

THE LARVAE OF THE ARMY ANTS

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Army ants are among the most notorious insects of the tropics. They have been written about by travelers and studied by entomologists for more than a century. But their larvae, by contrast, are seldom seen and have received comparatively scant attention even from myrmecologists.

Army ants belong to the Subfamily Dorylinae. The most conspicuous genera are *Dorylus* in the Old World tropics and *Eciton* in the Neotropical and southern Nearctic Realms. Less common is the Old World *Aenictus*. *Cheliomyrmex* is found only in the warmest parts of the Neotropical and is only locally abundant. The African *Aenictogiton* is known only from males. The genus *Leptanilloides* is known only from a few workers of the type species collected in Bolivia and its position in the Dorylinae is uncertain. *Leptanilla*, formerly regarded as a doryline, is now placed in a separate subfamily.

In this paper the larvae of thirteen species in four genera have been described. In addition I have included all the references to doryline larvae that I have been able to find in the literature.

Subfamily **Dorylinae** Leach

Larvae elongate, slender, subcylindrical; with a slight progressive attenuation toward the anterior end; nearly straight but with the anterior end slightly curved ventrally; orthocephalic.¹ Twelve or thirteen distinct somites. Spiracles minute. Vestigial legs relatively large and conspicuous. Hairs short; sparse to moderately abundant; mostly simple (but branched or plumose in *Acamatus*). Head large, with short simple hairs. Antennae with two sensilla each. Mandibles poorly developed; of two types—elongate, slender, slightly curved and denticulate, or short, small, acuminate and feebly sclerotized. Maxillary palps wanting or represented by a more or less elevated group of sensilla. *Trophorhinium*² poorly developed or absent.

Wheeler (1922, p. 39) describes the larvae of the Dorylinae as "more or less cylindrical, with short hairs, without hooked setae; mandibles small, slender, falcate." Forel, 1928, Vol. I, p. 131 = 1921, Tome I, p. 136: "More or less cylindrical, with short hairs and no hooked hairs" ("plus ou moins cylindriques, à poils courts, sans poils d'accrochage").

Emery (1904, p. 115) describes the doryline type as having a "forma sottile, quasi cilindrica."

Gallardo, 1920, p. 309: "Larvas más o menos cilíndricas, con pelos cortos, sin pelos para engancharse."

¹*Orthocephalic*, having the head at the anterior end of the body, in contrast with *hypocephalic*, having the head apparently on the ventral surface near the anterior end.

²*Trophorhinium*, a term applied by Wheeler (1920, p. 257) to the aggregate of roughened surfaces of the mouth parts which might be used in triturating food.

"The less independent larvae of the Dorylinae receive from their ♀ balls of food prepared beforehand from the prey." Forel, 1928, Vol. I, p. 516=1922, Tome 3, p. 136: "Moins indépendantes, les larves des Dorylinae reçoivent de leurs ♀ des boulettes alimentaires toutes préparées faites avec des proies." Additional notes from Wheeler and Bailey on feeding may be found below under Eciton.

Wheeler found the larvae of the Dorylinae and those of the Cera-pachyinae to be extremely alike. "The mandibles are small, narrow, pointed and rather feebly chitinized, and I have failed to find a trophorhynchium in either group. Apparently the young are fed only on soft food." (1920, p. 50).

KEY TO THE GENERA OF DORYLINE LARVAE

1. Body relatively enormous; anterior end bent ventrally at an angle of 90°; terminal somite a very slender conical "tail"..... ♂ of **Dorylus**
Not as above..... 2
2. Maxillary palp represented only by scattered sensilla..... **Dorylus** (**Anomma**)
Maxillary palp, a conspicuous, compact group of sensilla, which is more or less elevated..... 3
3. Integument of body with neither spinules nor papillae..... **Aenictus**
Integument with numerous minute spinules or papillae arranged in rows.... 4
4. Integument papillose..... **Eciton s. str.** and **E. (Labidus)**
Integument spinulose..... 5
5. With only simple hairs on the body..... **Cheliomyrmex**
With both simple and branched hairs on the body..... **Eciton (Acamatus)**

Tribe **Cheliomyrmecini** Wheeler

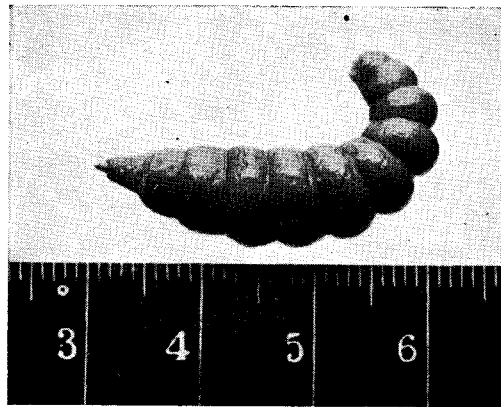
Genus **Cheliomyrmex** Mayr

Body hairs sparse, short, simple, flexuous. Integument spinulose. Head hairs numerous. Mandibles small, simple, acuminate, sharp-pointed, feebly sclerotized. Maxillary palp represented by a large convex, elliptical area bearing 11-15 sensilla.

