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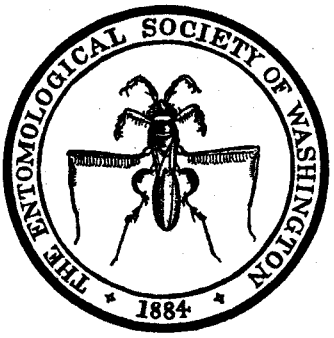

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THE ANT LARVAE OF THE SUBFAMILY DOLICHODERINAE[1]

(HYMENOPTERA, FORMICIDAE)

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The Dolichoderinae are one of the highly specialized subfamilies of Formicidae, surpassed only by the Formicinae. But they have become specialized mostly through reductions and losses rather than by elaborations. For example: no stridulating organ; no cocoon; sting vestigial; poison gland reduced; integument thinner and more pliable (and hence less opportunity for spines and sculpture).

Even their larvae show this same type of specialization: body length is reduced; mobility is almost lost; hairs are few, short and simple; labrum and mandibles are reduced in size and the latter are practically vestigial; the trophorhinium is poorly developed; palps and galea are little more than clusters of sensilla. About the only specializations by elaboration are the hooked hairs in *Azteca* and the bosses on the body in several other genera. The former are common among the Myrmicinae; the latter are simpler and show less variety than do the tubercles in the higher Ponerinae.

Myrmecologists have apparently never shown much enthusiasm for the Dolichoderinae. They have seemingly considered the ants of this subfamily from a sense of duty and usually as a part of some more inclusive study. This is rather to be expected, since the dolichoderines, with few exceptions, have little to offer in the way of interesting structures and habits. Their economic importance is generally slight, with the notable exception of the Argentine ant (*Iridomyrmex humilis*). They are primarily a tropical group, with few species ranging into temperate regions. And finally, the subfamily is a rather small one, though not one of the smallest.

In this article we have described the larvae of 35 species representing 12 of the genera. References from the literature are cited for 11 additional species, making a total of 46 species considered.

[1]The research on which this article is based was aided by a grant-in-aid from the Sigma Xi Research Fund.

Subfamily **DOLICHODERINAE** Forel

Plump, chunky and turgid; straight or slightly curved; mostly subellipsoidal, with both ends broadly and equally rounded; anterior end formed by the enlarged dorsal portion of the prothorax; head ventral, near the anterior end; no neck. Anus ventral. Leg vestiges present. Segmentation indistinct. Spiracles small, but not uniform in size; the first abdominal is the largest and the last abdominal the smallest. Body and head practically naked; hairs typically very few and widely scattered; exceedingly minute to short; simple, straight or slightly curved; base stout, tapering to a fine sharp-pointed apex. Head hairs generally like body hairs in size, shape and abundance. Labrum usually small, short and broad; breadth 2-6× the length; shape varied; anterior surface with sensilla and/or minute hairs; posterior surface with 6-12 sensilla near the middle; posterior surface usually spinulose, the spinules minute and inconspicuous, but generally arranged in rows. Mandibles small, short and feebly sclerotized; ratio of head width to mandible length = 4-10; ratio of mandible length to its width at the base = 0.8-1.7; basal portion inflated; distal portion slender, acuminate and usually appearing as an apical tooth; no teeth on the mesal border; surfaces rarely spinulose or denticulate; spinules (when present) few. Maxillae and labium rarely spinulose; spinules, if present, few and minute; palps and galea never paxilliform but represented merely by clusters of sensilla which are usually somewhat elevated; palps with 3-5 sensilla, galea two. Opening of sericteries small. Hypopharynx conspicuously spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. Food liquid; almost always of vegetable origin, regurgitated by the workers. Practically immobile when mature.

To most of the characters in the foregoing definition there are exceptions. *Leptomyrmex* is decidedly aberrant in the shape of body and head and in the uniformity in size of spiracles. Body hairs are rather numerous in *Leptomyrmex, Dorymyrmex, Araucomyrmex* and *Azteca instabilis*. Head hairs are very abundant in *Dolichoderus s. str.* We have found bifid hairs in only one species, (*Dolichoderus* (*Hypoclinea*) *plagiatus*), and oncochaetae only in *Azteca*. The labrum is narrow (breadth less than twice the length) in *Leptomyrmex* and *Bothriomyrmex*. The mandibles of *Leptomyrmex* are moderately large; those of *Liometopum, Araucomyrmex* and *Iridomyrmex nitidus* have a small tooth on the mesal border.

Athias-Henriot, 1947:— "Les larves de *Dolichodérinés* sont les plus immobiles et les plus simplifiées" (p. 253). Internal anatomy is discussed very briefly (pp. 259 and 263). "Il y a concordance de classement anatomique entre larves et adultes. Mais les Dolichodérinés possèdent des larves très évoluées, alors que les adultes sont plus primitifs que ceux des Formicinés" (p. 268).

Bischoff, 1927, p. 81:— "Die Larven von . . . der Dolichoderinen,

besonders *Tapinoma*, sind . . . so weit auf die Kropffütterung durch ihre Pflegerinnen eingestellt, dass ihre Mandibeln so gut wie funktionlos und unbeweglich geworden sind.'' The larvae are fed the fluid contents of the workers' crops (p. 384).

Brun, 1924, p. 95:— ''Die Fütterung wird nun bei den höheren Ameisen (Camponotinen, Dolichoderinen und Myrmicinen) gewöhnlich in der Weise vorgenommen, dass die fütternde Arbeiterin einen Tropfen Nahrungsflüssigkeit aus ihrem Kropfe ausbricht und denselben auf den Mund der Larve fallen lässt.''

Emery, 1899, p. 7:— Dolichoderine larvae do not spin cocoons.

Forel, 1921, p. 138:— ''Nymphes constamment dépourvues de cocon; larves en général immobiles.'' (=1928, Vol. I, p. 133: ''Nymphs consistently deprived of cocoons; larvae generally immobile.'')

Forel, 1922, p. 136:— ''Enfin les larves . . . sont nourries directement par leurs ☿, qui leur dégorgent le contenu de leur jabot.'' (=1928, Vol. I, p. 517: ''Lastly, the larvae . . . are directly fed by their ☿, which disgorge to them the contents of their crops.'')

Gantes, 1949:— ''Les *Dolichoderidés* ont des larves évoluées, immobiles'' (p. 84). ''Chez les *Dolichoderidés* les larves sont très évoluées avec encore une progression: *Bothriomyrmex* est plus primitif que *Tapinoma.*'' (p. 89).

Wheeler, 1922, p. 200:— ''The larvae are fed with liquid food, almost always of vegetable origin regurgitated from the nurse's crop; the *Aztecae* are mostly insectivorous.''

Wheeler, 1937, p. 38:— The larvae are fed by ''a careful administration *per os* of liquid food regurgitated from the nurse's crop.''

KEY TO THE GENERA OF MATURE DOLICHODERINE LARVAE IN OUR COLLECTION

1. Body hairs of two types: (1) simple and (2) spiral with hooked tip (oncochaetae) ..... *Azteca*, p. 192
   No hooked hairs 2
2. Body elongate and stout; dorsal profile strongly curved, ventral profile nearly straight; head guitar-shaped ..... *Leptomyrmex* p. 178
   Body and head not as above 3
3. Posterior end of body with a knob or cone 4
   Posterior end of body broadly rounded; without knob or cone 8
4. Low paired bosses on the dorsa of the anterior somites ..... *Engramma* p. 194
   Dorsa of somites without bosses 5
5. Posterior projection a cone pointing posteroventrally ..... *Dorymyrmex* p. 182
   Posterior projection a knob 6
6. Head hairs about 30 in number and about 0.036 mm long ..... *Araucomyrmex* p. 183
   Head hairs fewer and up to 0.018 mm long 7

7. Terminal segments turned dorsally and produced into a conspicuous knob; anus terminal ..... *Technomyrmex* p. 201
Knob a low swelling; anus ventral ..... *Tapinoma* p. 195
8. With six low rounded middorsal bosses, one each on the mesothorax, metathorax and abdominal somites I-IV ..... *Froggattella* p. 182
Without such bosses on the dorsal surface 9
9. With numerous (about 300) hairs on the head ..... *Dolichoderus* (*Dolichoderus*) p. 177
With fewer (not over 100) hairs on head 10
10. With lateral longitudinal welts continued over the anterior end of the body as a hood ..... *Dolichoderus* (*Monacis*) p. 176
Without lateral longitudinal welts continued into a hood 11
11. Slender distal portion of mandible about a third or less of the total length ..... *Iridomyrmex* p. 184
Slender distal portion of mandible about half the total length 12
12. Maxillae with a lateral patch of spinules between the palp and galea ..... *Liometopum* p. 181
Maxillae without spinules 13
13. Labrum with breadth 3-4X the length; bosses on prothorax low, not connected by a shelf ..... *Dolichoderus* (*Hypoclinea*) p. 172
Labrum with breadth only slightly greater than length; bosses on prothorax prominent and frequently connected by a shelf ..... *Eothriomyrmex* p. 189

Tribe **DOLICHODERINI** Emery

Genus **Dolichoderus** Lund

Subellipsoidal and nearly straight. A pair of ventrolateral bosses on the prothorax. Mandibles very small; base moderately dilated and relatively short, distal part slender, curved, sharp-pointed and relatively long. Palps represented by clusters of sensilla; galea by two sensilla.

This genus is particularly difficult to define. The common characters are subfamilial. Perhaps this is equivalent to saying that the genus is generalized. The subgenera are also troublesome. *Hypoclinea* is especially so because of the marked specific differences and because we lack mature larvae of most of the species.

Dolichoderus subgenus **Hypoclinea** Mayr

With lateral longitudinal welts, which are distinct in young larvae but inconspicuous when mature. Leg vestiges large. Body hairs few; minute to short; scattered but somewhat more abundant on the prothorax. Cranium subcordate in anterior view. Posterior surface of labrum spinulose. Galea represented by a cluster of two sensilla, which in some species is slightly elevated. Labial palp represented by a cluster of 3-5 sensilla, which is usually on a low elevation.

Dolichoderus (Hypoclinea) taschenbergi (Mayr)
(Pl. I, figs. 1-6)

Plump, chunky and turgid; subellipsoidal; anterior end formed by the enlarged dorsal portion of the prothorax; head ventral but near the anterior end; a pair of low ventrolateral bosses near the anterior margin of the prothorax; lateral longitudinal welts inconspicuous. Anus ventral. Leg vestiges large and protruding. Segmentation indistinct. Spiracles small, but not uniform in size; first abdominal the largest, eighth abdominal the smallest. Integument very thin; spinulose, except on the welts and around the hair-bases on the prothorax; spinules in transverse rows of 2-5. Body hairs exceedingly few; minute (0.006-0.018 mm long); simple; slightly curved or flexuous; widely scattered, except for a cluster of the longest hairs on the anterior portion of the ventral surface of the prothorax. Head subcordate in anterior view; maximum breadth equal to length; dorsolateral borders depressed; mouth parts small. Head hairs few; irregularly scattered; more numerous below the antennal level; short (0.006-0.036 mm); slightly curved or flexuous; basal half stout, distal half fine and lash-like. Each antenna with three minute discoidal sensilla, each of which bears a spinule. Labrum not distinctly marked off from clypeus; short and thick, breadth 3× length; bilobed due to a wide shallow impression of the ventral surface; eight sensilla on anterior surface near ventral border and five on each half of posterior surface near the middle; posterior surface sparsely spinulose, the spinules minute and in short rows running obliquely upward and outward from the middle. Mandibles very small and feebly sclerotized; acuminate; base moderately dilated; distal half very slender, curved, sharp-pointed; sometimes with a few small denticles on the medial surface. Maxillae feebly developed; apex paraboloidal, with a few scattered sensilla; palp represented by two or three sensilla in a cluster, which is sometimes on a slight elevation; galea represented by two sensilla. Labium very short and broad; palp a cluster of three minute sensilla; opening of sericteries a transverse slit. Hypopharynx with a few subtransverse rows of spinules, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from North Dakota.)

Queen larvae are similiar to worker larvae except for the larger body size and hence the relatively smaller head and hairs.

Wheeler, G. C., 1938, p. 141:—"In the sexual larva . . . the wing rudiments have a complicated internal cuticular structure."

Dolichoderus (Hypoclinea) bidens (Linnaeus)

Similar to *taschenbergi* except in the following characters: Body hairs short (0.018-0.072 mm); longest near the head; thick at base but tapering evenly and rapidly to a slender tip. Head hairs longer (0.018-0.072 mm). Labrum 4X as broad as long; not bilobed; six sensilla low on the anterior surface; posterior surface more densely spinulose. Maxillary palp a low elevation bearing 4 or 5 sensilla; galea represented

by two elevated sensilla. Hypopharynx with a few minute spinules which are isolated or in short rows. (Material studied: four damaged integuments from British Guiana.)

Dolichoderus (Hypoclinea) bituberculatus (Mayr)

Apparently similar to *taschenbergi* except as follows:—Body hairs few and exceedingly minute. Head hairs very few and exceedingly minute (about 0.009 mm.) Antenna small; each with three or four sensilla, each of which bears a spinule. Labrum 5½X as broad as long; subtrapezoidal in anterior view, narrowed below; ventral border nearly straight; anterior surface with about six sensilla and/or minute hairs; posterior surface with about eight sensilla near the middle and with minute spinules in short to long transverse subparallel rows; spinules continued onto the ventral surface. Mandibles with the base greatly inflated; distal half slender, acuminate, with needle-like point. Maxillae bulging laterally; with two sensilla and one minute hair between palp and galea; palp represented by three sensilla (one button-like) in a loose cluster; galea represented by two sensilla. Labrum with about six scattered sensilla and/or minute hairs; palp represented by a cluster of three sensilla (one button-like). (Material studied: two damaged integuments from Borneo.)

