

## Larvae of the Formicine Ant Genus *Polyrhachis*

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### ABSTRACT

The mature larval stages of 11 species of *Polyrhachis* from Malaysia are described. For 5 of these species (*armata*, *bihamata*, *muelleri*, *scissa* and *ypsilon*) all 5 instars are described. The 17 species that we have described in previous publications are cited but descriptions are not repeated. We are unable to differentiate the larvae of the 10 subgenera studied: the differences among the larvae of the 38 species are not congruent with adult differences and they are not of subgeneric magnitude. We have also stressed the homogeneity of the genera of the tribe Camponotini.

The Old World genus *Polyrhachis* and the cosmopolitan *Camponotus* both belong to the tribe Camponotini, the former has monomorphic workers, while the latter is highly polymorphic. According to Emery's "Genera Insectorum" *Camponotus* is the world's largest genus with 618 species, while *Polyrhachis* is third with 359 species. Wheeler (1922) recognized 36 subgenera in *Camponotus* but only 12 in *Polyrhachis*.

The 11 species of *Polyrhachis* described here for the first time are all from Malaysia, thanks to the very generous donation of Dr. Wolfgang Dorow of Johann Wolfgang Goethe-Universität, Frankfurt am Main, West Germany.

Dr. Dorow included three one-liter bottles each containing the entire brood from a single nest, in order that we might estimate the numbers. Our results follow:

*Polyrhachis bihamata*, coll. No. 173: 7000 larvae, 5200 pupae.

*Polyrhachis bellicosa*, coll. No. 139: 13,000 larvae, 3900 pupae.

*Polyrhachis ypsilon*, coll. No. 156: 11,600 larvae, 6500 pupae.

We are using the mature larva of *Polyrhachis (Myrmhopla) muelleri* Forel as the standard because we have all stages from the first instar inside the egg through prepupa. The other species are described only as they differ from *P. muelleri*. They are arranged alphabetically under subgenera, which are arranged alphabetically.

The 17 species previously described by us are cited by year and page. They were based on a comparison with the mature larva of *P. (Chariomyrma) hookeri* Lowne (Wheeler and Wheeler 1953:205).

*Polyrhachis muelleri* differs from *P. hookeri* in the following details. The entire

integument of *muelleri* is spinulose. *P. hookeri* integument is spinulose only on floor of praesaepium, and all surfaces of AX. The body hairs of *muelleri*: (1) 0.025-0.1 mm long, unbranched, slender, slightly curved, numerous on all somites; (2) 0.036-0.125 mm long, unbranched, denticulate, few, on all somites; (3) 0.2-0.4 mm, uncinatate, stout, few on dorsum of AIII-AVIII; (4) ca. 0.05 mm long, 2- to 6- branched, few, on dorsal and lateral surfaces of abdominal somites. *P. hookeri* body hairs: (1) 0.08 mm long, 2- to 6- branched, branches whip-like; (2) 0.11 mm long, denticulate; (3) 0.13 mm long, unbranched, on venter of T1-AII. *P. muelleri* head hairs 0.05-0.175 mm long, denticulate. *P. hookeri* head hairs, 0.07-0.11 mm long: (1) unbranched; (2) denticulate; (3) 2- to 4- branched.

#### TRIBE CAMPONOTINI

In our initial treatment of the larvae of the subfamily (Wheeler and Wheeler 1953) we characterized the tribe Melophorini in 6 lines, Prenolepidini in 2 and Formicini in 9; but Camponotini required 37. Seven tribes could not be characterized at all, because the genera did not have enough characters in common. The genera in the tribe Camponotini are so deficient in conspicuous differences that we did not attempt to separate them in our 1976 key. We stress this homogeneity to show why we have not been able to separate the subgenera of *Polyrhachis*.

The only exceptions: (1) *Colobopsis* (which was formerly a subgenus of *Camponotus*) in which both larval and adult characters are so different that we restored it to generic rank in 1982. (2) In 1988 we removed *Notostigma* from the tribe when we found that the larvae did not possess a chilosclere, which is distinctly characteristic of the tribe and in which the adult also shows marked differences.

The net result is that we regard the tribe Camponotini as comprising ten genera: *Calomyrmex*, *Camponotus*, *Colobopsis*, *Dendromyrmex*, *Echinopla*, *Opisthopsis* and *Polyrhachis*, which we have studied, and 3 (*Forelophilus*, *Overbeckia*, *Phasmomyrmex*) which we have not seen.