C. megalonyx Wheeler.—Figs. 14-18. Moderately stout; orthocephalic; pro- and mesothorax slightly inclined ventrally forming an angle with the rest of the body, which is straight; thickest at the fourth abdominal somite, somewhat attenuated toward either end; posterior end bluntly pointed; anus subterminal; vestigial legs large rounded elevations. Minute vestigial gonopods on the seventh, eighth, and ninth abdominal somites. Twelve distinct body segments. Body rather sparsely clothed with simple flexuous hairs about 0.1 mm. long, arranged in bands around the middle of each segment; the anterior and posterior margins of each segment naked, except on the terminal segment where the hairs are uniformly distributed. Integument of body (but not of head) roughened with short transverse rows of exceedingly minute spinules, 3-6 in each row. Head large, cranium in anterior view subtrapezoidal, a trifle broader than long, broadest just above the level of the antennae; posterior angles broadly rounded. Head beset with numerous short (about 0.04 mm.) simple hairs. Antennae situated quite low on the cranium; each with two sensilla. Labrum small, transverse, twice as broad as long, appearing in profile as a short thick flap with the free edge rounded; the dorsal

surface bearing several short hairs, the ventral spinules in short arcuate rows. Mandibles small, simple and feebly sclerotized; basal half dilated; apical half acuminate. Maxillae large, subtriangular in anterior view, bearing a few small hairs; palp represented by an elevated elliptical area bearing 11-15 sensilla; galea a small papilla bearing two apical sensilla. Labium with the free end broadly rounded; palp represented by a minute circular elevation bearing four or five sensilla, and a single isolated sensillum nearby. Trophorhinium consisting only of the spinules on the ventral surface of the labrum. (Material studied: numerous specimens from British Guiana.)

In a recent paper (1938, p. 140) I have referred to the vestigial legs of this same species.



Text Figure 1. Male larva of *Dorylus (Anomma) wilverthi* Emery, photographed beside a centimeter scale. $\times 1\frac{1}{2}$.

Tribe Dorylini Forel

Genus *Dorylus* Fabricius

Body hairs sparse, short, simple, flexuous. Integument without spinules or papillae. Head hairs few. Mandibles small, simple, acuminate, sharp-pointed, feebly sclerotized. Maxillae and labium inflated; typical palps and galeae lacking; numerous sensilla scattered over the surfaces.

Forel (1928, Vol. II, p. 298=1923, Tome 5, p. 116) states that the larvae of *Dorylus (Anomma)* "are much less nimble and more dependent upon the workers than those of the Ponerinae" ("bien moins ingambes et plus dépendantes des δ que celles des Ponerinae").

D. (*Anomma*) *wilverthi* Emery.—Figs. 1-6. Slender, subcylindrical, orthocephalic, nearly straight but with the anterior end somewhat attenuated. Thirteen distinct postcephalic somites, the prothorax being the longest. Anus terminal. Vestigial legs relatively large convex elevations. Body beset with a very few simple hairs.

Head large; in anterior view somewhat longer than broad, with the cranium subhexagonal and bearing four groups of sensilla and a few simple hairs about 0.09 mm. long. Antennae large and convex, each with two sensilla. Front bulging and convex. Labrum transverse, short, and very thick; narrowed distally, with the anterior angles rounded; anterior surface bearing eight hairs similar to those on the cranium; numerous sensilla on the distal surface and two on the posterior surface. Mandible small and feebly sclerotized, with the base slightly expanded and the apex slender, straight, and acute. Maxillae inflated and subglobular, furnished with a few simple hairs; palp represented by a loose cluster of 14–21 sensilla, one of which is mounted on a small projection; galea a short, rather stout papilla, apparently without sensilla. Labium with the prementum swollen, moderately large, and feebly impressed at the middle of the distal surface; postmentum inflated and sagging; palp represented by a diffuse cluster of sensilla, some of which bear a spinule; opening of sericteries a long transverse arcuate groove. Trophorhinium wanting. (Material studied: Four slightly damaged specimens from the Belgian Congo.)

A number of years ago I had the opportunity of photographing (Text fig. 1) a male larva of this species from the Belgian Congo, but was unable to obtain the specimen for further study. Apparently it is indistinguishable from the male of *D. molesta* described below.

There is a reference in my paper on vestigial legs (1938, p. 140) to the above species.

D. (Anomma) nigricans Illiger.—Forel (1912, Pl. I, fig. 6) has figured a semipupa.

D. (Anomma) nigricans var. **molesta** (Gerstäcker). *Male*.—Fig. 7. Size enormous (relative to worker); length of mid-dorsal line 47 mm.; maximum diameter (at 5th abdominal somite) 8.8 mm. Body moderately stout, subcircular in cross-section, tapering gradually toward the ends, which are both acute. Anterior portion, *i. e.*, first six somites, bent ventrally at an angle of 90 degrees. Thirteen distinct somites. Terminal somite having the shape of a slender cone—much more slender than the penultimate somite, into which it is partially retractile. Penultimate somite having a shape somewhat like the