Goot, 1917 (translated from the Dutch original):—"The just hatched larva may be distinguished from the eggs by the somewhat pointed anterior end and sometimes by the indistinct segmentation of the anterior portion. The body is nearly naked; only the head and thorax show a number of short scattered erect hairs. The length is about 0.48 mm and the breadth 0.30 mm. During its later development the young larva keeps its place against the wall of the nest; it is practically immobile and is wholly dependent upon the care of the workers, which supply it regularly with liquid food and in case of danger remove it to safety. In captivity the workers feed the older larvae in part with freshly laid eggs from the same nest . . . As the larva grows it changes more and more into an unwieldy sausage-shaped blob[2] with rounded ends from which only the mouth parts on the under side of the head project as a small pellet. . . . The color of the growing larva changes gradually; at first almost watery transparent, it becomes by degrees a more opaque white. The full-grown larva is immobile and cylindrical, with equally rounded ends; its length is 2.3 mm, its breadth 1.1 mm. . . .The semipupa shows a constriction between the thorax and abdomen; its color is an opaque white but the thorax is always more glassy-transparent; its length is 2.5-2.6 mm. . . . The sexual larvae may be distinguished by their larger size in the latter part of their development. Apparently there are no other external morphological differences between the larvae of the several castes" (pp. 5-7). Life cycle (pp. 5-8): egg 12-16 days, average 14 days; larva 9-20 days, average 15 days; worker pupa 12-16

[2]The Dutch is quite intriguing at this point: *een plomp worstvormig klompje.*

days, average 14 days; total 37-52 days, average 43 days. Table 2 (p. 116) gives the duration of the larval periods of 29 larvae. Pl. I, fig. 2, a photograph of larvae and pupae of workers and queens.

Dolichoderus (Hypoclinea) championi Forel
(Pl. I, fig. 12)

Plump and chunky; nearly straight; not attentuated toward either end; ends round; enlarged dorsal portion of the prothorax forming a prominent welt across the anterior end; this welt continued along each side of the body to the posterior end. Anus ventral, with a conspicuous posterior lip. Other characters apparently as in the mature *taschenbergi* except as follows:—Labrum 6X as broad as long; subtrapezoidal, narrowed below; ventral border nearly straight; two minute hairs near the middle of the anterior surface. Distal portion of mandible shorter and less sharp at the tip. Maxillary palp a conoidal projection bearing four sensilla (one of which is apical); galea a low elevation bearing two sensilla. Labial palp a low elevation bearing four sensilla. (Material studied: four immature larvae from Panama.)

Dolichoderus (Hypoclinea) plagiatus (Mayr)
(Pl. I, figs. 7-11)

Plump and chunky; nearly straight; ends round; lateral longitudinal welts prominent. Head on anterior end. Anus ventral, with conspicuous anterior and posterior lips. Thirteen differentiated somites. Spiracles small, but not uniform in size; first abdominal the largest, eighth abdominal the smallest. Integument thin; spinulose, the spinules minute and isolated or in short rows anteriorly but larger, more numerous and in longer rows posteriorly. Body hairs few, most abundant on prothorax diminishing progressively toward the posterior end; short (about 0.035 mm); simple; slightly curved, with stout base, gradually attenuated to a very slender sharp tip; a few are bifid. Head a fourth broader than long; lateral borders and dorsal corners broadly rounded; occipital border concave; mouth parts small. Antennae large, elliptical, each with three sensilla, each of which bears a minute spinule. Head hairs numerous and uniformly distributed; short (about 0.036 mm); the majority have a stout base and taper rapidly to a long lash; a few are bifid. Labrum short and thick; breadth 3½X length; mostly concealed behind clypeus; bilobed due to a wide shallow impression of the ventral surface; about eight sensilla on the ventral surface; posterior surface of each half bearing a cluster of three sensilla near the middle, one or two sensilla near the ventral border and a few minute spinules in short oblique rows. Mandibles very small and feebly sclerotized; acuminate; base moderately dilated; distal half rather slender, slightly curved; sharp-pointed; median surface with minute denticles, a few lines (rows of spinules?) on the anterior surface. Maxillary palp a cluster of three sensilla on a low convexity; galea represented by two elevated sensilla. Labium short and broad; palp a discrete elevation bearing three sensilla;

opening of sericteries a transverse slit. Hypopharynx with subtransverse rows of spinules, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: five immature larvae from Michigan.)

Dolichoderus (Hypoclinea) scabridus Roger

Apparently similar to *taschenbergi* but differing in the following particulars: Integument beset with long (about 0.027 mm) hair-like spinules on the prothorax and on the mesothorax (but not on their lateral welts); elsewhere the spinules are exceedingly minute or lacking. Labrum 4X as broad as long; posterior surface more densely spinulose. Maxillae roughened with spinules in groups of two or three; palp a cluster of five elevated sensilla; galea two sensilla on a low elevation. Labium spinulose, the spinules in transverse rows of four or five; palp a cluster of five elevated sensilla. (Material studied: several damaged integuments from New South Wales.)

Dolichoderus subgenus **Monacis** Roger

With lateral longitudinal welts, which are distinct in young larvae but inconspicuous when mature. Prothorax as a whole forming a rounded collar about the head. Body practically naked; hairs few, exceedingly minute and widely scattered. Head practically naked; hairs very few and exceedingly minute. Cranium transversely subelliptical in anterior view. Labrum small; its posterior surface spinulose. Maxillae transversely subelliptical; palp represented by a cluster of 3-7 sensilla; galea by two sensilla. Labium small; palp represented by a cluster of three sensilla. Hypopharynx sparsely spinulose, the spinules arranged in rows.

Dolichoderus (Monacis) debilis Emery
(Pl. I, figs. 13-16)

Plump, chunky and turgid; subellipsodial; anterior end formed by the enlarged dorsal portion of the prothorax; head ventral but near the anterior end; a pair of ventrolateral bosses near the anterior margin of the prothorax; lateral longitudinal welts inconspicuous. Prothorax as a whole forming a rounded collar about the head. Anus ventral. Leg vestiges present. Segmentation indistinct. Spiracles small but not uniform in size; first abdominal the largest, eighth the smallest. Integument thin and sparsely spinulose; spinules minute and isolated or in short rows, most conspicuous on the terminal somite. Body hairs few, exceedingly minute (0.006-0.009 mm long), simple, slightly curved, scattered. Cranium transversely subelliptical. Antennae small; each with three minute sensilla, each of which bears a spinule. Head hairs very few, exceedingly minute (0.005-0.018 mm long), widely scattered, simple, slightly curved. Labrum very small; subtrapezoidal in anterior view, narrowed ventrally; breadth 4½X length; ventral border feebly impressed; anterior surface bearing six sensilla and two minute hairs;

posterior surface with about nine sensilla near the middle; posterior surface spinlose, the spinules minute and arranged in short transverse rows. Mandibles very small and feebly sclerotized; basal half moderately enlarged; distal half slender, acuminate, sharp-pointed and slightly curved near the tip. Maxillae transversely subelliptical in anterior view; palp consisting of three sensilla on a slight elevation, two small and bearing each a spinule, and one larger; ~~galea represented by two sensilla, each of which bears a spinule, and one larger;~~ galea represented by two sensilla, each of which bears a spinule. Labium small; palp a cluster of three sensilla, two of which are minute and bear each a spinule, the other larger and conoidal; opening of sericteries a transverse slit inside the mouth. Hypopharynx sparsely spinulose, the spinules minute and in rows. (Material studied: numerous larvae from Panama Canal Zone.)

In the young larva the enlarged dorsal portion of the prothorax forms a prominent welt across the anterior end; this welt continues along each side of the body to the posterior end.

Queen larvae are generally similar to worker larvae, except for the larger body size and hence the relatively smaller size of head and hairs. The body, however, is extremely smooth: there are no welts or bosses and there is no evidence of segmentation.

Dolichoderus (Monacis) bispinosus (Olivier)

Similar to *debilis* but differing in the following respects: Antennae large. Labrum with spinules on the ventral surface and with the posterior surface more densely spinulose. Mandibles with apical half stouter. Maxillae spinulose, the spinules isolated laterally but in short rows medially; palp a cluster of five sensilla on a slight elevation. Labium with the posterior surface spinulose; palp a cluster of five sensilla, two of which bear each a spinule. (Material studied: twelve larvae from Panama Canal Zone.)

Dolichoderus (Monacis) laminatus (Mayr)

Apparently similar to *debilis* except as follows: Body hairs very few and widely scattered except for about a dozen around the anus. Head with depressed dorsolateral areas. Antennae large. Mandibles roughened with short transverse rows of minute spinules. Maxillary palp represented by 5-7 sensilla, three or four of which are agglomerated. Labial palp a cluster of four or five sensilla. (Material studied: numerous damaged larvae from Panama Canal Zone.)

Dolichoderus subgenus **Dolichoderus** Lund

Body practically naked; hairs few, exceedingly minute and widely scattered. Cranium suboctagonal in anterior view; broader than long; integument granular; head hairs short and very numerous. No spinules on posterior surface of labrum. Maxillae with conoidal apex and a large hairy paraboloidal ventrolateral lobe. Labium large.

Dolichoderus (Dolichoderus) attelaboides (Fabricius)
(Pl. I, figs. 17-19)

Plump, chunky and turgid; subellipsoidal; anterior end formed by the enlarged dorsal portion of the prothorax; head ventral but near the anterior end; a pair of low ventrolateral bosses near the anterior margin of the prothorax. Anus ventral, with conspicuous lips. Leg, wing and gonopod vestiges present. Segmentation indistinct. Integument spinulose, the spinules minute and isolated or in short transverse rows; more prominent on ventral surfaces of prothorax and abdominal somites VIII-X. Body hairs very few; exceedingly minute (about 0.009 mm long); widely scattered; curved; basal third stout, the rest slender. Cranium suboctagonal in anterior view; broader than long; integument granular. Head hairs short (0.004-0.045 mm); slender and slightly curved; very numerous (about 350); more abundant below the antennal level; several hairs between the antennae. Each antenna a low circular convexity arising from the center of a larger circular glabrous area; bearing three minute sensilla. Labrum short and thick; breadth 4X length; ventral border widely concave; anterior surface with 6-8 minute hairs and with six sensilla near the ventral border; posterior surface with eight sensilla near the center. Mandibles very small and feebly sclerotized; basal half somewhat dilated, but its width is only half the total length; apex acuminate, slightly curved, sharp-pointed. Maxillae with the apex conoidal and small; with a much larger hairy paraboloidal ventrolateral lobe; two sensilla between palp and galea; palp represented by a cluster of three sensilla, galea by two sensilla. Labium large, prominent, bilobed; palp a low convexity bearing three sensilla; opening of sericteries a transverse slit within the mouth. Hypopharynx spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: four integuments from British Guiana.)

Dolichoderus (Dolichoderus) decollatus F. Smith

Similar to *attelaboides* but differing as follows: Body hairs more numerous and longer (0.036 mm). Head hairs longer (0.018-0.072 mm). Labrum subtrapezoidal, narrowed below; breadth 3X length; anterior surface with four minute hairs near each dorsal corner and about eight sensilla near the ventral border; posterior surface with 12 sensilla in a central cluster. Mandibles shorter and stouter; surface irregularly denticulate. Labial palp a low convexity bearing three sensilla. (Material studied: four integuments from British Guiana.)

Tribe **LEPTOMYRMICINI** Emery
Genus **Leptomyrmex** Mayr

Elongate, stout and slightly curved; diameter greatest at the third and fourth abdominal somites, decreasing rapidly toward either end. The three posterior somites small and directed ventrally. Prothorax differentiated into two parts, the anterior part very short above, longer

below. Head placed low on the anterior end. Segmentation distinct. Spiracles minute and nearly uniform in size. Body hairs numerous, minute and uniformly distributed; basal half stout, distal half slender and flexible. Head hairs few and short. Head guitar-shaped, due to the fact that the mouth parts are elongated ventrally and constricted at the base; cranium subcircular in anterior view; mouth parts large and conspicuous, except the labrum. Labrum small and relatively narrow; anterior surface with numerous (12-20) sensilla and/or minute hairs; near the middle of the posterior surface are two rows of about five sensilla each, from which short arcuate rows of spinules extend obliquely outward and upward. Mandibles with a few short rows of spinules on the anterior surface of the basal half. Maxillae large, inflated, lobose; galea a short conoid bearing two apical sensilla. Young larvae extremely long and slender and terminating in a slender subconical postanal tail; head on the anterior end.

Wheeler (1915, p. 260) characterizes the larvae of this genus as "very peculiar," which is certainly no exaggeration.

