spiracles unequal in size, the first much the largest, the remainder diminishing gradually. The thoracic somites and the first seven or eight abdominal somites bear each a pair of conspicuous lateral welts; each welt is elongate dorsoventrally and narrow antero-posteriorly; it stains deeply with acid fuchsin and

its surface is rugose.⁴ On either side, between these welts and near their ventral ends, there are integumentary structure of unknown nature

⁴ These welts should be compared with the lateral projections described by Eidmann and Menozzi. See our Figs. 3 and 4.

and function. Integument of posterior somites spinulose, the spinules minute and isolated. Body hairs sparse. Of two types; (1) simple, minute (0.003–0.018 mm) fairly uniformly distributed; (2) nearly straight two-hooked uncinate hairs, moderately long (about 0.1 mm),

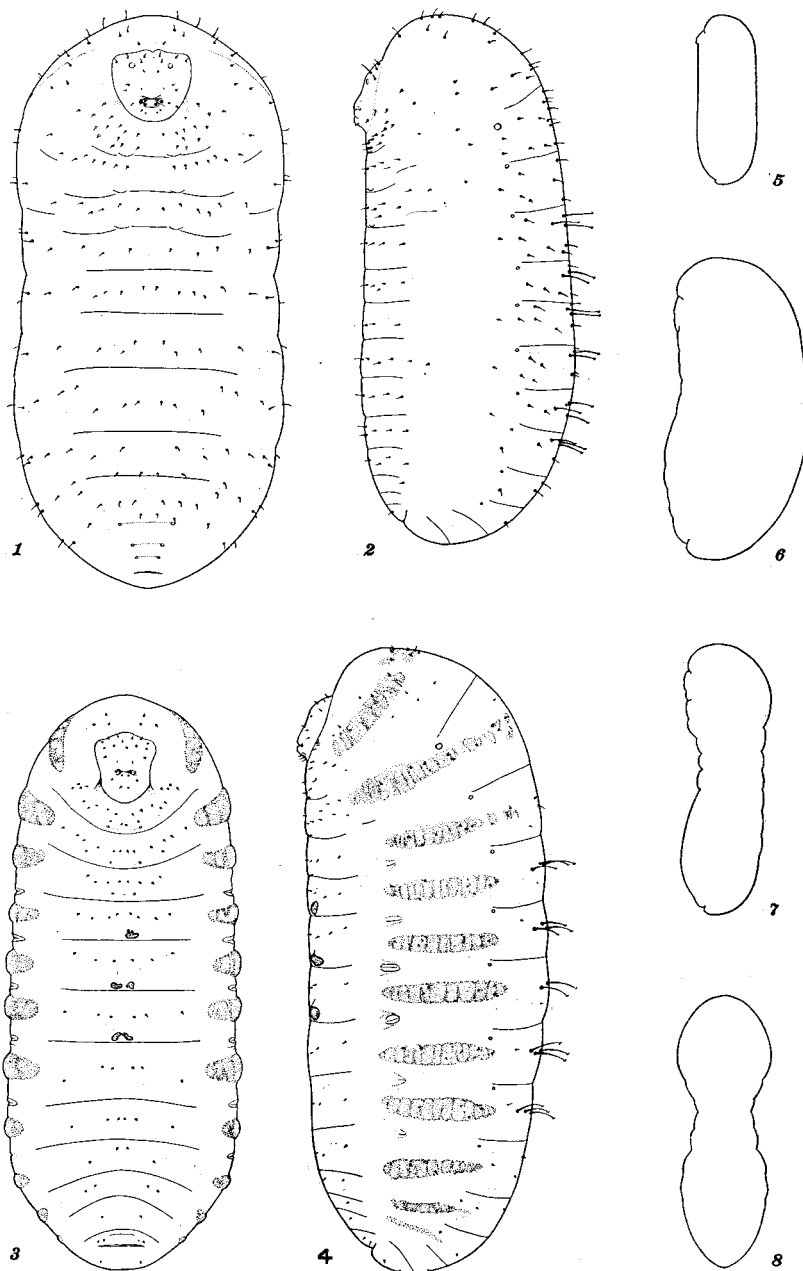


FIG. 2.—*Crematogaster (Acrocoelia) lineolata subopaca* Emery: 1, Larva of type A in ventral view, $\times 32$; 2, larva of type A in side view, $\times 32$; 3, larva of type B in ventral view, $\times 32$; 4, larva of type B in side view, $\times 32$; 5, profile of worker larva, $\times 8$; 6, profile of queen larva, $\times 8$; 7, profile of male larva, $\times 8$; 8, outline of male larva in ventral view, $\times 8$.

three to six in a row across the dorsal surface of each abdominal somite I-V. Head subrectangular in anterior view, slightly broader than long; small dorsolateral areas depressed and thin; integument sclerotized; mouth parts small. At the ventrolateral corner of the head on each side a sclerotized lobose structure emerges and enters the prothorax, where it extends for a short distance; from this a narrow sclerotized bar extends dorsally inside the gena. Antennae minute, with three sensilla each. Head hairs sparse, short (about 0.027 mm), simple and slightly curved; four minute (about 0.003 mm) hairs on the clypeus. Labrum very small, short (length $\frac{1}{3}$ x the width), subrectangular, ventral border feebly concave; anterior surface of each half with four isolated and two agglomerated sensilla; posterior surface with four minute sensilla. Mandibles very small; apical two-thirds slender, sharp-pointed, slightly curved medially and moderately sclerotized; basal one-third feebly sclerotized and widely inflated. Maxillae small; the apex paraboloidal and directed medially; palp represented by four agglomerated sensilla; galea represented by two agglomerated sensilla. Labium small; palp an agglomerated cluster of four sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit.