EXPLANATION OF PLATE I

Dorylus, *Aenictus*, and *Cheliomyrmex*

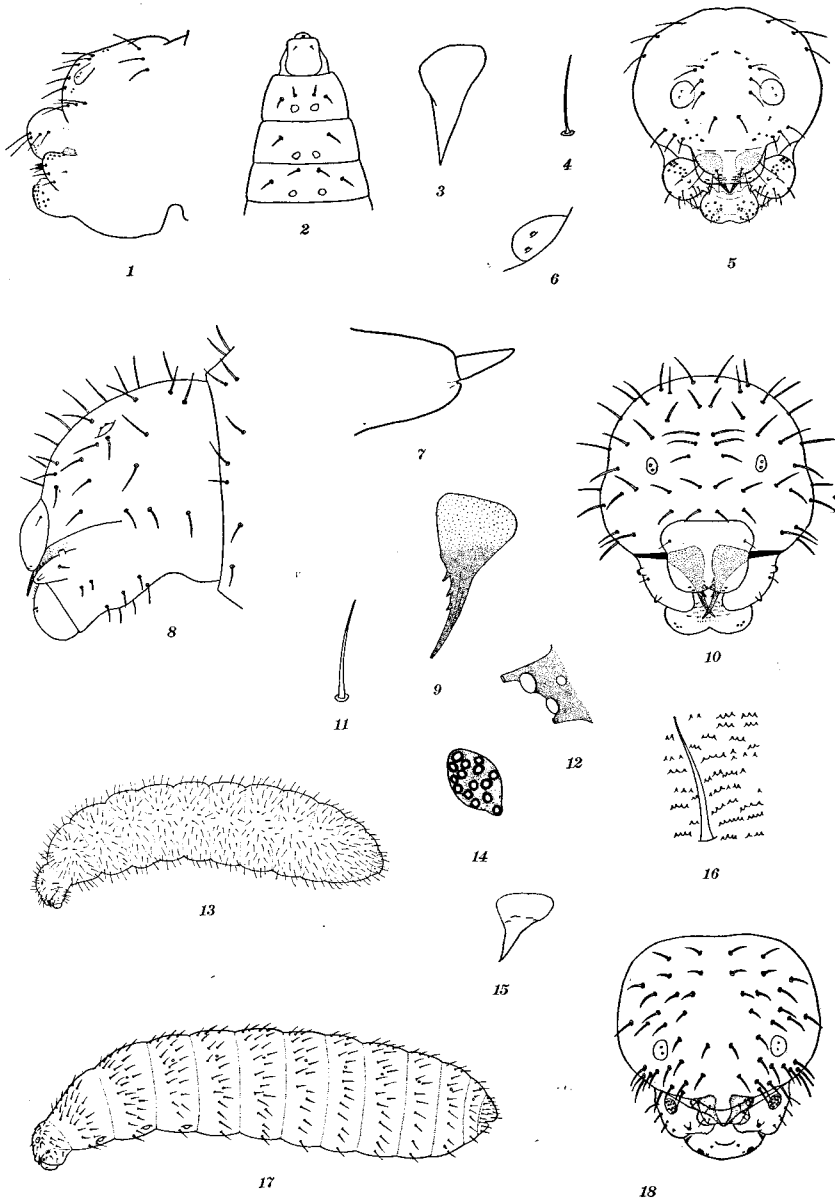
Dorylus (*Anomma*) *wilverthi* Emery, Figs. 1–6. 1, head in side view, $\times 53$; 2, head and thorax in ventral view, $\times 17$; 3, mandible in anterior view, $\times 133$; 4, body hair, $\times 185$; 5, head in anterior view, $\times 53$; 6, antenna in side view, $\times 175$.

Dorylus (*Anomma*) *nigricans* var. *molesta* (Gerstäcker), ♂. Fig. 7, last two somites in side view, $\times 4$.

Aenictus (*Typhlatta*) *leviceps* (F. Smith), Figs. 8–10. 8, head in side view, $\times 91$; 9, mandible in anterior view, $\times 197$; 10, head in anterior view, $\times 91$.

Aenictus (*A.*) *aratus nesiotis* var. *fraterculus* Wheeler, Figs. 11–13. 11, body hair, $\times 253$; 12, maxillary palp, $\times 333$; 13, larva in side view, $\times 17$.

Cheliomyrmex *megalonyx* Wheeler, Figs. 14–18. 14, maxillary palp, $\times 211$; 15, mandible in anterior view, $\times 133$; 16, body hair and integumentary spinules, $\times 181$; 17, larva in side view, $\times 14$; 18, head in anterior view, $\times 61$.



frustrum of a cone; anus on the apical end beneath the base of the terminal somite. Spiracles exceedingly minute in proportion to body size. No hairs on body. Head relatively very small, the maximum breadth being only 0.6 mm. The head is, in fact, so small and delicate in proportion to the vast bulk of the body that it is easily broken off from preserved larvae, especially when shipped in vials with other specimens. Most of the larvae available to me have therefore been decapitated. On the basis of inadequate material, the head seems to be quite similar to that of the worker larva of *D. wilverthi*. (Material studied: several larvae collected in Kenya by G. van Someren and made available to me through the courtesy of Dr. N. A. Weber.)

D. (D.) affinis Shuckard.—Emery (1901) has figured (Pl. II) a ♂ semipupa in side view (fig. 1), head of same in side view (fig. 2), ventro-lateral view of head (fig. 3), and mouth parts in side view (fig. 4). His description (p. 429) follows:

“Queste larve sono tutte bianchissime, subcilindriche, debolmente assottigliate in avanti, coi segmenti poco marcati. Sono fornite di peli piuttosto lunghi, ma semplici e poco numerosi, disposti in zone segmentali che si riducono a semplici serie trasversali sui segmenti posteriori del corpo. Il capo é piccolo, ritondato. Labbro superiore e mascelle sono ritondati, queste sono fornite di alcune papille non colorate né notevolmente sporgenti, ultimo rudimento forse delle due punte che offrono nelle larve delle Ponerine. Il labbro inferiore costituisce anch'esso una sporgenza rotonda, un poco incavata nel mezzo superiormente, ed é fornito di peli e di alcune piccole papille; nessun vestigio di filiera. Le mandibole sono molto piccole, acuminate, brune. Al disopra della bocca, il capo presenta un paio di piccole sporgenze lenticolari che credo debbansi considerare come rudimenti di antenne. Se si esamine una larva in cui le antenne dell'immagine siano già formate, ma il capo non si sia ancora staccato dalla cuticola larvale, l'estremità delle antenne corrisponde ai rudimenti anzidetti.”