Leptomyrmex erythrocephalus (Fabricius)
(Pl. II, figs. 1-3 and 6)

Elongate and stout; diameter greatest at the third and fourth abdominal somites, decreasing rapidly toward either end. Slightly curved; dorsal profile strongly curved, ventral nearly straight, except at posterior end where the three small terminal segments are directed ventrally. Prothorax differentiated into two parts; the anterior part wedge-shaped, very short above and produced posteroventrally into a prominent boss. Head placed low on the anterior end, the mouth parts directed forward. A broad low welt along either side of the body. Anus ventral. Leg vestiges present. Thirteen differentiated somites. Spiracles minute, approximately uniform in size; first abdominal the largest, eighth the smallest. Body hairs numerous, uniformly distributed, minute (about 0.08 mm long); with stout base and slender flexible apical half. Head guitar-shaped, due to the fact that the mouth parts are elongated ventrally and constricted at the base; cranium subcircular in anterior view; mouth parts large and conspicuous. Antennae oval and slightly raised; each with three minute sensilla. Head hairs few, scattered, short (0.018-0.036 mm); with stout base and slenderer tip. Labrum small and narrow; breadth 1.5X length; subrectangular; lateral borders sinuate; ventral border feebly impressed; anterior surface with about 20 sensilla and/or minute hairs. Near the middle of the posterior surface of the labrum are two rows of about five sensilla each; from these, short arcuate rows of minute spinules run obliquely upward and outward. Mandibles moderately large (for a dolichoderine) and a feebly sclerotized; basal half inflated; apical half slender, acuminate and sharp-pointed; anterior surface of basal half with a few short transverse rows of minute spinules. Maxillae large, inflated, lobose; palp a cluster of three irregularly shaped sensilla and two isolated sensilla all mounted

on a low knob-like projection; galea a short conoid bearing two apical sensilla. Labium large and prominent; palp a low convexity bearing five sensilla; opening of sericteries a conspicuous hole between the galeae. Hypopharynx spinulose, the spinules minute and arranged in subtransverse rows; the rows on each half forming a somewhat fan-shaped pattern, converging laterally. (Material studied: numerous larvae from Australia.)

The very young larva of *erythrocephalus* is extremely long and slender and terminates in a slender subconical postanal tail. The head is on the anterior end.

Leptomyrmex nigriventris (Guérin)

Similar to *erythrocephalus* but differing in the following characters: Ventral profile curved. No ventral boss on the prothorax. Labrum subtrapezoidal, narrow ventrally. Anterior surface of labium produced into a pair of large bosses. (Material studied: ten larvae from New South Wales.)

Wheeler, 1915, pp. 260-261: "The head is violin-shaped, with very small, pointed, vestigal mandibles, showing that the food of the larva is purely liquid and imbibed directly from the regurgitating workers. The sensory papillae on the maxillae and labium are well-developed. The body shows three well-marked thoracic and five or six abdominal segments. It is covered with extremely short hairs." Fig. 4 on p. 261 shows a larva in side view and a head in anterior view.

Leptomyrmex unicolor Emery

(Pl. II, figs. 4 and 5)

Apparently similar to *erythrocephalus* but differing in the following characters: Head ventral, near the anterior end. No ventral boss on prothorax. Integumentary spinules few and isolated. Head not guitar-shaped; cranium transversally subelliptical, but only slightly broader than long. Labrum subtrapezoidal, narrowed ventrally; breadth 2X length ; ventral border trilobed; anterior surface with about 16 sensilla and/or minute hairs; posterior surface with about eight sensilla, which are not in rows. Maxillary palp a distinct elevation bearing five sensilla. [Material studied: two integuments—apparently of semipupae—from Queensland; these are the specimens studied by Dr. W. M. Wheeler (see below).]

Wheeler, 1915, p. 261: "The larva of *L. unicolor* has a short rounded head, much like that of other ant larvae, though the mandibles are very feebly developed. The body is covered with hairs which are somewhat sparser and stiffer than in *nigriventris*." Fig. 4*c* on p. 261 shows the head in anterior view.

We are inclined to suspect that our *unicolor* specimens are semipupae, which may account for the marked differences between this and the other species of *Leptomyrmex*.

Leptomyrmex varians ruficeps Emery

Apparently similar to *erythrocephalus*, except as follows: Body hairs

most abundant on the ventral surface of the prothorax. Integument sparsely spinulose, the spinules minute and either isolated or in short rows. Anterior surface of labrum with 12 sensilla and/or minute hairs. More spinules on the mandibles. On the anterior surface of the labium near its base there is a pair of mammiform projections each bearing an apical sensillum. Labial palps a pair of irregular raised areas each bearing about four sensilla. (Material studied: three damaged integuments from Queensland.)

According to Wheeler (1915, p. 261), this larva is similar to that of *nigriventris*, "but the skin is entirely naked."

Tribe **TAPINOMINI** Emery

Genus **Liometopum** Mayr

Body and head practically naked; body hairs exceedingly few; short and widely scattered. Head hairs very few, exceeding minute, widely scattered. Antennae rather large. Posterior surface of labrum with two subvertical rows of sensilla near the middle and near the ventral border short transverse rows of minute spinules. Mandibles small. Maxillae with a lateral patch of isolated spinules between palp and galea; spinules with stout base and needle-like apex; palp a low convexity bearing one large and three small sensilla. Labium with spinules and a few sensilla on the anterior surface; palp a low convexity bearing one large and three small sensilla.

Liometopum apiculatum Mayr

(Pl. I, figs. 23 and 24)

Plump and chunky; nearly straight; subellipsoidal; anterior end formed by the enlarged dorsal portion of the prothorax; head ventral near the anterior end. Anus ventral. Leg and gonopod vestiges present. Spiracles small but not uniform in size; first abdominal the largest, eighth abdominal the smallest. Body practically naked; hairs exceedingly few, widely scattered, stout, slightly curved, short (0.018-0.027 mm). Head hairs very few, widely scattered, exceedingly minute (about 0.003 mm long). Antennae rather large; each with three minute sensilla. Labrum short and broad; ventral border feebly impressed; anterior surface with four scattered sensilla and two minute hairs; posterior surface with two subvertical rows of four sensilla each near the middle and near the ventral border short transverse rows of minute spinules. Mandibles small and feebly sclerotized; basal half moderately enlarged; distal half narrowed, slightly curved medially, sharp-pointed. Maxillae with a lateral patch of isolated spinules between palp and galea; spinules with stout base and needle-like apex; palp a low convexity bearing one large and three small sensilla; galea represented by two sensilla. Labium with spinules and a few sensilla on the anterior surface; palp a low convexity bearing one large and three small sensilla. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two narrow subtriangles which have their bases near the middle. (Material studied: four unsatisfactory specimens from California.)

Genus **Froggattella** Forel

Six low unpaired middorsal bosses, one each on mesothorax, metathorax and abdominal somites I-IV. Body practically naked; body hairs and head hairs very few, widely scattered, exceedingly minute. Cranium subpentagonal in anterior view; narrowed ventrally. Antennae very small. Labrum small, narrow and bilobed; no spinules on posterior surface. Maxillae bulging. Labium small, short and narrow.

Froggattella kirbyi (Lowne)
(Pl. II, figs. 7-10)

Plump, chunky and turgid; subellipsoidal; ventral profile nearly straight; six low unpaired middorsal bosses, one each on mesothorax, metathorax and abdominal somites I-IV; anterior end formed by the enlarged dorsal portion of the prothorax. Head rather thin (anteroposteriorly) and applied to the ventral surface about a fourth of the body length from the anterior end. Anus ventral. Leg vestiges present. Segmentation indistinct. Spiracles small but not uniform in size; largest on the first abdominal somite, smallest on the eighth. Body hairs and head hairs exceedingly minute (length 0.009 mm); very few; widely scattered; straight, stout at the base, tapering rapidly to a sharp point. Cranium subpentagonal in anterior view; narrowed ventrally. Antennae very small; each with three minute sensilla. Labrum small and short; breadth 2X length; bilobed, due to a median incision of the ventral border; anterior surface with four hairs near the base and one near the center of each lobe, and with a sensillum near the ventral border of each lobe; posterior surface with a median cluster of 6-8 sensilla. Mandibles feebly sclerotized; basal 2/3 inflated, with several coarse denticles on its anterior surface; distal third slender, acuminate, sharp-pointed, with two or three denticles on its mesal surface. Maxillae bulging; palp a low knob bearing five sensilla; galea a small conoid bearing two apical sensilla. Labium small, short and narrow; palp a low knob bearing three sensilla; opening of sericteries a transverse slit within the mouth. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from New South Wales.)

Genus **Dorymyrmex** Mayr

Body slightly curved. Anterior portion of prothorax forming a short stout neck. Posterior end terminating in a small subcone which points posteroventrally. Body hairs and head hairs short, moderately abundant, uniformly distributed; straight and rather stout but with the tip slightly curved and tapering rapidly to a sharp point. Cranium suboctagonal in anterior view; as long as broad. Antennae small. Labrum small, narrow and bilobed, with subparallel lines (rows of spinules?) on the posterior surface. Young larva slender and elongate; head on anterior end; thorax swollen; abdomen constricted at its anterior end and produced posteriorly into a slender subconical tail.

Dorymyrmex pyramicus (Roger)
(Pl. II, figs. 11-18)

Plump, chunky and turgid; slightly curved; not attenuated toward either end; ends broadly rounded; anterior end formed from dorsa of prothorax and mesothorax. Head ventral, near anterior end; anterior portion of prothorax forming a short stout neck. At the posterior end a small terminal subcone pointing posteroventrally. Anus ventral. Leg vestiges present. Segmentation indistinct. Spiracles small, but not uniform in size; first abdominal the largest, eighth the smallest. Hairs moderately abundant and uniformly distributed; short (length 0.012-0.057 mm); straight and rather stout but with the tip slightly curved and tapering rapidly to a sharp point. Cranium suboctagonal; length equal to breadth. Head hairs moderately numerous; uniformly distributed; short (about 0.036 mm); straight and rather stout but with the tip slightly curved and tapering rapidly to a sharp point. Antennae small and elliptical; each with three minute sensilla, each of which bears a spinule. Labrum small; breadth twice the length; bilobed due to a median incision of the ventral border; anterior surface with two minute hairs near the base and two or three sensilla near the ventral border of each lobe; posterior surface with a median cluster of about eight sensilla and with transverse subparallel lines (rows of spinules?). Mandibles feebly sclerotized; width (at base) equal to length; basal 2/3 subparabolic in anterior view; apical third a narrow sharp-pointed cone. Maxillary palp a low knob bearing five sensilla; galea a low knob with two apical sensilla. Labial palp a low knob bearing five sensilla, one of which has a transparent cap; opening of sericteries concealed inside the mouth. Hypopharynx spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from Oklahoma and Texas.)

Young larva elongate and very slender; thorax swollen and bent ventrally; head on anterior end; abdomen constricted at the anterior end and produced posteriorly into a slender subconical postanal tail.

Wheeler, G. C., 1938, p. 141: reference to wing rudiments.

Genus **Araucomyrmex** Gallardo

Body slightly curved. With a rather large postanal knob, which is directed posteroventrally. Body hairs short and moderately abundant; uniformly distributed on thorax and abdominal somites I-V; a few on VI and on the ventral surface of the remainder; straight and rather stout but with the tip slightly curved and tapering rapidly to a sharp point. Cranium subhexagonal in anterior view; broader than long. Antennae small. Head hairs short and few, shaped like body hairs. Labrum small, narrow and bilobed; posterior surface with a few spinules in short transverse rows. Mandibles short and stout; slightly wider (at base) than long; subtriangular in anterior view; mesal border with a rounded subapical notch which causes the distal sixth to resemble a short slightly curved tooth; dorsal to the notch a small tooth on the

mesal face; a few rows of minute spinules on the anterior surface. Maxillae bulging; a few longitudinal rows of minute spinules on the mesal surface. Middle of anterior surface of labium with minute spinules in short transverse rows.

Araucomyrmex tener (Mayr)

(Pl. I, figs. 20-22)

Plump and chunky; slightly curved; ends broadly rounded; not attenuated toward either end. Head applied to the ventral surface about a fourth of the body length from the anterior end. At the posterior end a rather large postanal knob which points posteroventrally. Anus ventral. Leg and wing vestiges present. Segmentation indistinct. Spiracles small, but not uniform in size; first abdominal the largest, eighth abdominal the smallest. Hairs moderately abundant; uniformly distributed on thorax and abdominal somites I-V; a few on VI and on the ventral surface of the remainder; short (0.018-0.036 mm); straight and rather stout but with the tip slightly curved and tapering rapidly to a sharp point. A few minute integumentary spinules on the posterior somites and on the ventral surface of the prothorax. Cranium subhexagonal in anterior view; slightly broader than long; narrowed ventrally. Head hairs few; short (about 0.036 mm); shaped like body hairs. Antennae small, each with three minute sensilla, each of which bears a spinule. Labrum small; breadth 2½X the length; narrowed ventrally; bilobed due to a median impression of the ventral border; anterior surface with four sensilla (near the ventral border) and two minute hairs; posterior surface with a median cluster of about eight sensilla and with a few minute spinules arranged in short transverse rows. Mandibles short and stout; slightly wider (at base) than long; feebly sclerotized; subtriangular in anterior view; mesal border with a rounded subapical notch which causes the distal sixth to resemble a short slightly curved tooth; dorsal to the notch there is a small tooth on the mesal face; anterior surface with a few rows of minute spinules. Maxillae bulging; mesal surface with a few longitudinal rows of minute spinules; palp a low knob bearing four sensilla; galea a low conoid bearing two apical sensilla. Anterior surface of labium with a small median anterior convexity bearing short transverse rows of minute spinules; palp a low knob bearing four sensilla. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two subtriangles which have their bases near the middle. (Material studied: seven damaged integuments from Argentina.)