#### Genus *POLYRHACHIS* F. Smith

CHARACTERIZATION. Cranium subtrapezoidal in anterior view, wider below, or transversely subelliptical. Antennae large. Gula spinulose. Head hairs moderately long. Mandible with few longitudinal ridges, some of which may bear minute spinules. Maxillary palp a stout-based skewed peg; galea a tall frustum. Labial palp a low knob.

#### Subgenus *MYRMHOPLA* Forel

#### ***Polyrhachis muelleri* Forel**

Figures 1-6

EGG. 0.44 X 1.12 mm to 0.5 X 1.2 mm.

FIRST INSTAR LARVA. Length (through spiracles) 1.1-2.1 mm. Body straight; head on anterior end, greater in diameter than T1; anus posteroventral. Spiracles all 0.001 mm in diameter. Integument spinulose. Body hairs very few, 0.063-0.13 mm long, uncinatate, 8-10 on each T1-T2, 4 on T3, 2-8 on AI, 2-6 on AII, 2-4 on AIV. Cranium feebly transversely subelliptical. Antennae small, above midlength of cranium. Head hairs few (ca. 22). Of 2 types: (1) 0.05-0.138 mm long, unbranched, the longest flexuous; (2) 0.05-0.075 mm long, unbranched, uncinatate, few (ca. 6). Labrum paraboloidal, small; anterior surface with ca. 14 hairs, 0.025-0.05 mm long; ventral surface with 4 sensilla; posterior surface with numerous

ridges (or rows of minute spinules?) and 16 sensilla middorsally. Mandible small, feebly sclerotized, short, subtriangular, with a small apical denticle; anterior and posterior surfaces with feeble rows of vertical ridges; medial surface with a few minute denticles. Maxilla divided into 2 portions: (1) basal portion swollen laterally and bearing palp and galea, which are subequal in height, palp a short peg with 5 sensilla and galea a short knob with 2 apical sensilla; (2) apex stout and digitiform. Labium with numerous ridges (or rows of spinules?); palp a slight elevation with 5 sensilla; opening of sericteries a short transverse slit with a slight elevation adjacent to each end. Hypopharynx with numerous transverse rows (ridges or rows of minute spinules?)

**SECOND INSTAR LARVA.** Length (through spiracles) 1.8-2.5 mm. Similar to first instar larva except as follows. Spiracles on T2 = 0.008 mm, T3-AVIII = 0.005 mm in diameter. Body hairs of 2 types: (1) 0.05-0.125 mm long, uncinata, 14 on T1, 12 on T2, 4 on T3, 2 on each AI-AIII; (2) 0.13-0.2 mm long, whip-like, on T2-AI. Cranium subtrapezoidal, widest ventrally. Head hairs 0.05-0.1 mm long, more numerous (ca. 40), unbranched, 8 feebly hooked, remainder slightly curved. Labrum with small feebly stained chiloscleres. Mandible with more prominently erose medial surface. Maxilla with stouter apical portion; palp a subcone; galea a slender subcone, taller than palp. Labial palp taller; opening of sericteries with a small knob at each end.

**THIRD INSTAR LARVA.** Length (through spiracles) 3.1-3.7 mm. Similar to second instar larva except as follows. Praesaepium feebly developed. Spiracles 0.008 mm in diameter. Body hairs of 2 types: (1) 0.05-0.175 mm long, unbranched, denticulate; (2) ca. 0.3 mm long, uncinata, 4 on dorsum of each AIII-AVI and AVIII, 6 on AVII.

**FOURTH INSTAR LARVA.** Length (through spiracles) 4.1-6.4 mm. Similar to third instar larva except as follows. Praesaepium well developed; anus with anterior and posterior lips. Integument on venter of T1-AII spinulose, the spinules minute and in rows. Spiracles on T2 = 0.02 mm, T3-AVIII = 0.018 in diameter. Body hairs rather numerous. Of 3 types: (1) 0.033-0.163 mm long, denticulate, on all somites; (2) 0.025-0.15 mm long, unbranched, slightly curved to flexuous, on anteroventral surfaces; (3) ca. 0.325 mm long, uncinata, 6 on each AIII-AVI, 8 on each AVII-AVIII. Head hairs moderately numerous (ca. 60), 0.05-0.125 mm long, denticulate. Labrum with well developed chiloscleres. Mandible camponotoid, apex short and sharply curved medially; anterior and posterior surfaces with rather large sublongitudinal arcuate ridges, some bearing spinules; middle portion of medial surface with small denticles. Maxilla with spinulose integument; basal portion swollen ventrally; apex digitiform and directed medially; palp a frustum; galea a subcone. Labium with numerous fine rows of minute spinules; palp a short subcone; opening of sericteries wide and salient. Hypopharynx densely spinulose, the spinules arranged in rows, the rows grouped in 2 subtriangles with bases near middle.