Tribe **Ecitonini** Forel

Body hairs moderately abundant; short, simple or branched. Head hairs simple. Mandibles elongate, slender, slightly curved, with the medial border denticulate.

EXPLANATION OF PLATE II

Eciton

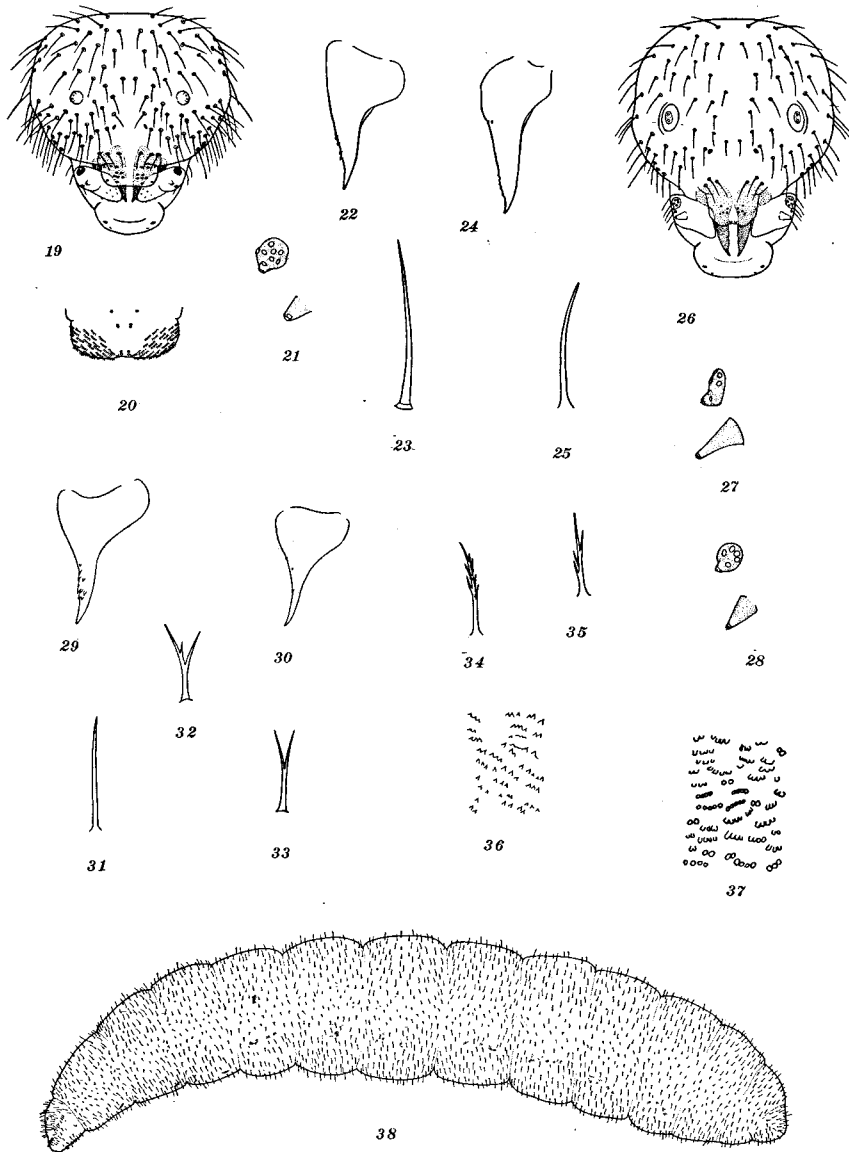
Eciton (*E.*) *hamatum* (Fabricius), Figs. 19-23 and 38. 19, head in anterior view, $\times 49$; 20, labrum in posterior view, $\times 87$; 21, maxillary palp and galea, $\times 167$; 22, mandible in anterior view, $\times 108$; 23, body hair, $\times 185$; 38, larva in side view, $\times 12$.

Eciton (*Labidus*) *coecum* (Latreille), Figs. 24-28. 24, mandible in anterior view, $\times 153$; 25, body hair, $\times 185$; 26, head in anterior view, $\times 73$; 27, maxillary palp and galea in profile, $\times 187$; 28, maxillary palp and galea in face view, $\times 187$.

Eciton (*Acamatus*) *schmitti* Emery, Figs. 29-33. 29, mandible of ♂ in anterior view, $\times 83$; 30, mandible of ♀ in anterior view, $\times 167$; 31-33, body hairs, $\times 185$.

Eciton (*Acamatus*) *pilosum* F. Smith, Figs. 34-36. 34-35, body hairs, $\times 185$; 36, integumentary spinules, $\times 185$.

Eciton (*E.*) *burchelli* (Westwood), Fig. 37, integumentary papillae, $\times 181$.



Genus *Aenictus* Shuckard

Body hairs simple. Integument without spinules or papillae. Hairs of head few. Labrum large and conspicuous. Maxillary palp represented by three subconical sensilla fused into an irregular projection.