Genus **Iridomyrmex** Mayr

Body slightly curved. Anus ventral. Only nine pairs of spiracles. Body nearly naked; body hairs and head hairs exceedingly few and widely scattered; minute, straight and acuminate. Head moderately large. Cranium subpentagonal in anterior view; narrowed ventrally. Antennae small. Anterior surface of labrum with two minute hairs. Maxillae small, narrow and curved. Labium short, broad and rounded.

Iridomyrmex pruinosus (Roger)
(Pl. III, figs. 1-6)

Plump, chunky and turgid; slightly curved; not attentuated toward either end; ends broadly rounded; dorsal part of prothorax forming the anterior end. Head ventral, near anterior end. Anus ventral. Leg vestiges present. Segmentation indistinct. Spiracles small, but not uniform in size; first abdominal the largest, seventh the smallest, eighth apparently wanting. Body hairs exceedingly few; widely scattered except for a slight concentration on the ventral surface of the prothorax; straight and acuminate; minute (0.012-0.018 mm long). Head moderately large; cranium subpentagonal in anterior view; narrowed ventrally; somewhat broader than long. Head hairs very few (about 14) and widely scattered; minute (0.012-0.18 mm long); straight and acuminate. Antennae small; circular; each bearing three minute sensilla. Labrum short and broad; breadth 6X length; ventral border straight; lateral borders convex; anterior surface with two minute hairs; posterior surface with a median cluster of about nine sensilla. Mandibles feebly sclerotized; inflated; subtriangular in anterior view; breadth at base about 1½X length; apex forming a minute acuminate tooth. Maxillae small, narrow, curved; palp a discrete elevation bearing five sensilla, most of which are mounted on minute projections; galea a small indefinite swelling bearing two sensilla. Labium short and broad, rounded ventrally; anterior surface with a median elevation near the base, below which is the slit-like opening of the sericteries; palp a discrete elevation bearing five sensilla, most of which are mounted on minute projections. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from Oklahoma and Texas).

Queen larvae are similar to worker larvae, except for the larger body size and hence the relatively smaller head and hairs.

Iridomyrmex itoi Forel
(Pl. III, figs. 7 and 8)

Generally similar to *pruinosus* but differing in the following respects: Integument spinulose, the spinules minute and in short rows. Head narrower and longer. Anterior surface of labrum with six minute hairs and/or sensilla. Mandibles narrower, the apical tooth longer. Maxillary palp represented by a cluster of three sensilla; galea by two elevated sensilla. The median elevation on the anterior surface of the labium is spinulose. The young larva has on the metathorax and on each of the four anterior abdominal somites a low rounded middorsal tubercle. (Material studied: eight young larvae from Japan; courtesy of Mr. Cho Teranishi.)

Teranishi, 1927 (translated from the Japanese by two university students):—"The glutinous dorsal tubercles occur on abdominal somites I-V. They are not paired; each somite bears only one which is near

its anterior border. The shape differs from that of the tubercles of Ponerinae in that the end is rounded off. These tubercles are very distinct in the early instars but gradually diminish as the larva matures and finally in the last instar are only slight elevations. All five of the tubercles are of the same size and shape at any given stage and all change simultaneously. There are no other tubercles. The body of the larva is short and plump; it does not have a neck. The head is very small. The mandibles are poorly developed and indistinct; the maxillae are well developed. The segmentation of the thorax is indistinct'' (p. 299). ''The function of the glutinous dorsal tubercles is to attach the larva to the walls or ceiling of the nest'' (p. 297). ''The larvae are fed by regurgitation by the workers and do not need to stretch and seek their own food'' (p. 300). Fig. 6, first-instar larva in side view; Fig. 7, second-instar larva, part of dorsal profile to show tubercles; fig. 8, same for third-instar larva; all figures on page 299.

Iridomyrmex nitidus Mayr
(Pl. III, fig. 9)

Generally similar to *pruinosus* but differing in the following characters: A cluster of hairs around the largest spiracle. Head hairs few (about 24). Labrum bilobed due to a deep median incision of the ventral border; anterior surface with four sensilla and two minute hairs; posterior surface with a few rows of minute spinules. Manibles short and very stout; width at base slightly greater than length; apical fourth forming a stout blunt tooth, which has a denticle on its mesal face; anterior (?) surface with numerous ridges (rows of exceedingly minute spinules?). (Material studied: five damaged integuments from New South Wales.)

Iridomyrmex geinitzi (Mayr)

Wheeler (1914, p. 87) recorded 12 larvae and pupae in Baltic amber ''in all probability belonging to this species.'' Fig. 41a on page 87 shows a larva in side view.

Iridomyrmex goepperti (Mayr)

Wheeler, 1914, p. 91:— ''In the Geolog. Inst. Koenigsberg Coll. there is one block of amber (without a number) containing a worker *I. goepperti* with its larvae.''

Iridomyrmex humilis (Mayr)

Essig (1926) gives the life cycle (p. 866): egg 18-55 days; larva about 31 days; pupa 15 days; total 78 days. He reproduces Woodworth's (1910) Fig. 3 as Fig. 730 on p. 865.

Goetsch (1937, p. 137) gives the life cycle: egg 11-20 days, larva 8-29 days, pupa 8-35 days.

Hertzer (1930) has reported that the larvae are kept in the dampest part of the nest, where the temperature ranges from 70°-83° (F., pre-

sumably), with 80° preferred; that the queen took an active part in the care of the brood, even when workers were present; that "larvae will likely eat solid matter." A queen "held her mouth to the mouthparts of two larvae after which she put the larval skin partly in the mouth of the large larva. When she left, movement of the larval mouthparts was observed. Evidently the skin was being chewed" (p. 602).

Newell (1908, p. 31) gives a brief account of the larva. It was incorporated in the longer account of Newell and Barber (1913), except for this sentence:— "The larva is pure white, but with a dark color sometimes appearing in the abdominal region, as if it had been fed with some black or dark-colored food."

Newell (1909, pp. 185-187): essentially the same as Newell and Barber (1913), including Pl. 7 (=Pl. IV in 1913).

Newell and Rosenfeld (1909) repeats Pl. 7B of Newell (1909).

Newell and Barber (1913).—"The larva when first hatched is not distinguishable from the egg without the assistance of a magnifying glass. For a time after hatching the body is considerably curved, the cephalic end being almost in touch with the caudal end, but as development progresses the larva assumes more and more of a straight form. The curvature is not entirely lost, however.

"A recently hatched larva, measured with the compound microscope and eyepiece micrometer, was 0.49 mm. long by 0.32 wide. The fully grown larvae (workers) average 1.7 mm. long by 0.66 mm. wide. The largest one under our observation measured 1.87 mm. by 0.765 mm.

"With the exception of slight constrictions of the body, the larvae are incapable of motion, thus being entirely helpless and relying altogether upon the ministrations of the attendant workers. The latter, however, perform their duties faithfully, and care for their charges with the greatest solicitude. They feed and groom the young larvae continually and transport them from place to place whenever necessary. In case of danger their first instinct appears to be to remove the young to a place of safety, and they readily sacrifice their own lives in order to accomplish this.

"The larvae are fed often by the attending workers upon reguritated and presumably predigested food. There is nothing in the appearance or actions of the workers which do the feeding to indicate that they are different from those which perform other duties, or that they are assigned to the particular and exclusive duty of being nurses. The feeding of the larvae has several times been observed under a magnifying glass, and is as follows: The larva ordinarily lies upon its side or back. The attending worker approaches from any convenient direction, usually from one side or from the direction in which the head of the larva lies, and, spreading her mandibles, places them over the mouth parts of the larva, which are slightly extruded. The tongue of the worker is also in contact with the larval mouth. While the worker holds the body and mandibles stationary a drop of light-colored, almost transparent fluid appears upon her tongue. This fluid disappears within the mouth of the

larva, but it can not be ascertained to what extent the larval mouth parts are moved during the operation, as they are obscured from view by the mandibles and head of the attending worker. Slight constrictions of the larval abdomen during feeding are sometimes noticeable, at other times not. The time required for feeding a single larva varies from 3 to 30 seconds, depending doubtless on the hunger of the 'baby.' The workers proffer food to, or at least inspect, each larva, for the worker doing the feeding will place her mandibles to the mouth of one larva after another, feeding those which seem to require it.

"Both larvae and pupae are groomed or licked with the tongues of the workers; thus they are ever kept in a state of absolute cleanliness.

"The most pronounced increase in size of the larvae occurs during the first five days after hatching. As in the case with other ants, nothing is voided from the alimentary canal during the larval period, the undigested portions of the food being retained in the stomach, the latter having no open connection with the intestine. As the larva reaches its full growth this meconium, or mass of undigested material, becomes quite large and is distinctly visible as a dark object in the posterior portion of the body. At about this time communication is established between stomach and intestine and the meconium is voided. The larva then enters the prepupal or semipupal stage. While the insect in this stage is not very different in appearance from a full-grown larva, close examination shows a number of slight differences. Aside from the absence of the meconium, the cephalic and thoracic regions become markedly smooth and shining, with segmentation very indistinct, while the segmentation in the abdominal region is, if anything, more pronounced than before. The line of demarkation between abdomen and thorax is now in evidence, but without any very noticeable constriction. The mouth parts are protruded more than in the larva. The difference in appearance between larval and prepupal stages is not great but is sufficient to enable one to predict, with reasonable accuracy, the approaching transformation to the pupal stage proper.

"In the later portion of the larval stage we have first been able to distinguish between the males and workers. The male larvae grow to a somewhat larger size than do the worker larvae, and it is thus possible to predict with some degree of certainty which of grown larvae will transform to males and which to workers. In all other respects, however, they are apparently alike. The larval stage of the queen is unknown to us" (pp. 40-41).

The duration of the larval stage varied from 11 to 61 days; the average was 31.4 days. The average for the egg stage was 27.8 days; pupal stage average 15 days. Pl. IV B is a photograph of larvae and worker pupea; C, of larvae, more enlarged.

Marlatt, 1916: Fig. 3*b* on p. 6 shows a young larva in side view; *c*, full-grown larva in side view. (Repeated: Marlatt, 1930; Back, 1937; Back, 1946; Essig, 1942; Fernald, 1921; Williams, 1937; and probably others.)

Wheeler and Bailey (1920, p. 251) quote Newell's (1909) account of the feeding of the larvae.

Woodworth, 1910, p. 54: Fig. 2, a very young larva; Fig. 3, a full-grown larva. (Repeated: Eckert and Mallis, 1937 and 1941; Fig. 3 by Essig, 1926.)

Iridomyrmex iniquus nigellus Emery

"Glistening white larvae" (Wheeler, 1929, p. 89).

Iridomyrmex sanguineus Forel

"The caterpillar [of *Cyclotorna monocentra* Meyr] subsists in the second stage solely upon the ant grubs by sucking out their juices. A grub is first felt or examined, then the very movable claws grasp it more firmly and the small head becomes quite still, and tremors pass through the caterpillar, ending in slight upward jerks of the terminal segments, soon it is seen that the poor grub is collapsing, then when its skin has fallen in considerably it is abandoned and another one sought out and tackled. I have witnessed three grubs disposed of in succession in a few minutes by a large larva." (Dodd, 1912, p. 584.) Referred to by Wheeler (1928, p. 259) and Brues (1946, p. 340).

Genus **Bothriomyrmex** Emery

Prothorax swollen ventrally and furnished with a pair of anteroventrolateral conoidal bosses, which are united across the venter by a narrow "shelf." Head anteroventral. Spiracles minute; only eight pairs. Body hairs short, very few; most numerous on prothorax. Head moderately large, cranium subheptagonal in anterior view. Mouth parts small. Head hairs short and few; mostly below the level of the antennae. Labrum small and narrow; bilobed. Galea a frustum bearing two apical sensilla. Labial palp a large irregular elevation bearing five sensilla. In the young larva the prothoracic bosses are produced into finger-like projections.

Bothriomyrmex (Chronoxenus) pusillus (Mayr)
(Pl. III, figs. 10 and 12-14)

Plump and chunky; subellipsoidal; anterior end formed by the enlarged dorsal portion of the prothorax. Prothorax swollen ventrally and furnished with a pair of anteroventrolateral conoidal bosses, which are united across the venter by a narrow "shelf." Head anteroventral. Anus ventral. Leg vestiges present. Segmentation indistinct, especially in the posterior half. Only eight pairs of spiracles found; all minute; size decreasing posteriorly. Body hairs very few; most numerous on the prothorax; short (0.018-0.024 mm); base stout, tapering to a slender apex; simple and slightly curved. Head moderately large; cranium subheptagonal in anterior view. Mouth parts small. Head hairs few; mostly below the level of the antennae; short (0.01-0.023 mm); simple and slightly curved; base stout, tapering to a slender apex. Each antenna

with three (occasionally two) minute sensilla. Labrum small; bilobed due to a wide and deep median notch in the ventral border; narrowed ventrally; breadth at base a third greater than length; anterior surface with four sensilla near the ventral border and two hairs near the base. Mandibles feebly sclerotized; somewhat broader (at base) than long; basal half dilated; narrowed abruptly so that the apical half is rather slender and acuminate. Maxillary palp an irregular elevation bearing 5-6 sensilla; galea a frustum bearing two apical sensilla. Labial palp a large irregular elevation bearing five sensilla; opening of sericteries a transverse slit within the mouth. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from New South Wales.)