**FIFTH INSTAR (= MATURE) LARVA.** Length (through spiracles) 6.9-9.1 mm. Profile pogonomymecoid (i.e., diameter greatest near middle of abdomen, decreasing gradually toward head and more rapidly toward posterior end, which is rounded; thorax more slender than abdomen and forming a neck, which is curved ventrally). Praesaepium well developed (i.e., posterior portion of AII raised to form a transverse welt and, on either side, ridges extend forward from welt to form sides of praesaepium); floor of praesaepium without hairs, densely spinulose, spinules in transverse rows. Anus posteroventral, with a prominent posterior lip. Gonopod and leg vestiges present. Spiracles T2 = 0.023 mm, T3-AVIII = 0.018 mm in diameter. Entire integument densely spinulose, spinules minute and in short transverse rows. Body hairs rather sparse. Of 4 types: (1) 0.035-0.1 mm long, unbranched, slender, slightly curved, numerous on all somites; (2) 0.038-0.125 mm long, denticulate, few on all somites; (3) 0.2-0.4 mm long, uncinata, stout, few on dorsum of AIII-AVIII; (4) ca. 0.05 mm long 2- to 6-branched, few, on dorsal and lateral surfaces of abdominal somites. Cranium subtrape-

zoidal, widest ventrally, 1.6 wider than long. Antennae large, above midlength of cranium, each with 3 sensilla on a slight elevation on a larger base. Head hairs moderately numerous (ca. 80); 0.05-0.175 mm long, denticulate. Labrum paraboloidal; chiloscleres (i.e., the pair of conspicuous dark brown spots, 1 on either side of labrum, consisting of a bar along the lateral margin of the labrum, from this a branch extends at a right angle onto, and fades out on, the anterior surface) well developed; anterior surface with ca. 24 hairs and 8 sensilla; ventral surface with 4 sensilla and minute spinules; posterior surface densely spinulose, the spinules in numerous short arcuate rows, the rows subparallel to ventral border, ca. 20 sensilla. Mandible camponotoid (i.e., subtriangular; base broad, its width at least 2/3 its length; apex forming a small short tooth; no medial teeth; medial border erose); anterior and posterior surfaces of apical portion with rather coarse arcuate longitudinal ridges, some of which bear spinules, subapical quarter of medial surface with a few small sharp denticles. Maxilla with base swollen ventrolaterally, integument with short rows of rather long spinules, palp a short subcylinder with 5 (4 apical and 1 subapical) sensilla; galea digitiform with 2 apical sensilla; apical portion of maxilla digitiform, directed medially, spinulose. Labium with numerous subtransverse rows of minute spinules; palp a slender frustum with 5 (4 apical and 1 subapical) sensilla; opening of sericteries a transverse slit, salient, with a sclerotized subtriangular area at each end. Hypopharynx densely spinulose, the spinules arranged in subtransverse rows, the rows grouped in 2 subtriangles with bases near the middle.

Material studied; numerous larvae from Gombak Field Station (30 km N Kuala Lumpur), #936, #937, #981B.

Subgenus *CAMPOMYRMA* Wheeler

*Polyrhachis femorata* F. Smith (1953:207).

*Polyrhachis hecuba* Forel (1970:649).

*Polyrhachis schwiedlandi* Forel (1974:62).

*Polyrhachis* sp. (1968:22; p. 212, fig. 12-18).

Subgenus *CYRTOMYRMA* Forel

***Polyrhachis rastellata*** (Latreille)

Figure 7

**MATURE LARVA.** Length (through spiracles) 4.1-6 mm. Similar to *P. muelleri* except as follows. Body hairs of 4 types: (1) 0.025-0.09 mm long, unbranched, denticulate apically, on all somites; (2) 0.019-0.075 mm long, 2- to 5-branched, most numerous of T1 decreasing to AVIII; (3) 0.05-0.2 mm long, unbranched, slender, flexuous, ventrolaterally on T1-AIII and a pair each on AIV-AVI; (4) ca. 0.15 mm long, uncinuate, 4-6 on AIII, 10 on AIV, 10-12 on AV, 12 on AVI. Cranium transversely subelliptical. Head hairs shorter (0.025-0.075 mm long), unbranched, with or without denticles. Anterior surface of labrum with ca. 8 hairs.