A. (Typhlatta) leviceps (F. Smith).—Figs. 8–10. Slender, subcylindrical; diameter greatest at the fifth abdominal somite; orthocephalic, nearly straight but slightly curved ventrally toward the anterior end; posterior end bluntly rounded. Twelve distinct postcephalic somites. Anus terminal. Vestigial legs small and papilliform. Body and head furnished with a moderately dense covering of simple, slightly curved hairs about 0.05 mm. long. Cranium subtrapezoidal in anterior view with the posterior border broadly rounded and the genae bulging. Antennae small, each with two sensilla. Labrum convex; somewhat broader than long, being broadest above the mandibles; distal border emarginate at the middle; lateral borders feebly emarginate over the mandibular bases; anterior angles broadly rounded; eight spinulose sensilla along the distal border. Mandibles rather heavily sclerotized; base dilated, distal portion very long and slender and curved posteriorly; apex acute; three small teeth near the middle of the medial border. Maxillae round-pointed; palp short and thick with three distal sensilla; galea somewhat more slender, subconical, with one apical sensillum. Labium swollen, protruding, bilobed; palps represented by two clusters of three sensilla each; anterior surface roughened with short rows of spinules; opening of sericteries not evident. Trophorhynchium poorly developed, including only the spinulose surface of the labium. (Material studied: numerous specimens from the Philippine Islands.)

A. (T.) martini Forel.—Similar to *A. leviceps*. (Material studied: numerous specimens from the Philippine Islands.)

A. (A.) aratus nesiotis var. **fraterculus** Wheeler.—Figs. 11–13. Similar to *A. leviceps*, but the maxillary palp and galea are larger and the former bears six sensilla. (Material studied: numerous specimens from the Philippine Islands.)

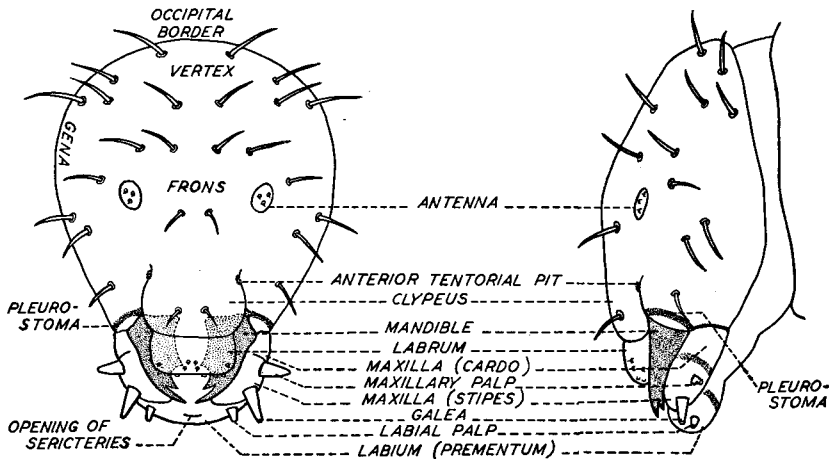
Genus *Eciton* Latreille

Body with simple hairs (*Eciton s. str.* and *Labidus*) or with both simple and branched hairs (*Acamatus*). Integument papillose (*Eciton s. str.* and *Labidus*) or spinulose (*Acamatus*). Labrum small and inconspicuous. Maxillary palp represented by a discoidal area bearing 5–9 sensilla.

Escherich (1917, p. 95) characterizes *Eciton* larvae as “*annähernd zylindrisch*.”

Forel (1928, Vol. II, p. 298=1923, Tome 5, p. 116) states that the larvae of *Eciton* “are less nimble and more dependent upon the worker than those of the *Ponerinae*” (“*bien moins ingambes et plus dépendantes des ♀ que celles des Ponerinae*”). Wheeler (1910, p. 72) describes the larvae of this genus as cylindrical and states (p. 263) that those of Texan species are slender.

E. (E.) hamatum (Fabricius).—Figs. 19–23 and 38. Slender, sub-cylindrical, orthocephalic; with the anterior end slightly curved ventrally and the rest of the body nearly straight; thickest at the sixth abdominal somite, attenuated toward either end; posterior end bluntly pointed. Vestigial legs relatively large (diameter 0.05 mm.) rounded elevations. Anus ventral. Thirteen distinct postcephalic somites, the terminal small. Body provided with a moderately dense covering of short (0.025–0.12 mm.) simple hairs, which are uniformly distributed. Integument of body beset with short transverse rows of minute papillae, 3 or 4 in each row. Head small, cranium transversely subelliptical in anterior view; rather thickly beset with simple hairs about 0.1 mm. long. Antennae in the form of a minute paraboloid bearing two minute sensilla and mounted eccentrically on a low



Text Figure 2. Synthetic head of an ant larva to illustrate terminology.

elevation. Labrum small, thick, twice as broad as long, with the distal border nearly straight; numerous sensilla on the dorsal surface, a few on the ventral surface and distal border; ventral surface roughened with short arcuate rows of spinules. Mandibles long and narrow with the base dilated, feebly sclerotized and somewhat variable in shape; the apical portion slender and slightly curved medially but not posteriorly; medial borders sparsely denticulate. Maxillae large; the stipes conoidal and furnished with a few spinules; palp a discoidal area bearing one ungulate and 4–8 discoidal sensilla; galea a truncate cone with two apical sensilla. Labium prominent; the prementum subhemispherical; palp a group of four sensilla, three of which form a compact cluster, the fourth isolated; opening of sericteries a long transverse, arcuate slit. Trophorhynchium consisting of the spinulose ventral surface of the labrum and the spinules on the maxillae. (Material studied: numerous specimens from the Panama Canal Zone.)