YOUNG: Length 0.75-0.95 mm. Plump and chunky; with broad lateral longitudinal welts; dorsal profile C-shaped; ventral profile sinuate; about five somites distinct; the prothorax shows two ventrolateral bosses and a transverse ventral welt. Head on the anterior end. Anus ventral. Body hairs similar to the mature type A larva, but a little shorter. On some young larvae (about 0.95 mm long) there are one to six abdominal leg vestiges (?); presumably these would belong to Type B.

QUEEN: Of two types, A and B; each type is similar to worker type A or B respectively, except that the body is much more voluminous and the head and hairs relatively smaller.

MALE: More elongate; thorax swollen; abdominal somites I-II constricted; rest of abdomen swollen; ends rounded, the posterior more narrowly so; anterior end formed from the dorsal portion of the prothorax. Anus subterminal. Leg and wing vestiges present. The only distinct somites are abdominal I-III, otherwise similar to type A worker larva.

(Material studied: Numerous larvae from five nests collected in Arkansas and Texas.)

***Crematogaster (Acrocoelia) aegyptica senegalensis* Roger**

Gantes, 1949: "♂ 3 mm. Ce sont des larves évoluées, le corps est massif, la tête forme un mamelon à la partie antérieure; les segments sont séparés par de simples lignes blanches: 11 segments. Le corps est couvert de plusieurs sortes de poils, mais on remarque immédiatement sur le dos, des poils à double crochet de 0 mm. 11 de long; ils sont dressés raides sur le dos, on a cinq rangs de six poils, uniquement sur les segments abdominaux. Sur tout le corps on a des poils défensifs de 0 mm. 18 de long. Près de l'anus un poil assez long, fourchu, de 0 mm. 05 et un minuscule à trois branches de 0 mm. 009. La tête est large, couverte de poils simples. Les mandibules sont très petites, 0 mm. 032, fines et aiguës, elles s'insèrent dans la tête par deux branches courtes: elles ressemblent à une lame de couteau. Le palpe proximal et le palpe labial n'ont que quatre sensilles" (p. 83). Pl. V, Fig. IX—larva in side view; hairs enlarged. Growth data are given on page 86.

***Crematogaster (Acrocoelia) auberti laestrygon* Emery**

Athias-Henriot, 1947: "Sa tête mal différenciée (un simple mamelon buccal), son corps presque cylindrique, ses six segments abdominaux. Le corps est recouvert d'une fine pubescence et les segments abdominaux portent dorsalement deux énormes macrochètes fourchus et crochus" (p. 252). Internal anatomy is discussed on pages 260 and 263.

Eidmann (1926, p. 726) referred to the absence of lateral papillae and the presence of uncinat hairs in var. *submaura*. (Mentioned by Eidmann, 1927.)

Gantes, 1949: "Ressemble beaucoup à [*senegalensis*], mais elle a des poils plus variés, les mandibules sont plus longues, 0 mm. 41 et plus fines. Les poils à double crochet en six rangs de quatre à partir du métathorax sont plus longs, 0 mm. 21 et se dressent rigides sans ressort. Vers le bout de l'abdomen ils sont un peu plus courts, 0 mm. 198. De plus sur le thorax nous trouvons des poils identiques, mais plus courts, 0 mm. 115. Sur tout le reste du corps on trouve des poils fourchus de 0 mm. 05 et des poils

simples de 0 mm. 04" (p. 83). Pl. V, Fig. IX P9, five hairs.

**Crematogaster (Acrocoelia) auberti
sordida** Forel

Fig. 1 (11-13)

Subcylindrical and relatively slender. Body hairs numerous. Of three types: (1) minute (0.009 mm), simple, with apical half fine and flexible, on the ventral surface; intergrading on the lateral surfaces to (2) longer (0.09 mm), simple and slightly curved, on the dorsal surface; (3) a row of 4-6 nearly straight, moderately long (0.18 mm), 2-hooked uncinata hairs across the dorsal surface of each abdominal somite I-VI. Head hairs minute and exceedingly numerous (about 300). Head subhexagonal in anterior view; dorsal region thin and depressed. Antennae moderately large. Other characters apparently similar to *laeviuscula*. (Material studied: About 50 damaged integuments from Tunis.)