**IMMATURE LARVA.** Length (through spiracles) ca. 2.8 mm. Similar to mature larva except as follows. Body hairs of 4 types: (1) 0.013-0.09 mm long, longest ventrolaterally on anterior somites, unbranched, slightly curved; (2) 0.013-0.05 mm long, apex denticulate; (3) 0.05-0.1 mm long, uncinuate, 8 on AIII, 14 on each AIV-AV, 16 on AVI, 12 on each AVII-AX; (4) 0.019-0.03 mm long, 2- to 3-branched, very few. Chiloscleres feeble. Mandible small and stout; ridges on anterior and posterior surfaces feeble. Maxillary apex stout and digitiform.

**VERY YOUNG LARVA.** Length (through spiracles) 1.3-1.6 mm. Similar to immature larva except as follows. Body hairs very few, 0.025-0.075 mm long, uncinuate, on dorsal surface of each somite: 2 on T1, 2-4 on T2-AI, 6-8 on AII-AIII, 8-10 on AIV, 8 on AV, 8-

12 on AVI-AVII, 6-8 on AVIII, 4-8 on AIX, 4 on AX. Cranium subcircular in anterior view. Head hairs few (ca. 22), ca. 0.025 mm long, uncinat. Mandible feebly sclerotized; lateral border saddle-shaped, medial border sigmoid; anterior and posterior surfaces with shorter ridges; medial surface with erose area; apex short, stout, acute. Maxillary apex stout digitiform with few isolated spinules; palp a short peg; galea a short cone. Labial palp a slight elevation; opening of sericteries a short transverse slit.

Material studied: numerous larvae from Gombak Field Studies Center (30 km N Kuala Lumpur), #443 and Genting Highlands (50 km N Kuala Lumpur), #797.

Subgenus *HAGIOMYRMA* Wheeler

*Polyrhachis schencki* Forel (1968:221).

Subgenus *HEDOMYRMA* Forel

*Polyrhachis chrysothorax* Viehmeyer (1974:62).

*Polyrhachis turneri* Forel (1974:62).

*Polyrhachis* sp. (1968:221; p. 212, fig. 20).

Subgenus *HEMIOPTICA* Roger

***Polyrhachis scissa* Roger**

FIFTH INSTAR (=MATURE) LARVA. Length (through spiracles) 4.6-8.3 mm. Similar to mature larva of *P. muelleri* except as follows. Integument on venter of anterior somites only with numerous spinules in short transverse rows. Body hairs moderately numerous. Of 3 types: (1) 0.025-0.23 mm long, 3- to 6-branched (rarely 2-branched), on all somites, longest anteriorly; (2) 0.05-0.15 mm long, with stout unbranched shaft, distally lanceolate with denticulate border; (3) 0.15 to at least 0.45 mm long, whip-like, ventrolaterally on anterior somites and on dorsum of AII-AVIII, shorter ventrally. Head hairs less numerous (ca. 60), longer (0.075-0.2 mm long). Labrum with fewer (ca. 12) hairs, shorter (0.025-0.05 mm long) and fewer sensilla (ca. 4).

FOURTH INSTAR LARVA. Length (through spiracles) 2.8-3.6 mm. Similar to mature larva except as follows. Body hairs moderately numerous on thorax, decreasing posteriorly. Of 4 types: (1) 0.025-0.075 mm long, 3- to 6-branched, most numerous of thorax, decreasing posteriorly; (2) 0.025-0.175 mm long, uncinat, rather numerous on T1-AI, few on AII-AIII, more numerous on AVIII-AX; (3) at least 0.375 mm long, whip-like, on AII-AVIII; (4) 0.025-0.125 mm long, stout, denticulate. Head hairs of two types: (1) 0.1-0.15 mm long, flexuous; (2) 0.025-0.075 mm long, stout, distal portion denticulate.

THIRD INSTAR LARVA. Length (through spiracles) ca. 2.4 mm. Similar to fourth instar except as follows. Body hairs few. Of 2 types: (1) 0.025-0.15 mm long, uncinat, on dorsal and dorsolateral surfaces of T1-T3 and dorsal surfaces of AI-AII; (2) at least 0.325 mm long, whip-like, 10 on AIII, 8-9 on AIV, 2 on AV. Head hairs more numerous (ca. 74). Of 2 types: (1) 0.025-0.175 mm long, unbranched, flexuous; (2) 0.05-0.075 mm long, uncinat, near dorsal border. Galea on maxilla a subcone.