Bothriomyrmex (B.) meridionalis (Roger)
(Pl. III, fig. 11)

Young larva plump; diameter greatest at the middle, attenuated slightly toward either end. Head on the anterior end; prothorax swollen ventrally and furnished with a pair of finger-like ventrolateral projections. Body straight except for the posterior end, which is abruptly bent downward to form a stubby "tail"; anus on the anterior surface of this tail. Body hairs minute (about 0.009 mm long). Head hairs exceedingly minute (about 0.006 mm long) and extremely few (about eight). Each antenna a small frustum bearing three minute apical sensilla. Other characters apparently similar to those of *pusillus*. (Material studied: a single young larva—0.64 mm long,—and two damaged integuments—0.68 mm and 1.1 mm—from Switzerland.)

Bothriomyrmex (B.) inquilinus Santschi
(Pl. III, fig. 15)

Similar in general to *meridionalis*. (Material studied: two young larvae—1.25 mm and 1.35 mm long—from Tunis.)

Bothriomyrmex (B.) corsicus ligurica Emery

"La larva dell'operaia è lunga mm. 1,5-1,8 e larga al massimo mm. 0,8, completamente glabra, di forma subcilindrica, poco curvata in avanti, composta apparentemente di 10 segmenti, non compreso il capo, alquanto ristretta anteriormente in corrispondenza dei segmenti del torace, mentre gli uriti sono gradatamente più allargati e l'ultimo porta l'apertura anale in forma di fessura trasversa. Il sistema tracheale è di tipo olopneustico, con un paio di spiracoli al mesotorace e al metatorace e 6 all'addome. Il *capo* è di forma ovale, piuttosto piccolo, coll'epicranio fornito di tre paia di peli collocati sulla linea submediana longitudinale e di un altro paio collocati nel mezzo della linea trasverso-basale delle mandibole e pertinenti probabilmente al labbro superiore. Le *mandibole*, di forma triangolare, sono poco sviluppate, leggermente chitinizzate ed appuntite all'estremità anteriore. Il *labbro superiore*,

non delimitato posteriormente e malamente distinguibile, è membranoso, col margine anteriore apparentemente troncato. Le *mascelle* sono subrettangolari, più o meno arrotondate all'apice ed ivi strettamente incise in modo che ognuna sembra essere formata da due lobi sovrapposti, di cui il primo (superiore) porta quattro sensilli circoscritti da un'area alquanto più trasparente del restante tegumento, mentre il secondo (inferiore), che è un poco sporgente dal primo, è fornito di un unico sensillo. Il *labbro inferiore* è formato da un solo pezzo quadrangolare, col margine anteriore leggermente ma largamente incavato e limitato lateralmente da due piccoli lobi provvisti ciascuno di due sensilli conici; inoltre nel mezzo della sua faccia dorsale si scorgono per trasparenza un gruppo di sei sensilli placoidi rotondi. Il primo segmento del *torace* è il più lungo ed anche il più stretto dei tre che formano questa parte del corpo, ed è caratterizzato per avere al ventre, in ciascuno dei lati, una piccola appendice subcilindrica che probabilmente ha una funzione escretoria come è supposto per altre consimili appendici di cui sono fornite diverse larve di Formiche. Il secondo segmento è un poco più lungo del successivo ed alquanto più stretto. Negli *uriti* non ho notata nessuna particolarità degna di nota. La *larva* della *femmina* è del tutto simile a quella dell'operaia ora descritta; si distingue soltanto per essere di statura più grande, mm. 2-2,3.'' (Menozzi, 1933, pp. 10-11). Fig. II on p. 10 shows a larva in side view and a head (enlarged) in anterior view.

''*Bothriomyrmex decapitans* (parasite temporaire chez *Tapinoma*) a une larve qui ressemble à celle de l'hôte, mais elle ne compte que six segments abdominaux. La tête est mieux différenciée. On peut y distinguer une lobulation (labre, maxilles et labium) et deux petites mandibules. Dans le cas de ces deux genres, les caractères de morphologie externe des larves s'accordent avec les caractères des adultes, puisque le genre *Bothriomyrmex* est considéré comme plus primitif que le genre *Tapinoma.*'' (Athias-Henriot, 1947, pp. 252-253.) On p. 260 the food of the larva is said to be *substances sucrées.* References to internal anatomy: pp. 259, 260 and 264.

Gantes, 1949 (referring to *B.* (*B.*) *decapitans.*)—'' ☿ 2 mm. Ces larves sont massives, subcylindriques, avec une tête petite mais bien différenciée cependant. Elles n'ont que 10 segments post-céphaliques. Elles sont remarquables par leur *exsudatoires prothoraciques.* Le corps est complètement nu. La tête, légèrement recourbée vers la face ventrale, comprend toutes les pièces buccales. Elle porte quatre poils simples sur la partie postérieure. Le labre, d'une seule pièce, porte sur sa face ventrale trois sensilles en file. Les mandibules sont de simples petits triangles de 0 mm. 058. Les maxilles, assez proéminents, ont de légères saillies qui sont le palpe distal à deux sensilles et le palpe proximal à cinq sensilles, dont trois plus grosses. Entre les deux palpes se trouve un minuscule poil. Le labium porte ses deux palpes, á côté desquels sont plantés deux poils'' (pp. 83-84). Pl. VI, fig. 1 shows a larva in side view, an ''exudate organ,'' a mandible, an antenna, a maxillary palp

and a labial palp. "La croissance est uniformément faible á peine plus marquée au stade V" (p. 85). Data on the rate of growth are given in a table on p. 86. "*Bothriomyrmex* n'a de poils à aucun stade" (p. 87). Only nine pairs of spiracles (p. 88). Among the Dolichoderinae "les larves sont très évoluées avec encore une progression: *Bothriomyrmex* est plus primitif que *Tapinoma*" (p. 89).

Genus **Azteca** Forel

Relatively elongate and rather slender (for a dolichoderine); straight; ends narrowly rounded; dorsal profile nearly straight, ventral more convex. Prothorax with a ventrolateral swelling on each side. Anus subterminal. Leg vestiges large. Body hairs of two types: (1) short, simple and slightly curved; (2) oncochaetae. The latter are long and consist of a long stout terminal hook and a more slender spiral stem; restricted to dorsa of metathorax and abdominal somites I-V, two pairs on each somite. Head moderately large and subhexagonal. Antennae large. Head hairs few and scattered. Labrum very small; ventral border with 2-4 protruding sensilla and a few minute spinules; posterior surface with several short rows of minute spinules near each lateral border. Mandibles small; subtriangular in anterior view; slightly broader (at base) than long.

Wheeler, 1922, p. 200: ". . . the *Aztecae* are mostly insectivorous."

Azteca alfari Emery
(Pl. III, Figs. 16-21, 23 and 24)

Plump; relatively elongate and rather slender (for a dolichoderine); straight; subellipsoidal; prothorax with a ventrolateral swelling on each side; ends narrowly rounded; anterior end formed from the swollen dorsal portion of the prothorax. Dorsal profile nearly straight, ventral more convex. Head ventral, but near the anterior end. Anus subterminal. Leg vestiges large; wing and gonopod vestiges present. Segmentation moderately distinct; 13 somites. Spiracles small but not uniform; mesothoracic and first abdominal largest, eighth abdominal smallest. Integument rather densely spinulose, the spinules minute and arranged in transverse rows of 2-9. Body hairs few and restricted to dorsal and ventral surfaces; more abundant on the dorsal surface; of two types—(1) simple, slender, slightly curved, short (0.036-0.054 mm) and (2) oncochaetae. The latter are longer (about 0.18 mm) and have a long stout terminal hook and a more slender stem, which is spirally coiled, with one to three turns; restricted to dorsum of metathorax and abdominal somites I-V, two pairs on each somite. Head moderately large, subhexagonal in anterior view; cranium transversely subelliptical, breadth 1½× length. Head hairs few, scattered slender, slightly curved, short (0.018-0.036 mm). Antennae large; each with three minute sensilla. Labrum very small; breadth 3× length; narrowed ventrally; bilobed due to a wide shallow impression of the ventral border; ventral border with 2-4 protruding sensilla and a few minute spinules; anterior surface

apparently devoid of sensilla and hairs; posterior surface with about 12 sensilla near the middle, and (lateral to these) several short oblique rows of minute spinules. Mandibles small and feebly sclerotized; subtriangular in anterior view; slightly broader (at base) than long; apex forming a moderately stout round-pointed tooth; anterior and mesal surfaces with oblique rows of minute spinules. Maxillae lobose; apex with a few short rows of minute spinules; palp an elevated cluster of about five sensilla; galea a slight elevation bearing two sensilla. Labium with a few short rows of minute spinules on the basal half of the anterior surface; palp represented by a cluster of four or five sensilla; opening of sericteries small, on the anterior surface between the maxillae. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from Panama Canal Zone.)

Azteca instabilis (F. Smith)

Generally similar to *alfari*, except in the following particulars: Segmentation indistinct. Body hairs moderately numerous; lateral surfaces not naked. Head hairs minute (0.009-0.012 mm). Antennae smaller. Labrum twice as broad (at base) as long; anterior surface with about 10 sensilla and/or minute hairs; posterior surface with six sensilla. Apical tooth of mandibles twice as long and with a sharper point. No spinules on maxillae. Queen larvae have large and conspicuous vestiges of legs, wings, and gonopods; the integumentary spinules are longer than those of the worker larvae; the body is, of course, much larger than in the worker, but head and hairs are of approximately the same size. (Material studied: ten semipupae—six queens and four workers—from Panama Canal Zone.)

Azteca longiceps Emery
(Pl. III, fig. 22)

Similar to *alfari*, but differing as follows: Segmentation less distinct. Simple body hairs shorter (0.011-0.022 mm). Labrum with the ventral border feebly impressed; anterior surface with four sensilla near the ventral border. No spinules on mandible; apical tooth not so sharply differentiated but with a sharper point. No spinules on maxillae. (Material studied: numerous larvae from Panama Canal Zone.)

Azteca xanthochroa (Roger)

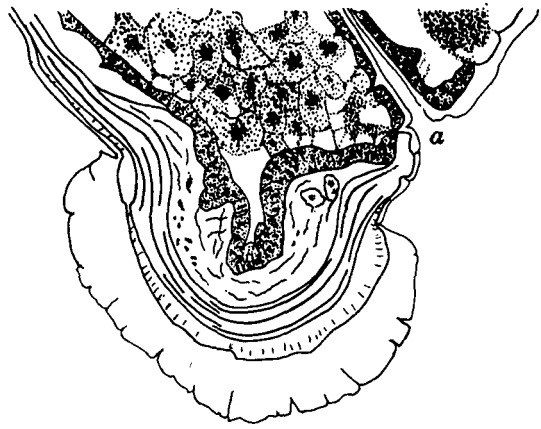
Similar to *alfari*, but differing in the following characters: Segmentation less distinct. Simple body hairs shorter (0.018-0.027 mm); none on ventrolateral surface of abdomen; those on thorax moderately numerous and uniformly distributed. Breadth of labrum 2⅓ times the length; ventral border slightly impressed; anterior surface with four sensilla near the ventral border; posterior surface with about eight sensilla. Apical tooth of mandibles longer and sharper. No spinules on maxillae. (Material studied: 13 integuments from Guatemala.)

Genus **Engramma** Forel

Straight and subcylindrical; posterior end somewhat attenuated and terminating in a conspicuous knob, which is constricted at its junction with the body. Dorsa of the anterior somites bearing each a pair of low indistinct bosses, which are largest on the prothorax and fade out posteriorly. Segmentation moderately distinct. Only nine pairs of spiracles. Body practically naked; hairs very few, widely scattered and minute. Head moderately large; cranium subrectangular in anterior view; broader than long. Antennae small; each with two sensilla. Head hairs few, short, mostly below the level of the antennae. Labrum crescentic; with two minute hairs (or sensilla?) on the anterior surface; no spinules on the posterior surface. Young larva short, broad and flat; a dorsoventrally elongated lateral boss on each side of each somite; paired dorsal bosses large and conspicuous; prothoracic bosses form a conspicuous collar; segmentation distinct.