Crematogaster (Acrocoelia) impressa Emery

Eidmann, 1941: "Die Larven zeigen in ihrem Habitus mancherlei Besonderheiten und weichen in dieser Hinsicht von dem üblichen Aussehen der Ameisenlarven nicht unwesentlich ab. Sie sind walzenförmig und gerade gestreckt, also nicht, wie zumeist, ventral eingekrümmt. Das Vorderende ist dadurch ausgezeichnet, dass der Kopf von dem stark entwickelten Prothorax kapuzenförmig überragt wird. Der hintere Teil der Kopfkapsel ist weit in den Prothorax zurückgezogen, so dass die Mundteile senkrecht nach unten, d.h. nach der Ventralseite herausragen. Bei den jüngeren Larven ist die Vorwölbung des Prothorax weniger ausgesprochen als bei den Altlarven. Sämtliche Larven tragen auf der Dorsalseite der ersten sechs Abdominalsegmente grosse ankerförmige Hafthaare, die in je einer Querreihe angeordnet sind. Jede dieser Querreihen besteht aus 4-7, im Durchschnitt 6 Haaren, deren Zahl von vorn nach hinten abnimmt. Bei dem letzten Segment sind meist nur 2-4 vorhanden, bei den jüngeren Larven weniger als bei den älteren... Sie dienen dazu, das Aneinanderhaften der Larven zu Paketen zu ermöglichen, wodurch besonders bei Junglarven der Transport durch die Arbeiter erleichtert wird, können aber, wie vermutlich im vorliegenden Fall, auch zum Anhängen der Larven an den rauen Wandungen der Nestkammern dienen

und dadurch zu einer festen Lagerung und gleichmässigen Verteilung im Nest beitragen" (p. 214). Fig. 4 on p. 214 shows a young larva in side view, a mature larva in side view and an uncinata hair enlarged.

Eidmann, 1944, p. 446: "Die Larven sind durch ihre walzenförmige, gestreckte Gestalt und den Besitz von reihenartig angeordneten, ankerförmigen Oncochaeten auf der Dorsalseite der Abdominalsegmente ausgezeichnet."

Crematogaster (Acrocoelia) laeviuscula Mayr

Fig. 1 (5-7)

Plump, chunky, and turgid; straight and subellipsoidal; ends narrowly rounded; diameter greatest at abdominal somite II. Head thin and flattened against the ventral surface near the anterior end; no neck. Anus posteroventral. Leg, wing, and gonopod vestiges present. No abdominal leg vestiges found. Segmentation indistinct. Spiracles unequal in size; the first much the largest, the remainder diminishing gradually. Integument of the last few somites spinulose, the spinules minute and isolated or in short transverse rows of two or three. Body hairs sparse, somewhat more abundant on the prothorax. Of three types: (1) simple, slender, slightly curved, 0.01-0.07 mm long, the most numerous type; (2) bifid, about 0.054 mm long, two to six on each of the thoracic somites and on abdominal somites I-VI; (3) nearly straight 2-hooked uncinata hairs, 0.12-0.18 mm long, five or six in a row on the dorsal surface of each abdominal somite I-VI. Head moderately large; subtrapezoidal in anterior view; dorsal outline frequently with a median notch; narrowed below; about as long as broad; extensive dorsolateral regions thin and depressed; mouth parts small. Inside the head just above the level of the mouth parts is a very slender sclerotized transverse bar; at either end it joins a sclerotized lobe, becomes external and extends out for a short distance into the prothorax; a slender branch from this lobe extends dorsally inside the gena and becomes external near the dorsal corner of the cranium. Antennae small, each mounted on a low convexity and bearing three (rarely two) sensilla. Head hairs sparse, short (0.01-0.35 mm), simple and slightly curved. Labrum very small, short (length a little less than one-fourth the width); subtrapezoidal, narrowed ventrally; ventral border feebly to deeply impressed;

anterior surface of each half with three isolated and two agglomerated sensilla; posterior surface with two or three sensilla on each half. Mandibles very small; apical third slender, sharp-pointed, slightly curved medially, moderately sclerotized; basal two-thirds widely inflated and feebly sclerotized. Maxillae small; apex paraboloidal and directed medially; palp a cluster of four sensilla; galea two agglomerated sensilla. Labium small; palp a cluster of four sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit. (Material studied: Numerous larvae from two nests collected in Texas).

**Crematogaster (Acrocoelia) menileki
proserpina Santschi**

Fig. 1 (8-10)

Body hairs sparse, of three types: (1) Simple, minute (about 0.012 mm), with recurved tip; (2) with frayed tip, about 0.036 mm long, on the dorsal surface only; (3) nearly straight two-hooked uncinat hairs, about 0.11 mm long, about four in a row on the dorsal surface of each abdominal somite I-V. Head hairs minute to very short (0.006-0.018 mm), with the tip recurved. Posterior surface of labrum with two isolated sensilla on each half. Mandibles with the apical two-thirds slender, sharp-pointed, slightly curved medially and moderately sclerotized; basal one-third inflated and feebly sclerotized. In other respects apparently similar to *lineolata*. (Material studied: A single damaged integument from the Belgian Congo.)