Schnierla has discussed the influence of larvae upon the behavior of the colony:

"The *Eciton* colony makes its nest by gathering into a cluster, and the site of this 'bivouac' changes from time to time. In *E. hamatum* and *E. burchelli* one may ascertain two conditions of general activity, which alternate according to the conditions of the brood. [Schnierla's footnote, p. 321: "W. Müller (Kosmos, 1886), from his study of an *Eciton burchelli* colony, was first to suggest the possibility of a relationship between the food-consuming ability of the *Eciton* colony, as affected by the presence of active larvae, and the general activity of the group."] The colony remains bivouacked in a given place, in the 'statory condition,' first when the eggs are present and during the period that precedes the development of the eggs into food-consuming larvae, and secondly during the period of about three weeks when the young are enclosed in cocoons. In contrast, the colony moves to a new bivouacked site each evening (is in the 'nomad condition') during the time the larvae are naked and consuming food, and again, after the brood has been hatched. Colonies in the statory condition are less active, and raid much less vigorously than when in the nomad condition." (1934, p. 319.)

"The nomadic phase is maintained as a result of the activity of developing larvae. . . . The movements of these larvae, particularly the active twisting movements of their anterior ends, shortly become an important source of stimulation to adult workers. For this it is important that the larvae as they grow larger and become more active are not massed together in the very center of the bivouac as before, but are held by individual workers or are piled up in small numbers in the spaces between ant-strands throughout the interior of the bivouac." (1938, p. 68.)

"To summarize, the foregoing theory is built upon the fact that a brood of larvae which contains many thousands of individuals all at the same stage in development, incidentally stimulates the adults through its activity and thereby greatly increases the general level of colony excitement. This accounts for the marked vigor of each day's raiding, and for the developments of raiding systems by great numbers of workers to an extent which makes a colony migration inevitable at the end of the day. When the maintaining cause ceases to function, colony excitement is markedly reduced and the value of raiding activity falls considerably below the threshold necessary for a general migration. Consequently the colony then enters a very different activity phase in which true migration does not occur." (1938, p. 75.)

In a recent paper (1938) I have described the vestigial legs (p. 140 and figs. 1, 2, and 3) and the vestigial gonopods (p. 141 and fig. 1) of this species. The absence of wing rudiments was also noted (p. 141).

The larval stage of *E. hamatum* lasts 20 days (Schnierla, 1938, pp. 58-61).

E. (E.) burchelli (Westwood). Fig. 37. The mature larva of this species is very similar to that of *E. hamatum*. The distal and lateral borders of the labrum are slightly concave; the maxillary palp has 6-9 sensilla; the galea is a trifle longer and more slender. (Material studied: numerous specimens from Trinidad collected by Dr. N. A. Weber.)

The young larva (i.e., 4-5 mm.) of *E. burchelli* resembles the mature

larva except as follows: the intersegmental furrows are impressed on the sides; the leg vestiges are small and feebly developed; the genae bulge at the level of the antennae; no spinules on the ventral surface of the labrum; the mandibles are a trifle stouter.

Emery (1899, p. 6) described the larva of *E. burchelli*: "Sono entrambe larve subcilindriche, coi segmenti tutti distinti; sono prive di tubercoli o altre appendici e fornite di peli numerosi, brevi e semplici, non esistono peli forcuti, ritorti o uncinati." On Pl. II he figured a larva in profile (fig. 6a), a head in profile enlarged (fig. 6b), mouth parts from in front (fig. 6c), and a mandible and maxilla in profile (fig. 6d).

In an article in the *Atlantic Monthly* (1919, pp. 454-464) Beebe has described (p. 463) cocoon-spinning by the larvae of *E. burchelli* (quoted also by Wheeler, 1921, p. 300). I am quoting it here by permission of the *Atlantic Monthly*:

"On the flat board were several thousand ants and a dozen or more groups of full-grown larvae. Workers of all sizes were searching everywhere for some covering for the tender immature creatures. They had chewed up all available loose splinters of wood, and near the rotten, termite-eaten ends, the sound of dozens of jaws gnawing all at once was plainly audible. This unaccustomed, unmilitary labor produced a quantity of fine sawdust which was sprinkled over the larvae. I had made a partition of a bit of a British officer's tent which I had used in India and China, made of several layers of colored canvas and cloth. The ants found a loose end of this, teased it out, and unraveled it, so that all the larvae near by were blanketed with a gray parti-colored covering of fuzz.

"All this strange work was hurried and carried on under great excitement. The scores of big soldiers on guard appeared rather ill at ease, as if they had wandered by mistake into the wrong department. They sauntered about, bumped into larvae, turned and fled. A constant stream of workers from the nest brought hundreds more larvae, and no sooner had they been planted and debris of sorts sifted over them, than they began spinning. A few had already swathed themselves in cocoons—exceedingly thin coverings of pinkish silk. As this took place out of the nest, in the jungle, they must be covered with wood and leaves. The vital necessity of this was not apparent, for none of this debris was incorporated into the silk of the cocoons, which were clean and homogeneous. Yet the hundreds of ants gnawed and tore and labored to gather this little dust, as if their very lives depended upon it. . . . When first brought from the nest, the larvae lay quite straight and still, but almost at once they bent far over in the spinning position. Then some officious worker would come along, and the unfortunate larva would be snatched up, carried off, and jammed down in some neighboring empty space, like a bolt of cloth rearranged upon a shelf. Then another ant would approach, antenna the larva, disapprove, and again shift its position. It was a real survival of the lucky, as to who should avoid being exhausted by kindness and over-solicitude. . . . There was no order of packing. The larvae were fitted together anyway, and meagerly covered with dust of wood and shreds of cloth. One big tissue of wood nearly an inch square was too great a temptation to be left alone, and during the course of my observation it covered

in turn almost every group of larvae in sight, ending by being accidentally shunted over the edge and killing a worker near the kitchen middens. There was only a single layer of larvae; in no case were they piled up, and when the platform became crowded, a new column was formed and hundreds taken outside. To the casual eye there was no difference between these legionnaires and a column bringing in booty of insects, eggs and pupae; yet here all was solicitude, never a bite too severe, or a blunder of undue force."