Engramma lujae Forel
(Pl. IV, figs. 1-7)

Plump and chunky; straight and subcylindrical; not attenuated toward the anterior end which is formed from the dorsal part of the prothorax. Posterior end somewhat attenuated and terminating in a conspicuous knob, which is constricted at its junction with the body. The dorsa of the anterior somites bear each a pair of low indistinct bosses; they are largest on the prothorax and fade out posteriorly. Prothorax anteroventral. Head ventral, but near the anterior end. Anus ventral. Leg vestiges lens-shaped, rather widely separated; gonopod vestiges present. Segmentation relatively distinct; eleven differentiated somites. Spiracles



Text Figure 1. *Engramma lujae* Forel. Sagittal section through the posterior end of the larva showing the thickening of the body wall of the caudal knob, X181; *a*, anus.

not uniform; first abdominal the largest, seventh the smallest; eighth apparently wanting. Body hairs very few and widely scattered; simple and slightly curved; minute (0.004-0.012 mm long), scarcely noticeable among the spinules. Integument spinulose, except on the posterior knob and in the intersegmental furrows; spinules coarse and mostly isolated. Head moderately large; cranium subrectangular, its breadth 1½× the length; gula inflated. Head hairs few; mostly below the antennal level; simple, slender, curved; short (about 0.027 mm). Antennae small; each with two minute sensilla. Labrum short, breadth more than 3× length; crescentic; anterior surface with two minute sensilla and/or hairs; posterior surface with about six sensilla near the middle. Mandibles feebly sclerotized; basal ⅔ subtriangular in anterior view; distal third a slender sharp-pointed cone; a few streaks (ridges?) on the mesal face near the base of the apical cone. Maxillary palp consisting of three or four sensilla on an indistinct elevation; galea represented by two sensilla on a slight elevation. Labial palp a cluster of about three sensilla on a low elevation; opening of sericteries a curved slit. Hypopharynx spinulose, the spinules arranged in subtransverse rows grouped in two subtriangles which have their bases near the middle. (Material studied: six integuments—three of them damaged—from the Belgian Congo.)

A sagittal section of a larva (Text fig. 1) reveals something of the nature of the caudal knob: it is an evagination of the body wall—both hypodermis and cuticula. The hypodermis is somewhat thickened, but the cuticula is enormously hypertrophied.

The young larva (length 1.5 mm) is shorter, broader and flatter than the mature larva (2.4 mm long); the greatest breadth (at the metathorax) is twice the depth; this excess of breadth is partly due to the dorsoventrally elongate lateral bosses, one pair on each somite. The paired dorsal bosses are large and conspicuous. On the prothorax each dorsal boss is united with a lateral boss; these two dorsolateral bosses form a conspicuous collar. Segmentation distinct.

Genus **Tapinoma** Förster

Body slightly curved. Posterior end flattened and provided with an indistinct knob, which is directed posterodorsally. Only nine ~~parts~~ pairs of spiracles. Body hairs very few, short and widely scattered. Head moderately large; cranium subpentagonal in anterior view; with scattered spinules below the antennae and on the gula. Antennae minute; each with two or three exceedingly minute sensilla. Head hairs short and very few; all below the antennal level. Labrum very small; parabolic; anterior surface with two minute hairs near the base and two sensilla near the apex; posterior surface without spinules but with eight sensilla near the apex. Maxillae indistinct. Young larva more slender; head and posterodorsal knob relatively larger; diameter greatest at the prothorax, diminishing toward the posterior end; segmentation distinct.

Bischoff, 1927:— "Die Larven . . . sind . . . so weit auf die Kropffütterung durch ihre Pflegerinnen eingestellt, dass ihre Mandibeln so

gut wie functionlos und unbeweglich geworden sind'' (p. 81). On p. 384 he states that the larvae of this genus occasionally take solid food; Escherich (1917, p. 98) makes a similar assertion.

Tapinoma sessile (Say)

(Pl. IV, figs. 8-12)

Salmon-colored. Plump, chunky and turgid; slightly curved; not attenuated toward the anterior end, which is broadly rounded and formed from the enlarged dorsal portion of the prothorax; posterior end flattened and provided with an indistinct knob, which is directed posterodorsally. Head thin (anteroposteriorly) and applied to the ventral surface about a fourth of the body length from the anterior end. Anus ventral. Leg vestiges present. Segmentation indistinct. Spiracles small but not uniform in size; first abdominal the largest, seventh the smallest; eighth apparently wanting. Integument beset with minute spinules. Body hairs very few; irregularly distributed, more numerous on the dorsal surface; simple and slightly curved; short (0.004-0.027 mm). Head moderately large; subpentagonal, with definite dorsolateral corners; narrowed ventrally; integument (below the antennae) with scattered spinules, some isolated, others in short rows; gula coarsely spinulose. Head hairs very few (about 10); all below the antennal level; simple and slightly curved; short (about 0.018 mm). Antennae situated rather high on the head; minute; each with two or three exceedingly minute sensilla. Labrum very small; parabolic in anterior view; anterior surface with two minute hairs near the base and two sensilla near the apex; posterior surface with a cluster of about eight sensilla near the apex. Mandibles feebly sclerotized; basal ⅔ enlarged and subtriangular in anterior view, its surface roughened with ridges (?); distal third a slender cone. Maxillae indistinct; palp a cluster of one large and three small sensilla; galea a small knob bearing two sensilla. Labium with a median anterior projection bearing two sensilla; palp a low rounded elevation bearing one large and three small sensilla; opening of sericteries a transverse slit between the tips of the maxillae. Hypopharynx spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from Minnesota, New York and West Virginia.)

The young larva is more slender and the head and posterodorsal knob are relatively larger. The diameter is greatest at the prothorax and diminishes somewhat toward the posterior end. Segmentation is distinct.

Queen larvae are similar to worker larvae, except for the larger body size and hence the relatively smaller size of head and hairs. The posterodorsal knob, however, is absolutely smaller than in the worker.

In our artificial formicary the young larvae were usually standing on the end of their posterodorsal knob (which is relatively quite large at this age) with the body inclined at 45° to the plaster floor or glass ceiling. Attachment seemed to be effected by adhesion of the temporarily

flattened part of the surface of the knob rather than by any sticky secretion. Workers were observed to lick assiduously the bodies of the larvae; the posterior end was apparently preferred. Whenever a larva was strongly stimulated a drop of clear fluid exuded from the anus and sometimes from the mouth also.

Smith, M. R., 1928:— "The freshly hatched larva is scarcely larger than the egg. As the larva grows its head becomes recurved ventrally, and a peculiar protuberance can be noted on the superior surface of the caudal end of the body. The body of the larva is distinctly segmented and also somewhat yellowish in color. Beneath the integument are small, scattered, white particles, probably excretory products. When full grown the larva is rather plump, being less distinctly segmented dorsally. The meconium is now quite apparent. The head of the larva appears even more recurved than formerly, and the caudal protuberance is very clearly evident. The larva now measures .72 by 1.74 mm. . . . The prepupa is an almost exact replica of the full grown larva except that the meconium is not evident, it having been cast out just before the larva went into this stage. The body is robust and very plump. The integument soon acquires a much wrinkled, dry appearance. The prepupa measures about 1.8 mm in length." (p. 315). Fig. 2 on p. 314 is a photograph which includes worker larvae. Life cycle starting with the April-June eggs: egg 12-20 days, larva and prepupa 13-29 days, pupa 6-18 days, total 31-67 days; averages—15, 22, 13, 50. Life cycle starting with the July-September eggs: egg 11-16 days, larva 14-16 days, prepupa 2-3 days, pupa 8-25 days, total 35-60 days; averages—12, 15, 2, 13, 42. (Page 316.)

Tapinoma melanocephalum (Fabricius)

Scarcely distinguishable from *sessile*. The head hairs appear to be fewer (6-8) and shorter (0.009 mm). The distal cone of the mandibles is smaller. The labium lacks the median anterior projection. (Material studied: numerous larvae from Panama.)

Tapinoma erraticum (Latreille)

Ern. André (1881-1886, Pl. V) labels Fig. 2 a larva of this species; it is more likely, however, that Fig. 5 is Tapinoma and Fig. 2 Tetramorium. Figs. 3 and 4 are probably hairs of Tetramorium, not Tapinoma, as labelled.

Berlese, 1901, p. 517 and 1909, pp. 521, 789, 790; internal anatomy.

Berlese, 1902:— "La larva di Tapinoma . . . ha forma obconica, essendo più larga all'innanzi che all'indietro, dove è anzi attenuata per gradi ed è alquanto curvata ad arco sul ventre; essa misura circa 800 μ di lunghezza. Il capo, grandetto, è apicale, non sporgendo troppo, per ora, anzi punto sul capo stesso il prima anello del corpo, al dorso. La testa, ovale, è provvista di un labbro superiore carnoso, spesso e tagliato ad arco; di due minute mandibole acutissime, gracili e dure, di un paio di mascelle larghe alla base, acute all'apice, e sulla loro faccia

esterna provviste di due papille, della quali una potrà rappresentare il palpo, l'altra il lobo esterno, (mentre l'interno è significato dall'apice stesso delle mascelle) e dal labbro inferiore triangolare, acuto all'apice, con due papille, una per lato, rappresentanti i palpi labiali. Queste papille e quelle mascellari sono brevi tubercoli tronco-conici, rivestiti di cuticola spessa, gialla con due o tre peluzzi minutissimi, apicali, sorgenti da brevi areole di cuticola meno spessa, ialina. Il resto del corpo è diviso in dodici anelli, decrescenti di diametro ed anche alquanto di altezza, mentre il primo è molto largo ed alto, più del secondo, questo più del terzo etc. L'ultimo segmento porta l'apertura anale in forma di fessura trasversa, e decisamente ventrale'' (pp. 233-234). The rest (pp. 234-241) deals with internal anatomy. Fig. 55 on p. 234, a very young larva in side view showing internal organs; most of peripheral musculature omitted. Fig. 56 on p. 235, same showing especially the peripheral musculature, the principal tracheal trunks and the groups of oenocytes (repeated: Berlese, 1909, Fig. 978 on p. 789). Fig. 57 on p. 237, same to show the principal internal organs (repeated: Berlese 1909, Fig. 594 on p. 521).

Donisthorpe, 1915: ''Yellowish white, narrow and pointed anteriorly and posteriorly, with the segments clearly defined. The ventral surface is sharply angled from the first abdominal segment to the pointed apex; the dorsal surface is broadly rounded, the prothoracic segment more prominent. The smaller larvae are almost glabrous, but under a high power short bristles can be seen, chiefly on the ventral surface. The larger larvae are quite glabrous, shining, and more 'sausage' shaped'' (p. 180). Pl. III shows photographs of young and mature larvae. (Repeated: Donisthorpe, 1927, p. 201 and Pl. III.)

Emery (1899, p. 7) characterizes the larva of this species as ''manifestamente ipocefale.''

Forel (1874) characterizes the larvae of *erraticum* as ''très courtes, épaisses aux deux bouts, raides et indistinctement annelées'' (p. 388) [1920 edition: ''très courtes, épaisses aux deux bouts, entièrement raides, surtout chez les *Tapinoma*, où elles ne peuvent se mouvoir, et indistinctement annelées'' (p. 265)] and also as ''extrêmement raides, presque incapables de remuer même leur tête'' (p. 388 = p. 266 in 1920). ''Les larves qui croissent le plus vite sont, je crois, celles de *Tapinoma*; les premières sortent de l'oeuf vers le commencement d'avril, et l'on trouve déjà des nymphes avant la fin de mai'' (p. 389 = p. 266 in 1920).

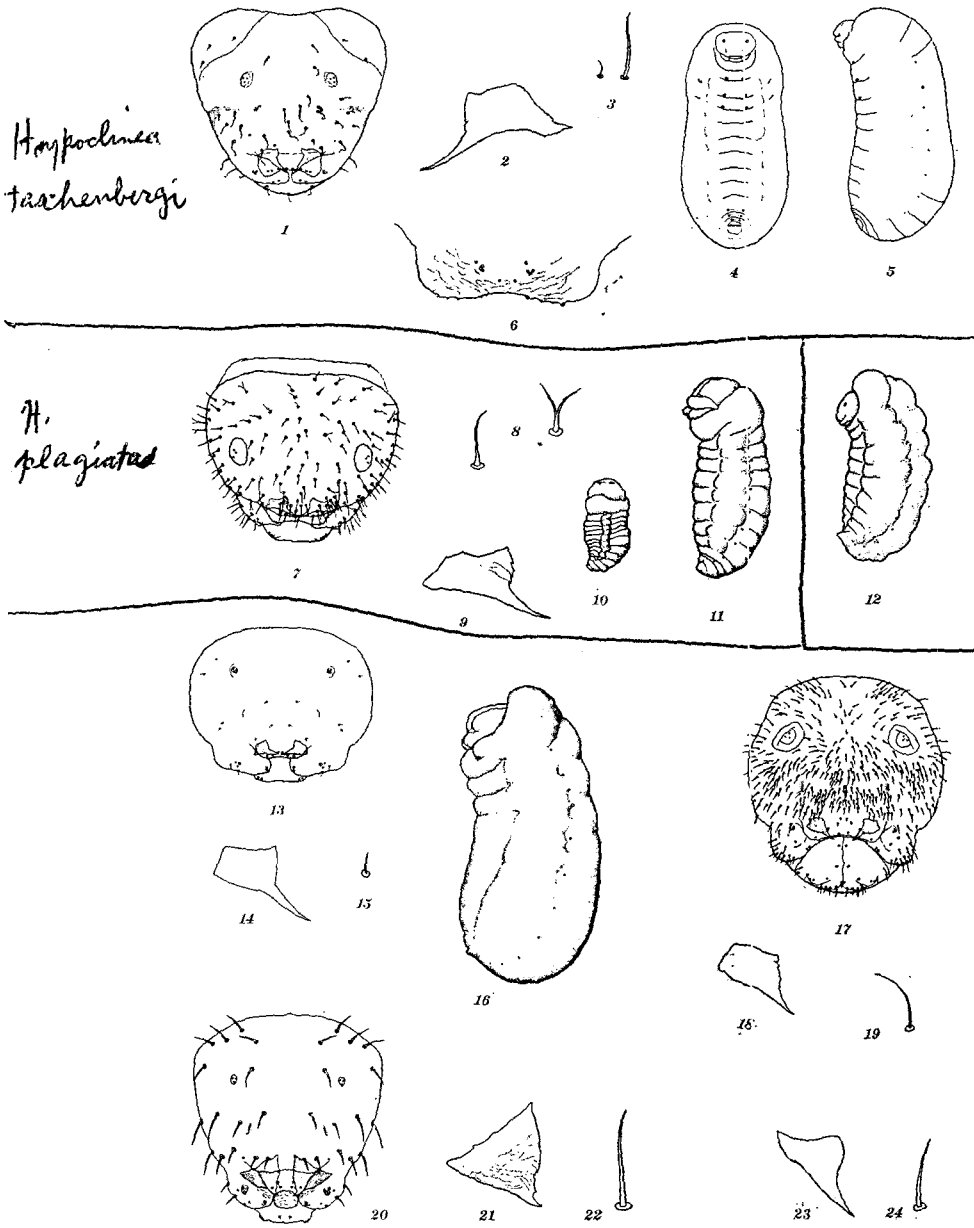
Forel, 1921:— ''Ici la larve courte et épaisse . . . est entièrement immobile et raide, incapable de rien manger, ni même de sucer seule; sa tête blanche et indistincte ne montre aucune mobilité perceptible des mandibules. Bref la larve des *Tapinoma* paraît être réduite à la merci complète du dégorgement des ☿ qui la soignent du reste d'autant mieux'' (p. 24) [''Here the short, thick larva . . . is entirely stiff and motionless, incapable of eating or even sucking on its own account. Its white, indistinct head shows no perceptible mobility in the mandibles. In short, the larvae of *Tapinoma* appear to be entirely at the mercy of

the regurgitation of the ♀ which accordingly take all the more care of them.'' (Forel, 1928, vol. I, p. 24)]. Fig. 1C on p. 23 shows a larva in side view (= 1928, Fig. 1C on p. 23).