SECOND INSTAR LARVA. Length (through spiracles) 1.4-1.9 mm. Similar to third instar except as follows. Head about same in diameter as T1. Body hairs few. Of 4 types: (1) 0.1-0.13 mm long, uncinat, on T1-AII; (2) ca. 0.6 mm long, whip-like, 8-10 on dorsum of AIII, 4-10 on AIV; (3) ca. 0.5 mm long, unbranched, slightly curved, ventrolaterally on T1; (4) 0.05 mm long, 2- to 3-branched, rare, on T1. Head hairs few (ca. 35). Of 2 types: (1) 0.038-0.088 mm long, uncinat; (2) 0.025-0.063 mm long, unbranched, slightly curved. Mandible relatively smaller and shorter. Opening of sericteries a short transverse slit.

FIRST INSTAR LARVA. Length (through spiracles) ca. 1.4 mm. Similar to second instar

except as follows. Body straight; head greater in diameter than T1. Body hairs ca. 0.1 mm long, uncinata, 12 on T1. Cranium subhemispherical. Head hairs less numerous (ca. 45). Of 2 types: (1) 0.05-0.88 mm long, uncinata; (2) ca. 0.063 mm long, unbranched, slender, few. Mandible smaller, stouter, with a few short ridges on anterior and posterior surfaces, a few small denticles on medial surface. Maxilla with stout paraboloidal apex; palp a rounded knob; galea a skewed lobe with 2 apical sensilla on a small terminal papilla.

Material studied: numerous larvae from Pasoh, near Field Study Center, #890; Gombak Field Study Center (30 km N Kuala Lumpur), #933.

Subgenus *MYRMA* Billberg

*Polyrhachis gagates* F. Smith (1953:207, p. 203 fig.19-22; 1976:63).

*Polyrhachis laboriosa* F. Smith (1953:207; 1974:63).

*Polyrhachis militaris cupreopubescens* Forel (1953:207).

Subgenus *MYRMATOPA* Forel

*Polyrhachis* sp. (1953:208).

Subgenus *MYRMHOPLA* Forel

***Polyrhachis arachne* Emery**

**MATURE LARVA.** Length (through spiracles) 5.1-7.9 mm. Similar to *P. muelleri* except as follows. Body hairs numerous. Of 4 types: (1) 0.075-0.15 mm long, with short base and long 3- to 6-branches, on posterodorsal portions of T1-T2, on dorsal and lateral surfaces of AI-AIII, on all surfaces of AIV-AIX and anterior portion of AX; (2) 0.05-0.275 mm long, unbranched, slightly curved, with numerous denticles apically, on ventrolateral and lateral surfaces of T1-AI, few on each AII-AIII and on all surfaces of AIX-AX; (3) up to at least 0.75 mm long, whip-like, on ventrolateral surfaces of T1-AIII adjacent to praesaepium, fewer on all surfaces of AIV-AVIII; (4) ca. 0.36 mm long, stout, with slightly curved shaft, uncinata, about 20 on dorsum of AVIII. Cranium transversely subelliptical. Head hairs fewer (about 62), 0.07-0.15 mm long, unbranched, slightly curved. Anterior surface of labrum with ca. 8 hairs (0.025-0.38 mm long) and 10 sensilla; ventral surface with numerous rows of minute spinules which continue onto anterior and posterior surfaces.

**YOUNG LARVA.** Length (through spiracles) 3.1 mm. Similar to mature larva except as follows. Body hairs sparse. Of 3 types: (1) 0.05-0.125 mm long, 2- to 3-branched, on dorsal and lateral surfaces of T1-AIII, on all surfaces of AIV-AX; (2) 0.1-0.2 mm long, uncinata, on dorsal and lateral surfaces of T1-AII and AVIII-AX; (3) 0.15-0.5 mm long, whip-like, on all surfaces of AII-AVIII. Head hairs less numerous (ca. 50). Of 2 types: (1) 0.1-0.15 mm long, unbranched, slender; (2) ca. 0.1 mm long, uncinata, ca. 2 near dorsal border. Chiloscleres feeble.