According to Wheeler and Bailey (1920, pp. 254-255) the stomach of the larval *E. burchelli* "is unlike that of any other known ant-larvae in being very long and slender and in having unusually thick, muscular walls. The larva is fed, apparently at considerable intervals, with rather large pellets consisting of the rolled up soft-parts of insects. These pellets are so compact that they retain their form in the narrow lumen of the stomach, where they lie in an irregular longitudinal series. Occasionally minute fragments of chitin or a few fungous spores are present, but owing to the feeble development of the larval mouth-parts so characteristic of the Dorylinae, it is evident that the worker must prepare these pellets by carefully trimming away the hard, chitinous portions of their insect prey and rolling up the denser, muscular portions of the flesh. The worker probably consumes much of the exuding juices while engaged in this operation and before stuffing the pellets into the gullets of the larvae."

The passage from Müller (1886, p. 87) referred to above in Schnierla's footnote under *E. hamatum* is as follows: "Der Punkt, wo der Wechsel eintritt, fällt ungefähr zusammen mit dem, wo sich die letzten Larven einspinnen, und dieses Zusammentreffen ist jedenfalls kein zufälliges. Larven brauchen ja im allgemein, besonders kurze Zeit vor der Verpuppung, bedeutend mehr Nahrung als die fertigen Insekten, und so scheint nichts natürlicher, als dass das Nahrungsbedürfnis der Gesellschaft ein geringeres wird und die Tiere entsprechend weniger auf Beute ausgehen, nachdem alle Larven eingesponnen."

Müller's paper bears the title "Beobachtungen an Wanderameisen (*Eciton hamatum* Fabr.)." Wheeler, however, has shown (1921, p. 293) that the species was in reality *E. burchelli*.

Müller described the larvae as "schlank" (p. 82). He observed (p. 89) that spinning and pupation of all larvae takes place within a comparatively short time; from this he concluded that all the individuals were of approximately the same age and that all eggs had been laid within the space of a few days. He also reported (p. 90) that the largest larvae spun first and developed into soldiers. Then followed the largest workers and after them the remaining workers; the younger the larvae were (or the later they pupated) the smaller were the emerging workers.

The specimens regarded by Müller (1886, p. 91 and fig. 2) and by Forel (1891, p. 163) as heteromorphic *Eciton* larvae are actually some ponerine larvae (*Pachycondyla*) which had been taken in a raid. (Emery, 1900, p. 513, and Wheeler and Long, 1901, pp. 168-172.)

Schnierla's discussion (1934, p. 319) of the influence of the larvae of *E. burchelli* upon the behavior of the colony may be found above under *E. hamatum*.

E. (E.) quadriglume dulcius var. **jujuyensis** Forel.—Gallardo (1920, p. 324) says of this form: "Se puede notar la esbeltez de las larvas que les permite una gran movilidad. . . ." Fig. 8 (on p. 322) is an excellent photograph of these larvae.

E. (E.) vagans (Olivier). These larvae are very similar to *E. hamatum*. (Material studied: numerous specimens from Trinidad collected by Dr. N. A. Weber.) In a recent paper (1938) I have figured (fig. 5) a section through an imaginal bud and vestigial leg.

E. (Acamatus) schmitti Emery—Figs. 29–33. Apparently similar to *E. hamatum*, except in the following characters. The body is densely and uniformly covered with hairs of two types: the majority are simple, straight or slightly curved, and 0.06–0.09 mm. long; a few are bifid or trifid and about 0.05 mm. long. The integument is furnished with short transverse rows of minute spinules. The labrum has 12 sensilla on the anterior surface and lacks spinules on the posterior surface. The apical portion of the mandibles is more slender; the point is more acute; and the denticles are minute and very few in number. The maxillae are without spinules; the palp bears 7 sensilla. Trophorhynchium wanting. (Material studied: 8 badly damaged specimens from Colorado).

I have studied a number of male larvae of this species extracted from cocoons 13 mm. long, which were collected in Texas by my brother, Dr. P. A. Wheeler. Since the larvae attain a length of 14–15 mm., the anterior end is sharply recurved to fit the shorter cocoon. In general, however, the shape is typically ecitonine. The wing rudiments appear as short transverse lines (grooves?); vestigial gonopods are wanting on the seventh and eighth abdominal somites and there is only a faint trace on the ninth. There are 13 distinct body somites. The body has a moderately dense covering of hairs which are uniformly distributed in transverse bands separated by naked zones along the shallow intersegmental furrows. These hairs are relatively minute (0.10–0.16 mm.), with the longest at the posterior end where they are flexuous with fine attenuate tips. So many hairs are broken off that the apparent absence of branched hairs is inconclusive; all remaining hairs are simple. The integumental spinules are like those of the worker. The heads of all my specimens are distorted by preservation but they seem to resemble the head of *E. hamatum*, except for genal bulges. The mouth parts resemble those of *E. hamatum* except as follows: the apical portion of the mandibles is more slender, with the denticles larger, more obtuse, and more numerous; the maxillae seems to lack spinules. The mandibles are relatively somewhat smaller than those of the worker.