**Crematogaster (Acrocoelia) rivai
luctuosa Menozzi**

Fig. 3

Menozzi, 1930: "La larva del primo stadio, o da pochi giorni uscita dall'uovo, ha corpo ovale, poco allungato, molto più assottigliato all'innanzi che all'indietro, col lato dorsale, visto di fianco, convesso e quello ventrale in parte, anteriormente concavo e poi convesso posteriormente. Ha distinti, oltre il capo, 10 segmenti, l'ultimo dei quali piuttosto ristretto all'indietro e terminato con una sorta di lobo più o meno sviluppato. Tutti i segmenti hanno qualche peluzzo di forma semplice, inoltre i segmenti 4-10 sono provvisti al dorso, sulla linea mediana trasversale, di 3 o 4 lunghe setole terminate a doppio uncino. Il capo visto di lato ha la forma di un cono tronco, è fornito di mandibole piccole, strette ed appun-

tite. Lunghezza mm. 1,7; larghezza massima mm. 0,9. La larva del secondo stadio ha il corpo all'incirca rotondeggiante, fortemente depresso, quasi lenticolare, piano al dorso, mediocrementemente convesso al ventre, diviso in 12 segmenti oltre il capo. Questo è più largo che lungo, coi lati lobiformi. I segmenti 1-8 dell'addome sono provvisti lateralmente e in continuazione del piano dorsale di lunghe appendici più o meno rettangolari coll'apice ottusamente arrotondato; il 9° segmento (ultimo) è tribolato, cioè ha due appendici laterali alquanto più piccole di quelle dei segmenti precedenti e di forma subtriangolare e termina posteriormente, nella linea mediana, con un lobo codale a forma di cappuccio; inoltre i segmenti addominali 3-7 hanno in più ognuno, al ventre, nella linea mediana longitudinale, un'altra appendice di forma all'incirca eguale a quella dei lati, ma più corta. La funzione di tali appendici, che trovano riscontro in altre conformazioni omologhe ed analoghe di altre larve di formiche, si ritiene che sia quella di facilitare l'uscita per osmosi dei prodotti di escrezione emmessi da parecchie cellule del tessuto adiposo: infatti, ad un esame istologico, si trova che la parte distale delle dette appendici è riempita di un essudato sotto forma di liquido più o meno nettamente granuloso, mentre nella parte prossimale vi è un ammasso di numero variabile di cellule adipose o trofociti, di cui alcune, sparse pel corpo, ma quasi sempre raccolte in vicinanza

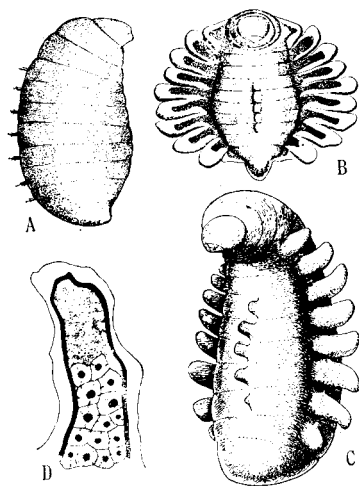


FIG. 3.—*Crematogaster (Acrocoelia) rivai luctuosa* Menozzi: A, B, and C, Larvae of the first, second, and third stadia; D, longitudinal section of a lateral projection of a larva of the second stadium. (After Menozzi, 1930.)

dell'entrata dell'appendice, contengono numerosi cristalli di urato. La chetotassi delle larve in questo stadio è su per giù eguale a quella della larva precedentemente descritta e così dicasi anche per le setole uncinatate che si trovano sul dorso dei segmenti 4-10. Lunghezza mm. 1,02; larghezza mm. 1,48. Larva matura.—In questo stadio fatte le debite proporzioni, il corpo della larva riprende la forma somigliante alquanto a quella del primo stadio, cioè ovale ma più allungata e ancora più fortemente ristretta in avanti. Sono distinti, oltre il capo, 12 segmenti; il 2° segmento toracico é come i precedenti coi lati arrotondati, i segmenti successivi, eccetto l'ultimo, hanno le appendici che si trovano nella larva del secondo stadio, solo che esse sono ridotte in lunghezza. Lunghezza mm. 2,5; larghezza massima, presa sul 10° segmento e comprese anche le appendici laterali, mm. 1,6." (pp. 100-102). Fig. 3 on p. 101: A, B & C—larvae in the 1st, 2nd and 3rd stadia; D—longitudinal section of a lateral appendage of a second-stadium larva.

***Crematogaster (Acrocoelia) scutellaris* Olivier**

Fig. 4

Berlese, 1902, p. 239: "Il primo grande stigma, perfettamente circolare è sul secondo segmento e tutti gli altri, che sono egualmente circolari, vanno decrescendo in diametro e sono scolpiti ciascuno su ciascuno dei segmenti successivi, cosicchè il primo e l'ultimo segmento del corpo non recano stigmi."

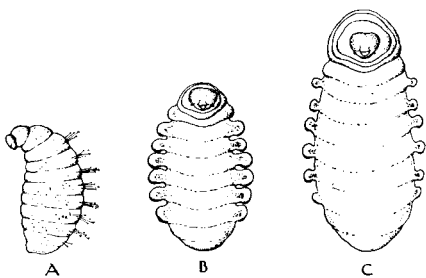


FIG. 4.—*Crematogaster (Acrocoelia) scutellaris* Olivier: A, Young larva in side view; B and C, older larvae in the ventral view. (After Eidmann, 1926.)