Tapinoma nigerrimum (Nylander)

Athias-Henriot, 1947:— ''Le corps est trapu, légèrement arqué, parfaitement cylindrique parce que les segments ne sont pas séparés par des constrictions, mais seulement par un petit pli de la cuticule qui est visible sous forme d'une ligne et même souvent difficile à discerner. A première vue, rien ne distingue le pôle anal du pôle buccal. Sur le premier l'anus est bien visible. Le second porte ventralement un tout petit mamelon buccal, muni de deux minuscules mandibules. Il y a dix segments post-céphaliques. La chitine est parfaitement lisse et dépourvue de toute pilosité. Elle laisse voir par transparence les disques des ailes et des pattes. A un fort grossissement et dans les cas favorables, on peut voir une fine ornementation polygonale de la cuticule, correspondant au dessin des cellules hypodermiques qui l'ont sécrétée. La larve vivante est très blanche'' (p. 252). ''Une pilosité nulle'' (p. 269). Fig. 1 on p. 251 shows a larva in side view. Internal anatomy: pp. 254, 257, 259, 260, 261, 263, 264, 266, 267, 269 and Fig. 5 on p. 265.

Gantes, 1949:— ''a) *Ouvrières*: le corps est massif, subcylindrique, légèrement arqué; le pôle anal et buccal se distinguent facilement; les segments se voient assez nettement: nous en avons 10. On trouve quelques poils simples, épars sur le corps. La tête comprend toutes les pièces buccales, mais peu proéminentes. Je n'ai pu voir les antennes chez une larve d'ouvrière. Le labre est petit et arqué. Les mandibules sont des triangles, plus étroits et plus petits que celles de *Bothriomyrmex*: 0 mm. 040. Le palpe distal de la maxille est exactement à son extrémité au bout duquel il y a deux grosses sensilles à soies; le palpe proximal n'a que quatre sensilles dont deux plus grosses sans soie. Le labium, complètement découvert, laisse voir ses deux palpes à quatre sensilles, dont une seule est sans soie. La partie postérieure de la tête est garnie de huit poils. Chez la larve néonate on voit un seul stigmate, énorme, mésothoracique. Le corps est complètement nu. b) *Sexués*: ils sont beaucoup plus gros, 5mm. Le corps est blanc laiteux, cylindrique, légèrement arqué, la tête sur un petit mamelon et l'anus entre deux lèvres. Les segments sont séparés par des lignes blanches et le corps est complètement nu. Ici j'ai pu voir les antennes, légère saillie à peine visible à un fort grossissement'' (p. 84). Pl. VI, fig. 2: a larva in side view, mandible, maxillary palp, labial palp. The larvae are fed by regurgitation (p. 73). ''Les larves des Formicidés sont des larves apodes ayant toutes à peu près la même forme, sauf chez les larves de sexués où l'on voit des types très différents, exemple: *Pheidole*, *Tapinoma*, *Solenopsis*. D'autres larves de sexués sont simplement plus grosses'' (p. 88). Only nine pairs of spiracles (p. 88). ''La jeune larve de *Tapinoma* a une seule paire de stigmates énormes; ils sont mésothoraciques et restent plus gros chez la larve adulte'' (p. 88). Maxillary and labial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palps have each four sensilla (p. 88). "Chez les larves très évoluées, immobiles, les mandibules sont minuscules. Ces larves évoluées n'ont pas besoin de mandibules tranchantes, car les ouvrières les nourrissent par régurgitation. Ainsi, pour *Tapinoma,* que j'ai observé vivant, les ouvrières lèchent très souvent le mamelon buccal des larves; ces dernières rentrent et sortent leur mamelon et agitent les mandibules. Je n'ai jamais vu de boulette de nourriture près des larves" (p. 88). The larvae are fed by regurgitation (p. 73). "Chez les *Dolichoderidés* les larves sont très évoluées avec encore une progression: *Bothriomyrmex* est plus primitif que *Tapinoma*" (p. 89).

Genus **Technomyrmex** Mayr

Somewhat attenuated toward the posterior end, which terminates in a large hemispherical posterodorsal knob. Ventral profile mostly straight but strongly curved dorsally at the posterior end. Anus posterior. Head and prothorax anteroventral. Only nine pairs of spiracles. Body practically naked; hairs exceedingly few, exceedingly minute and widely scattered. Head large, subhexagonal and practically naked; hairs very few and exceedingly minute. Labrum very small, short and broad; posterior surface with spinules in short oblique rows near each lateral border. Mandibles very small; breadth (at base) equal to length. Palps and galea represented by small clusters of minute sensilla—three in each for the palps and two for the galea.

Technomyrmex sp.

(Pl. IV, fig. 13-16)

Plump and chunky; straight; not attenuated toward the anterior end,

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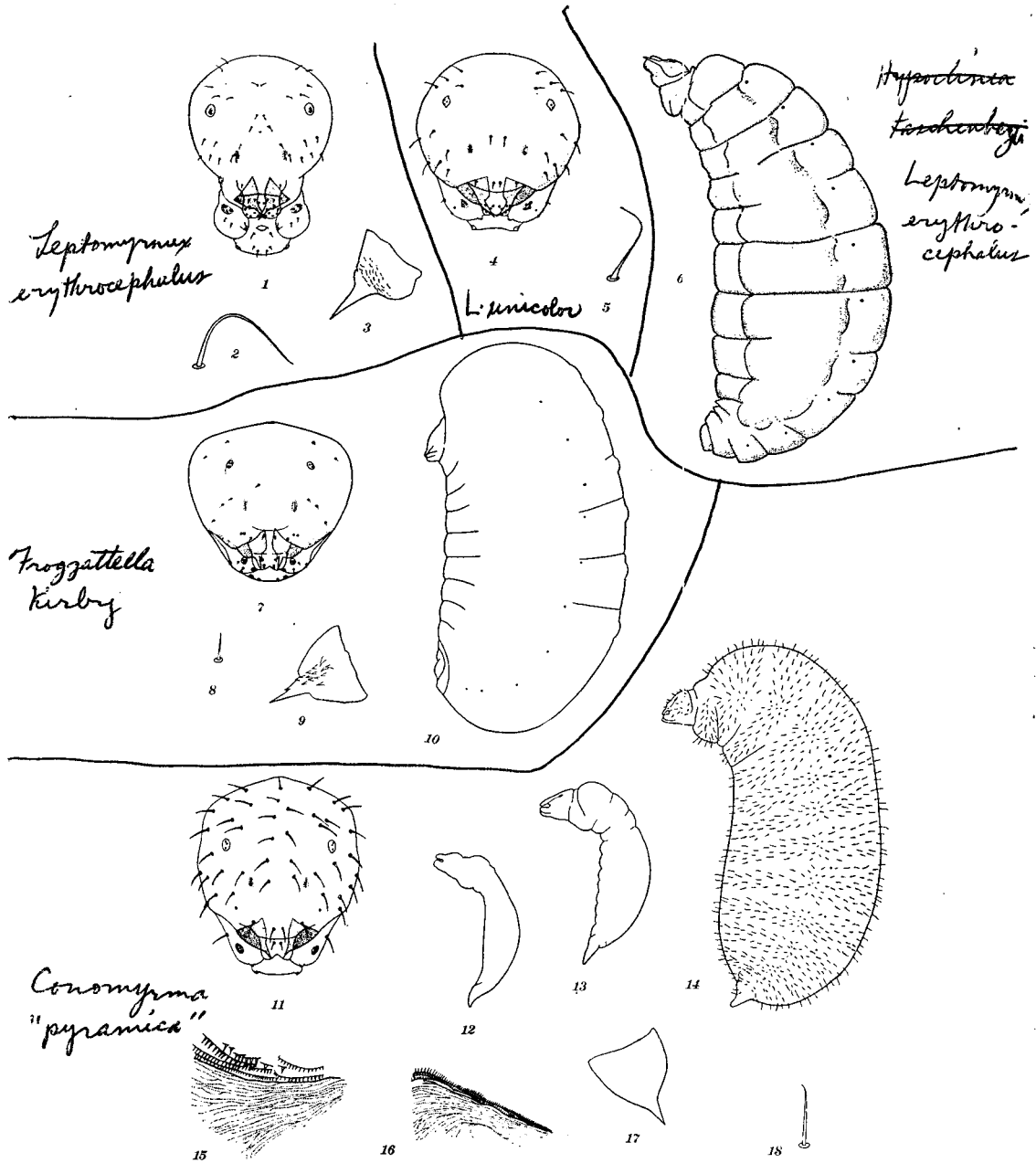
PLATE 30. LARVAE OF DOLICHODERINAE

Dolichoderus (*Hypoclinea*) *taschenbergi* (Mayr), Figs. 1-6—1, head in anterior view, X67; 2, left mandible in anterior view, X237; 3, two body hairs, X237; 4, mature larva in ventral view, X11; 5, larva in side view, X11; 6, labrum in posterior view, X185. *Dolichoderus* (*Hypoclinea*) *plagiatus* (Mayr), Figs. 7-11—7, head of young larva in anterior view, X67; 8, two body hairs, X237; 9, right mandible in anterior view, X237; 10, very young larva in side view, X22; 11, young larva in side view, X22. *Dolichoderus* (*Hypoclinea*) *championi* Forel, Fig 12, young larva in side view, X11. *Dolichoderus* (*Monacis*) *debilis* Emery, Figs. 13-16—13, head in anterior view, X60; 14, right mandible in anterior view, X237; 15, body hair, X467; 16, larva in side view, X22. *Dolichoderus* (*Dolichoderus*) *attelaboides* (Fabricius), Figs. 17-19—17, head in anterior view, X44; 18, right mandible in anterior view, X121; 19, body hair X467. *Araucomyrmex tener* (Mayr), Figs. 20-22—20, head in anterior view, X95; 21, right mandible in anterior view, X235; 22, body hair, X367. *Liometopum apiculatum* Mayr, Figs. 23 and 24—23, right mandible in anterior view, X235; 24, body hair, X467.