In a recent paper (1938) I have described the wing rudiments (p. 141) and vestigial gonopods (p. 142) and figured the thorax of the above male in ventral view (fig. 4).

An examination of one damaged larva and one extra head of *E. (A.) sumichrasti* Norton (from Mexico) reveals its close similarity to the larva of *E. (A.) schmitti*.

E. (A.) pilosum F. Smith (figs. 34–36). The larva of this species is likewise similar to *E. (A.) schmitti*, but the hairs are all stiff and plumose and the maxillary palp has only five sensilla. This conclusion is based on eight unsatisfactory specimens from Paraguay.

Eciton (Labidus) coecum (Latreille).—Figs. 24–28. Resembles *E. hamatum*, except in the following characters. The covering of hairs is much less dense. On the thorax the hairs are 0.09–0.11 mm. long and resemble those of *E. hamatum* in form; on the abdomen they are shorter, (0.054–0.072 mm.), stouter, and stiffer, and taper abruptly to a short, sharp point. Hairs of head shorter (0.036–0.054 mm.). The breadth of the labrum is less than twice the length. No spinules were found on the maxillae. The maxillary palp bears six sensilla with the unguulate sensilla more elongate than in *E. hamatum*; the galea is longer and more slender. Opening of sericteries inconspicuous. (Material studied: numerous specimens from British Guiana collected by Dr. N. A. Weber.)

LITERATURE CITED

- Beebe, Wm. 1919. The home town of the army ants. *Atlantic Monthly*, 124: 454–464.
- Emery, C. 1899. Intorno alle larve di alcune formiche. *Mem. R. Accad. Sci. Ist. Bologna*, (5) 8: 3–10, 2 pls.
1900. Nuovi studi sul genere *Eciton*. *Mem. R. Accad. Sci. Ist. Bologna*, (5) 8: 511–526, 1 pl.
1901. Studi sul polimorfismo e la metamorfosi nel genere *Dorylus*. *Mem. R. Accad. Sci. Ist. Bologna*, (5) 9: 415–433, 2 pls.
1904. Le affinità del genere *Leptanilla* e i limiti delle *Dorylinae*. *Archivio Zoologico*, 2: 107–116, 9 fig.
- Escherich, K. 1917. *Die Ameise*. (2nd ed.), xvi & 348 p., 98 fig. Braunschweig: Friedr. Vieweg & Sohn.
- Forel, A. 1891. Ueber die Ameisensubfamilie der *Doryliden*. *Verh. Gesell. deutsch. Naturf. und Aerzte*, 63: 162–164.
1912. Die Weibchen der "Treiberameisen" *Anomma nigricans* Illiger und *Anomma wilverthi* Emery, nebst einigen anderen Ameisen aus Uganda. *Mitt. nat. Mus. Hamburg*, 29: 173–181, 1 pl., 3 text figs.
1921. Le monde social des fourmis du globe comparé à celui de l'homme. Tome 1, xiv & 192 p., 1 pl., 2 pl. col., 30 fig. Genève: Librairie Kundig.
1922. Le monde social des fourmis du globe comparé à celui de l'homme. Tome 3, vii & 227 p., 8 pl., 2 pl. col., 28 text fig. Genève: Librairie Kundig.
1923. Le monde social des fourmis du globe comparé à celui de l'homme. Tome 5, vi & 174 p., 1 pl., 2 pl. col., 30 text fig. Genève: Librairie Kundig.
1928. The social world of ants compared with that of men. Translated by C. K. Ogden. 2 vol., xiv & 551 p., xx & 445 p., 24 pl. (8 col.), 138 text fig. London and New York: G. P. Putnam's Sons, Ltd.
- Gallardo, A. 1920. Las hormigas de la República Argentina. Subfamilia *Dorilinas*. *An. Mus. Nac. Hist. Nat. Buenos Aires*, 30: 281–410, 35 fig., 3 maps.
- Müller, W. 1886. Beobachtungen an Wanderameisen (*Eciton hamatum* Fabr.). *Kosmos*, 18: 81–93.
- Schnieffer, T. C. 1934. Raiding and other outstanding phenomena in the behavior of army ants. *Proc. Nat. Acad. Sci.*, 20: 316–321, 2 fig.
1938. A theory of army-ant behavior based upon the analysis of activities in a representative species. *Jour. Comp. Psych.*, 25: 51–90, 2 fig.
- Wheeler, G. C. 1938. Are ant larvae apodous? *Psyche*, 45: 139–145, 2 pl.
- Wheeler, W. M. 1910. *Ants, their structure, development and behaviour*. xxv + 663 p., 286 fig. New York: Columbia University Press.
1920. The subfamilies of Formicidae, and other taxonomic notes. *Psyche*, 27: 46–55.
1921. Observations on army ants in British Guiana. *Proc. Amer. Acad. Arts Sci.*, 56: 291–328, 10 fig.
1922. The ants collected by the American Museum Congo Expedition. *Bull. Amer. Mus. Nat. Hist.*, 45: 39–269, 22 pl., 76 text fig., 41 maps.
- Wheeler, W. M. and Bailey, I. W. 1920. The feeding habits of the *Pseudomyrmex* and other ants. *Trans. Amer. Phil. Soc.*, (Art. 4): 235–278, 5 pls., 6 text fig.
- Wheeler, W. M. and Long, W. H. 1901. The males of some Texan *Ecitons*. *Amer. Nat.*, 35: 157–173, 3 fig.