Eidmann, 1926: "Wie kommt es, dass die Larven nicht durch ihre Schwere nach unten fallen und sich im unteren Teil der Kammern anhäufen? Sie besitzen, um dies zu verhindern, sehr zweckmässige Anpassungen. Auf der Dorsal-seite der mittleren Segmente findet man je eine

Querreihe von eigenartigen starken Haaren, während der übrige Larvenkörper nackt ist. Bei starker Vergrösserung sieht man, dass diese Haare an ihrer Spitze höchst merkwürdige Bildungen tragen. Die meisten enden in zwei Klauen, die entweder in einer Ebene liegen und dadurch wie ein Anker aussehen, oder auch nach einer Seite gerichtet sind. Die Haare der mittleren Segmente sind fast alle so gestaltet. Auf den hinteren Segmenten trifft man dagegen ganz seltsam geformte Endigungen der hier meist kürzeren Haare. Zackige, geweihartige und kronenförmige Gebilde sieht man hier in allen möglichen Variationen vertreten, von denen die Abbildung eine Auswahl zeigt, und zwischen ihnen stehen hier und da kurze, starre, borstenförmige Haare. Wie ein Wald von Hellebarden und Enterhaken starren einem diese Gebilde unter dem Mikroskop von dem Rücken einer Larve entgegen. Diese Haare stellen eine ausgezeichnete Haftvorrichtung dar, sowohl zum Anhängen der Larven an die Wände der steilen Kammern als auch zum Zusammenhängen mehrerer Larven zu Bündeln. Selbst an totem Alkoholmaterial kann man die Wirkung noch beobachten, Watteflöckchen oder andere Fremdkörper haften ausserordentlich fest an ihnen und die zusammenhängenden Larven lassen sich nur schwer voneinander trennen. Sämtliche Larvenstadien sind mit diesen Hafthaaren versehen, die älteren Larven tragen jedoch neben diesen Haaren noch höchst merkwürdige Bildungen an ihrem Körper, die den jüngsten Stadien fehlen, und die ihnen ein ganz eigenartiges und ungewohntes Aussehen verleihen. Dies sind zwei Reihen von grossen, knopfartigen Papillen, die auf jeder Körperseite in einer Reihe hintereinander in der Zahl von sechs bis acht sitzen. Jedes Segment mit Ausnahme der ersten und letzten trägt links und rechts je eine solche Ausbuchtung. Es scheint als ob die Papillen dem Wachstum ihrer Träger nicht folgen, denn bei älteren Larven sind sie relativ viel kleiner als bei den jüngeren Stadien. Der Zweck der Papillen lässt sich nicht ohne weiteres erkennen, doch nehme ich an, dass auch sie in irgendeiner Beziehung zu der Lebensweise in den hohen Nestkammern stehen. Bei *Cr. submaura*, die in der Erde lebt, fehlen nämlich diese Bildungen und ihre Larven sehen wie jede andere Ameisenlarve aus. Sie haben zwar auch die langen, ankerförmigen Hafthaare, doch ist dies keine Besonderheit, da eine Reihe anderer Ameisenar-

ten (*Pheidole*, *Solenopsis* u. a.) gleichfalls damit versehen ist. Die Papillenreihen der *Scutellaris*-Larven dienen wahrscheinlich auch dazu, das Festhängen und Haften an der Wand der Kammern und untereinander zu gewährleisten, vielleicht enthalten sie auch Drüsen, die ein klebriges Sekret absondern, wie die Rückenspapillen der Larven von *Ponera coarctata*, wiewohl sich diese weder in ihrer Grösse noch in ihrer Anordnung mit den Papillen der *Scutellaris*-Larven vergleichen lassen. Schliesslich wäre noch an eine dritte Möglichkeit zu denken, nämlich, dass es sich um Exsudatorgane handelt, wie sie Wheeler (1923) von verschiedenen Arten beschrieben hat, doch kann darüber wie über die vorhergenannten Möglichkeiten nur die genaue Beobachtung am lebenden Objekt Aufschluss geben" (pp. 724-726). (Mentioned by Eidmann, 1927; 1928, p. 237; 1936, p. 36.) Fig. 10 on p. 725, hairs; fig. 11 on p. 726, a young larva in side view, and two older larvae in ventral view.