Leptomyrmex erythrocephalus
L. unicolor
Leptomyrmex erythrocephalus
Froggattella kirbyi
Conomyrma "pyramica"
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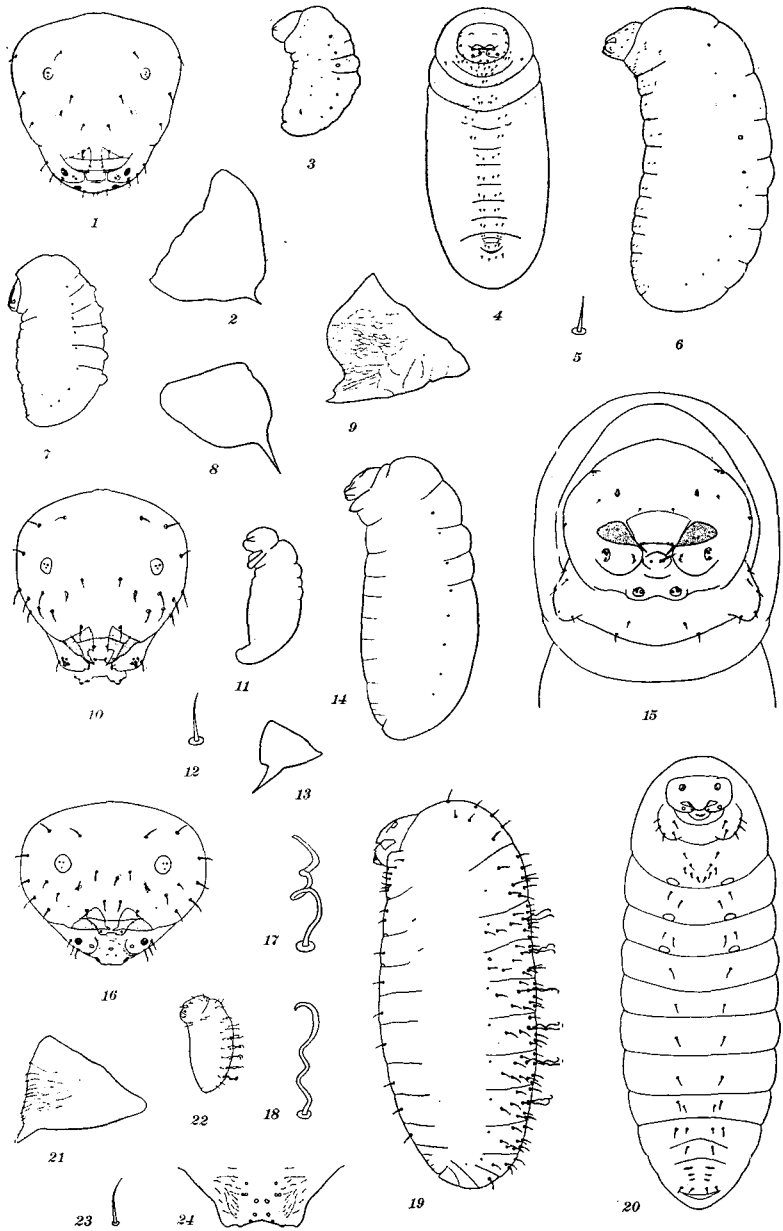
which is broadly rounded and formed from the enlarged dorsal portion of the prothorax; somewhat attenuated toward the posterior end which terminates in a large hemispherical posterodorsal knob. Ventral profile mostly straight, but strongly curved dorsally at the posterior end. Prothorax and head anteroventral. Anus posterior. Leg, wing and gonopod vestiges present. Segmentation indistinct. Spiracles of abdominal somite I enormous; other spiracles small and diminishing posteriorly; spiracles of abdominal somite VIII apparently wanting. Integument spinulose; the spinules coarse and either arranged in short transverse rows or isolated. Body practically naked; hairs exceedingly few, exceedingly minute (length about 0.003 mm) and widely scattered. Head large; subhexagonal in anterior view; narrowed ventrally; slightly broader than long; practically naked; hairs very few and exceedingly minute (about 0.003 mm long.) Antennae small; each with three exceedingly minute sensilla; situated low on the head. Labrum very small, broad and short; breadth about 4× length; ventral border nearly straight and furnished with four minute sensilla; posterior surface with a median cluster of about eight sensilla, from which a few short rows of minute spinules extend obliquely upward toward either side. Mandibles very small and feebly sclerotized; breadth (at base) equal to length; distal half narrowed, slightly curved and sharp-pointed. Maxillae swollen and indistinctly outlined; palp represented by a cluster of three minute sensilla; the galea by a cluster of two sensilla. Labium short; palp represented by a cluster of three minute sensilla; opening of sericteries a short transverse slit. Hypopharynx spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: four integuments from the Philippine Islands.)

Technomyrmex sp.

Apparently similar to the Philippine species described above, except as follows: the integumentary spinules are exceedingly minute and limited to the prothorax; the maxillae have distinct outlines and are not swollen. (Material studied: six integuments from Singapore.)

PLATE 31. LARVAE OF DOLICHODERINAE

Leptomyrmex erythrocephalus (Fabricius), Figs. 1-3 and 6—1, head in anterior view, X44; 2, body hair, X242; 3, right mandible in anterior view, X118; 6, larva in side view, X11. *Leptomyrmex unicolor* Emery, Figs. 4 and 5—4, head (of semipupa?) in anterior view, X57; 5, body hair (of semipupa?), X242. *Froggattella kirbyi* (Lowne), Figs. 7-10—7, head in anterior view, X95; 8, body hair, X467; 9, left mandible in anterior view, X235; 10, larva in side view, X28. *Dorymyrmex pyramicus* (Roger), Figs. 11-18—11, head in anterior view, X95; 12, profile of very young larva, X22; 13, young larve in side view, X22; 14, mature larva in side view, X22; 15, left half of hypopharynx in anterior view, X333; 16, left half of hypopharynx in ventral view, X333; 17, right mandible in anterior view, X235; 18, body hair, X235.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Technomyrmex albipes (F. Smith)

Apparently similar to the Singapore species described above, except as follows:— Body and head hairs longer (0.006 mm). Integumentary spinules as long as body hairs, coarse and isolated or grouped in short transverse rows; most abundant on mesothorax and metathorax; none on ventral surface of prothorax. Six hairs or sensilla on the anterior surface of the labrum; none on the ventral border. (Material studied: two damaged integuments from the Society Islands.)

Technomyrmex bicolor textor Forel

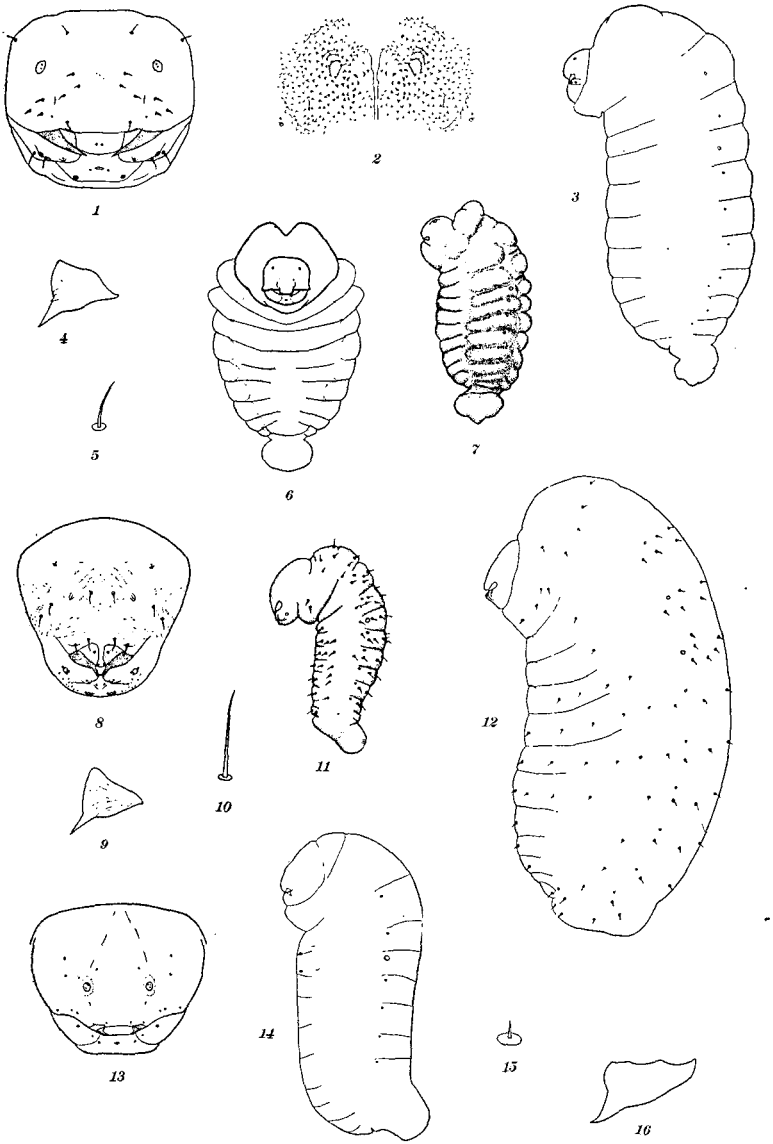
According to Forel (1923, p. 103 = 1928, Vol. 2, p. 285) Jacobson found this ant in Java living in small woven nests (''tissés et mimétiques des lichens''). (Referred to by Athias-Henriot, 1947, p. 259: ''Des larves fileuses, dont la soie est utilisée par les ouvrières''; also by Bischoff, 1927, p. 304.)

Technomyrmex gibbosus Wheeler

Teranishi, 1927 (translated from the Japanese by two university students):— ''There is only one glutinous dorsal tubercle, which is on the last segment. It is directed dorsally and posteriorly. There are a few hairs on the head but none on the body. There is no neck and the body tapers toward the posterior end. The thoracic segments are very large and quite indistinct. The head is slightly larger than in *Iridomyrmex itoi*. The lips are similar, the labrum being indistinct and the labium well developed. The tubercle persists as the larva matures'' (p. 299). Fig. 5, full-grown larva; Fig. 9, second-instar larva (p. 299). ''The function of the glutinous dorsal tubercles is to attach the larva to the walls or ceiling of the nest'' (p. 297). ''The larvae are fed by regurgitation by the workers'' (p. 300).

PLATE 32. LARVAE OF DOLICHODERINAE

Iridomyrmex pruinosus (Roger), Figs. 1-6—1, head in anterior view, X95; 2, right mandible in anterior view, X367; 3, young larva in side view, X22; 4, larva in ventral view, X22; 5, body hair, X367; 6, larva in side view, X22. *Iridomyrmex itoi* Forel, Figs. 7 and 8—7, young larva in side view, X22; 8, right mandible in anterior view, X367. *Iridomyrmex nitidus* Mayr, Fig. 9, left mandible in anterior view, X235. *Bothriomyrmex pusillus* (Mayr), Figs. 10 and 12-14—10, head in anterior view, X118; 12, body hair, X235; 13, left mandible in anterior view, X235; 14, larva in side view, X28. *Bothriomyrmex meridionalis* (Roger), Fig. 11, young larva in side view, X28. *Bothriomyrmex inquilinus* Santschi, Fig. 15, head and prothorax of young larva in ventral view, X118. *Azteca alfari* Emery, Figs. 16-21, 23 and 24—16, head in anterior view, X60; 17 and 18, two views of oncochaetae, X95; 19, larva in side view, X22; 20, larva in ventral view, X22; 21, left mandible in anterior view, X235; 23, simple hair, X95, 24, labrum in posteior view, X185. *Azteca longiceps* Emery, Fig. 22, very young larva in side view, X22.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Discussion

The larvae of the Dolichoderinae—like their adults—constitute a well defined and homogeneous group. They are readily distinguishable from the larvae of other subfamilies by the shape of the body; the position of the head; the indistinct segmentation; the variation in the size of the spiracles of different somites; the paucity and small size of the hairs; the reduced labrum and mandibles; the lack of teeth on the mesal border of the mandibles; the reduction of palps and galea; the scarcity of spinules on the mouth parts; the abundance and arrangement of spinules on the hypopharynx. None of these characters would alone serve to differentiate the larvae from all the genera of other subfamilies, but as a group they define the Dolichoderinae very well.

In general larval taxonomy parallels adult taxonomy. Genera are rather easily separated but the characters are less striking than those which separate ponerine genera. As far as our collection goes, species are distinguishable in *Dolichoderus, Leptomyrmex, Iridomyrmex, Bothriomyrmex* and *Azteca* but not in *Tapinoma.*

The larvae of the Dolichoderinae—again like their adults—are highly specialized. This specialization is manifest in every character in the definition given at the beginning of this paper, except possibly the spinulation of the hypopharynx. Furthermore a phylogenetic tree based on larvae would parallel very closely that based on adults. *Dolichoderus* is probably the most generalized dolichoderine genus we have studied. *Leptomyrmex* is a highly aberrant side-branch. *Liometopum* is probably the most generalized of the Tapinomini; the most specialized genera are *Engramma, Tapinoma* and *Technomyrmex.*

Plate 33. Larvae of Dolichoderinae

Engramma lujae Forel, Figs. 1-7—1, head of immature larva in anterior view, X86; 2, bosses on dorsum of prothorax of mature larva in dorsal view, X95; 3, larva in side view, X22; 4, left mandible in anterior view, X235; 5, body hair, X467; 6, young larva in ventral view, X22; 7, young larva in side view, X22. *Tapinoma sessile* (Say), Figs. 8-12—8, head in anterior view, X121; 9, left mandible in anterior view, X235; 10, body hair, X367; 11, young larva in side view, X44; 12, larva in side view, X44. *Technomyrmex* sp. (from the Philippine Islands), Figs. 13-16—13, head in anterior view, X44; 14, larva in side view, X20; 15, body hair, X867; 16, left mandible in anterior view, X235.

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CORRECTION ON ACAULONA PERUVIANA TOWNSEND

(DIPTERA, LARVAEVORIDAE)

In the Journal of the Washington Academy of Sciences 40 (11): 369-370 (Nov. 15, 1950), I stated that the cotton stainer parasite, *Acaulona peruviana* Tns., had not been formally described, although validated for nomenclatural purposes in a bulletin published in 1928. Accordingly, I described the species from Townsend material, and selected a neotype. However, Dr. Claude Dupuis of Paris has kindly called my attention to the serious oversight of the original description (Townsend, 1913, Psyche 20: 93). Fortunately, this error of cataloguing in no way affects the zoological conclusions of the paper or the status of the new species of *Acaulona* from Puerto Rico.

Inasmuch as the two "male and female . . . types" cited by Townsend as intended for deposit in the U. S. National Museum have not been found in his material, they are presumed lost, and the neotype designation is still pertinent.

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