Crematogaster (*Crematogaster*) *acuta* (Fabricius)

Fig. 5 (1-5)

Body straight, elongate-subellipsoidal, and rather slender; both ends rounded, but with the terminal somites directed posteroventrally and forming a low, blunt point; belly paunchy at abdominal somites III and IV. Head applied to the ventral surface near the anterior end; no neck. Anus ventral. Leg, wing and gonopod vestiges present. Segmentation indistinct. Spiracles unequal in size; the first much the largest, the remainder diminishing gradually. Integument of the dorsal surface of the posterior somites spinulose, the spinules isolated and minute. Body hairs moderately abundant, short to moderately long and rather uniformly distributed. Of three types: (1) Simple, short (0.02-0.08 mm), longest on the prothorax, slightly curved, limited to the ventral and ventrolateral surfaces; (2) curved, with multifid tip, 0.054-0.19 mm long, limited to the dorsal and dorsolateral surfaces, the tips directed dorsally or posteriorly, those on the prothorax the longest and most strongly curved; (3) nearly straight two-hooked uncinuate hairs, about 0.19 mm long, usually four on each abdominal somite I-VI. Head very small, subhexagonal in anterior view; a fourth broader than long; somewhat narrowed dorsally, ventral outline convex; integument sclerotized; from each ventrolateral corner a heavily sclerotized

structure passes into the prothorax; mouth parts small. Antennae minute raised areas, each with three sensilla. Head hairs sparse, simple, slightly curved, moderately long (0.009-0.054 mm), with stout base and flexible tip. Labrum very small, short (length one-fourth the width), subtrapezoidal, narrowed ventrally: ventral border feebly concave; anterior surface with three isolated and two agglomerated sensilla on each half; posterior surface with three isolated sensilla on each half; ventral border with a few spinules. Mandibles very small; apical three-fifths moderately sclerotized, slender, slightly curved medially and tapering to a sharp point; basal two-fifths feebly sclerotized and only slightly inflated. Maxillae small; apex paraboloidal and directed medially; palp represented by three agglomerated sensilla; galea represented by two agglomerated sensilla. Labium small; palp represented by three agglomerated sensilla; a minute sensillum between each palp and opening of sericterias; the latter a short transverse slit. (Material studied: Numerous larvae from Panama Canal Zone.)

YOUNG: Length about 1.4 mm. Similar to the adult except as follows: Posterior end of abdomen somewhat attenuated and turned ventrally at right angles; ventral profile otherwise straight. Anus subterminal. Body hairs relatively longer and seemingly more abundant. Head relatively larger.

G. C. and E. H. Wheeler have recorded (1924, p. 54) 26 larvae of this species which were parasitized by an undetermined eulophid. Fig. 2 on page 55 is a photograph of two eulophid pupae inside one of the ant larvae.

**Crematogaster (*Orthocrema*) *limata*
dextella Santschi**

Fig. 5 (9-14)

Straight, subcylindrical, and rather stout; ends rounded; head and prothorax slightly bent ventrally; head anteroventral; no neck. Anus posteroventral. Leg, wing, and gonopod vestiges present. Segmentation indistinct. Spiracles unequal in size, the first the largest, the tenth the smallest. Body hairs sparse, somewhat more abundant on the prothorax. Of three types: (1) A very few simple, minute (0.018-0.054 mm), flexible hairs on the ventral surface of the thorax; (2) hairs with denticulate tip, short (0.036-0.081 mm), generally distributed; (3) nearly straight two-hooked uncinuate hairs, mod-

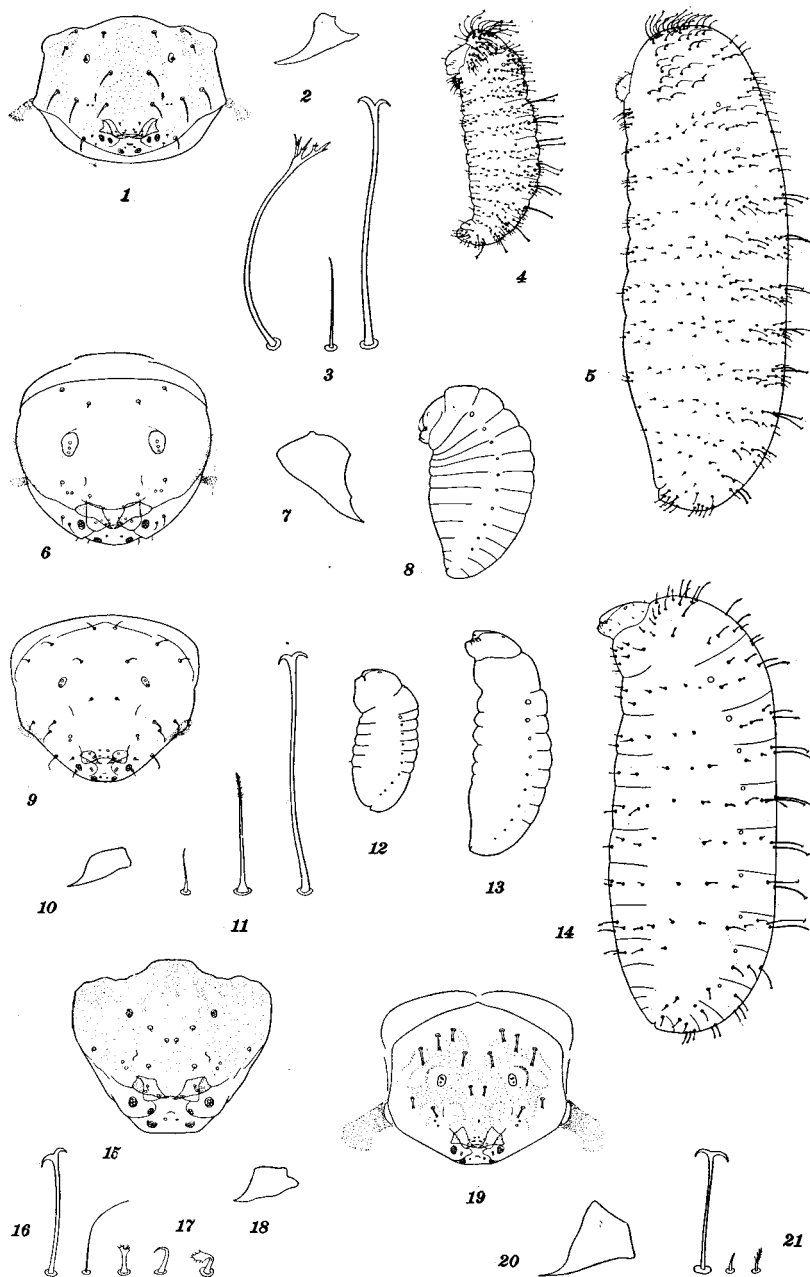


FIG. 5.—1-5, *Crematogaster* (*Crematogaster*) *acuta* (Fabricius): 1, Head in anterior view, $\times 86$; 2, left mandible in anterior view, $\times 216$; 3, three body hairs, $\times 185$; 4, young larva in side view, $\times 20$; 5, mature larva in side view, $\times 20$. 6-8, *C. (Orthocrema) minutissima missouriensis* Emery: 6, Head in anterior, $\times 95$; 7, right mandible in anterior view, $\times 216$; 8, young larva in side view (hairs omitted), $\times 33$. 9-14, *C. (O.) limata dextella* Santschi: 9, Head in anterior view, $\times 95$; 10, left mandible in anterior view, $\times 216$; 11, three body hairs, $\times 185$; 12, very young larva in side view (hairs omitted), $\times 32$; 13, young larva in side view (hairs omitted), $\times 32$; 14, mature larva in side view, $\times 32$. 15-17, *C. (O.) brevispinosa* Mayr: 15, Head in anterior view, $\times 167$; 16, three types of body hairs, $\times 185$; 17, the fourth type of body hair, $\times 185$; 18, left mandible in anterior view, $\times 216$. 19-21, *C. (Physocrema) deformis* F. Smith: 19, Head in anterior view, $\times 76$; 20, left mandible in anterior view, $\times 216$; 21, three body hairs, $\times 185$.

erately long (about 0.18 mm), about four in a row across the dorsal surface of each abdominal somite I-V. Head subhexagonal in anterior view, narrowed ventrally; dorsal and ventral outlines convex; breadth about equal to length; dorsal and dorsolateral areas thin and depressed; mouth parts very small. Inside the head, just above the level of the mouth parts, there is a slender transverse sclerotic bar; each end of the bar turns upward and comes to the surface in the gena. Antennae small, with two sensilla each. Head hairs sparse, short (about 0.018 mm), simple and slightly curved. Labrum very small, short (breadth $3\frac{1}{2}$ times length), bilobed due to a deep concave incision of the ventral border; anterior surface with four isolated and two agglomerated sensilla on each half; posterior surface with two isolated sensilla on each half; ventral border with a few spinules. Mandibles very small, moderately sclerotized, with a moderately wide base tapering to a sharp point, which is slightly curved medially. Maxillae small; apex paraboloidal and directed medially; palp represented by three agglomerated sensilla; galea represented by two agglomerated sensilla. Labium small; palp represented by three agglomerated sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit. (Material studied: Numerous larvae from Panama Canal Zone.)

JUST-HATCHED LARVA: Length 0.6 mm. Head on the anterior end; relatively large; apparently without hairs. Body almost hairless; the uncinate hairs of the adult are represented by small tubercles, each surrounded by its alveolus and articular membrane.

YOUNG LARVA: Length about 1.0 mm. Similar to the mature larva but the head relatively larger and on the anterior end; body hairs relatively longer and seemingly more abundant. Segmentation distinct on the anterior half.

Crematogaster (Orthocrema) brevispinosa Mayr

Fig. 5 (15-18)

SEXUAL FORM: Plump, chunky, and turgid; subovoidal, narrowed anteriorly; head ventral, near the anterior end. Anus posteroventral. Spiracles unequal in size; the first much the largest, the rest approximately equal. Integument of the posterior abdominal somites spinulose. Body hairs sparse, of four types: (1) Simple and very slender, a few on the lateral and dorsal surfaces, 0.018-0.07 mm long; (2) with the apex

broad, flat and denticulate, minute (about 0.018 mm), a few on the ventral surface of the mesothorax, metathorax and abdominal somites I-IX; (3) minute (about 0.018 mm), stout, with frayed tip, on the dorsal surface of the prothorax, mesothorax and abdominal somites IX and X, and on the ventral surface of the prothorax and abdominal somite X; (4) nearly straight two-hooked uncinate hairs, short (about 0.087 mm), three or four in a row across the dorsal surface of each abdominal somite I-V. Head subtrapezoidal in anterior view (but with a median dorsal truncate production), narrowed below; about as long as broad; integument somewhat sclerotized. Antennae minute, with three or four sensilla. Head hairs very few minute (about 0.006 mm) and simple. Labrum very small, short (length one-third the width), bilobed due to the concavity of the ventral border; anterior surface with two sensilla on each half; posterior surface with eight scattered sensilla; ventral border with a few spinules. Mandibles small; moderately sclerotized; basal two-thirds slightly inflated; apical one-third slightly curved medially and tapering rapidly to a sharp point. Maxillae small; apex paraboloidal and directed medially; palp represented by four agglomerated sensilla; galea represented by two agglomerated sensilla. Labium small; palp represented by four agglomerated sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit. (Material studied: Several larvae from Panama Canal Zone.)

Crematogaster (Orthocrema) brevispinosa tumulifera Forel

Similar to *brevispinosa* s. str. (Material studied: Several sexual larvae from Panama).

Crematogaster (Orthocrema) dispar Forel

Wheeler (1933, p. 89) stated that the queen larvae of a variety of this species "were nearly spherical and resembled pearls."

Crematogaster (Orthocrema) minutissima missouriensis Emery

Fig. 5 (6-8)

Leg and gonopod vestiges present. Spiracles unequal in size, the first much the largest, the rest diminishing gradually. Integument of the dorsal surface of the posterior somites sparsely spinulose, the spinules isolated and rather coarse. Head subcircular in anterior view, with the dorsal region thin and depressed. A slender sclero-

tized bar extends, just inside the gena, from the mandible to the level of the antennae; at its middle a stouter branch passes out and enters the prothorax. Antennae moderately large and drumlin-shaped, with three sensilla each. Labrum small, width 2.7 times the length, bilobed owing to the concavity of the ventral border; anterior surface of each half with four or five isolated and two agglomerated sensilla; posterior surface with four isolated sensilla on each half. Mandibles small, moderately sclerotized, subtriangular, with the apex slightly curved medially; medial border bearing a low, blunt tooth. Maxillae small; apex paraboloidal; palp a low knob bearing four or five sensilla; galea represented by two agglomerated sensilla. Labium small; palp a low knob bearing four sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit.

YOUNG LARVA: Length 0.77 mm. Plump and chunky, dorsal profile C-shaped, ventral profile sinuous; head ventral, near the anterior end; posterior end round-pointed. Anus ventral. Segmentation distinct on the anterior half; indistinct posteriorly. Other characters apparently as in the mature larva. (Material studied: One mature larva, one semipupa and a dozen young—all damaged—from Oklahoma.)

Crematogaster (Orthocrema) quadriformis roveretoi Forel

Eidmann, 1936, p. 42: "Die Larven sind spärlich behaart und zeigen im übrigen keine bemerkenswerten Besonderheiten."

Crematogaster (Physocrema) deformis F. Smith
Fig. 5 (19-21)

Plump, chunky, and turgid; straight and subellipsoidal; head flattened against the ventral surface near the anterior end. Anus ventral. Leg and gonopod vestiges present. Segmentation indistinct. Spiracles unequal in size, the first much the largest, the rest diminishing gradually. At the posterior border of each thoracic somite in the ventrolateral portion of the intersomitic groove is an integumentary structure that looks like a series of transverse folds or ridges; also in the intersomitic grooves between the thoracic and between the anterior abdominal somites are dark staining (with acid fuchsin) transverse bands on the dorsal and ventral surfaces. Body hairs exceedingly sparse, most abundant on the ventral surface of the prothorax. Of three types:

(1) Simple, minute (0.009–0.018 mm); (2) stout, denticulate or with frayed tip, minute (about 0.018 mm), on the ventral surface; (3) nearly straight two-hooked uncinuate hairs, about 0.09 mm long, about four in a row on the dorsal surface of each abdominal somite I–V. Head subhexagonal in anterior view; integument sclerotized; from each ventrolateral corner of the head a large sclerotized structure passes out and enters the prothorax; mouth parts small. Antennae small, with three sensilla each. Head hairs sparse and short (0.018–0.036 mm), stout, with the tip frayed. Labrum very small, short (width $3\frac{1}{2}$ times the length), bilobed due to a concavity of the ventral border; each half of the anterior surface with three isolated and two agglomerated sensilla; posterior surface with one sensillum on each half. Mandibles small, subtriangular; base broad; tapering to a long slender sharp point, which is curved medially. Maxillae small, apex paraboloidal and directed medially; palp a slightly raised cluster of four agglomerated sensilla; galea represented by two agglomerated sensilla. Labium small; palp a slightly raised cluster of four agglomerated sensilla; a minute sensillum between each palp and opening of sericteries; the latter a short transverse slit. (Material studied: Seven damaged integuments from Java.)

Crematogaster (Sphaerocrema) striatula Emery

Eidmann, 1944, p. 448: "Eben geschlüpfte Eilarven . . . fallen durch ihre gedrungene, kaum gekrümmte Gestalt auf, die Rückseite der Abdominalsegmente ist mit Reihen grosser ankerförmiger Oncochäten besetzt."

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