**VERY YOUNG LARVA.** Length (through spiracles) ca. 1.4 mm. Head on anterior end, greater in diameter than body, rudimentary praesaepium present, remainder of body decreasing in diameter posteriorly; posterior end narrowly rounded. Entire integument spinulose, the spinules minute and in short transverse rows, spinules largest on venter of T1. Body hairs of 3 types: (1) 0.075-0.13 mm long, uncinata, on dorsal and lateral surfaces of T1-T3, and on dorsal surface of AI-AVIII, on all surfaces of AIX-AX; (2) 0.025-0.06 mm long, unbranched, slightly curved, stout, adjacent to praesaepium; (3) 0.1-0.19 mm long, whip-like, on dorsal and lateral surfaces of AII-AVII. Head hairs fewer (ca. 46); 0.05-0.1 mm long, slender, uncinata. Mandible feebly sclerotized; anterior and posterior surfaces spinulose. Maxillary palp a short frustum; galea a short subcone. Labial palp a rounded knob.

Material studied: numerous larvae from Gombak Field Studies Center (30 km N Kuala Lumpur), #939; Kepong, Forest Research Institute (30 km E Kuala Lumpur), #958.

***Polyrhachis armata* Le Guillou**

FIFTH INSTAR (=MATURE) LARVA. Length (through spiracles) 5.9-11.4 mm. Similar to *P. muelleri* except as follows. Spiracles on T2 = 0.03 mm, T3 = 0.028 mm, AI = 0.025 mm, AVIII = 0.023 mm in diameter. Body hairs moderately numerous. Of 4 types: (1) 0.05-0.175 mm long, unbranched, slightly curved, denticulate apically, on all somites; (2) 0.1-0.35 mm long ventrally and up to at least 0.6 mm long on dorsal and lateral surfaces of AII-AVII, whip-like; (3) 0.05-0.125 mm long, 2- to 6- branched, few on T2-AIX; (4) 0.175-0.225 mm long, uncinata, ca. 18 on dorsum of either AVII or AVIII. Head hairs fewer (64-72), with or without denticles. Labrum with fewer hairs (ca. 10); posterior surface with fewer (ca. 14) sensilla. Mandible with more numerous ridges.

FOURTH INSTAR LARVA. Length (through spiracles) 3.3-4.7 mm. Similar to mature larva except as follows. Diameter of spiracles of T2 = 0.015 mm, on AVIII = 0.013 mm. Integument on venter of anterior somites and dorsum of posterior somites with minute spinules in short transverse rows. Body hairs sparse. Of 3 types: (1) 0.063-0.175 mm long, uncinata, on dorsal and lateral surfaces of AI-AIII, AIX-AX, few on dorsal surface of AVI-AVIII, few on AIV-AV; (2) 0.375-0.45 mm long, whip-like, on dorsal and lateral surfaces of AI-AVI, few on T1-T3; (3) ca. 0.1 mm long, unbranched, denticulate. Cranium feebly subtrapezoidal. Head hairs fewer (ca. 66) 0.038-0.088 mm long, unbranched, smooth or denticulate, some feebly uncinata. Hairs on anterior surface of labrum shorter (0.013-0.05 mm long). Mandible with short apical tooth turned medially, anterior and posterior surfaces with feebler ridges. Maxillary palp a short knob; galea a subcone. Labial palp a slightly raised cluster of sensilla.

THIRD INSTAR LARVA. Length (through spiracles) 2.4-2.8 mm. Similar to fourth instar except as follows. Body hairs: (1) 0.1-0.15 mm long, uncinata, on T1-AIII and AVII-AX (numerous on dorsum of AVII-AVIII); (2) at least 0.5 mm long, whip-like, few on T3-AVIII, more numerous on AVII-AIX (most numerous on AVI-AVII); (3) 0.025-0.15 mm long, unbranched, slightly curved, with or without denticles. Head hairs fewer (ca. 55), 0.038-0.063 mm long. Mandible subtriangular, apex short and curved medially. Opening of sericteries narrower.

SECOND INSTAR LARVA. Length (through spiracles) 1.9-2.1 mm. Similar to third instar except as follows. Diameter of spiracles: T2 = 0.013 mm, T3-AVIII = 0.01 mm. Integument on ventral surface of T1-T3 with rows of minute spinules. Body hairs 0.05-0.1 mm long, uncinata, ca. 20 on T1, 18 on T2, 10 on T3, 2 on each AI-AII. Cranium transversely subelliptical. Head hairs fewer (ca. 45), ca 0.05 mm long, uncinata. Apex of maxilla stouter; palp a slight elevation; galea a small skewed peg. Labial palp a slightly raised cluster of sensilla.

FIRST INSTAR LARVA. Length (through spiracles) 1.8-2.1 mm. Similar to second instar except as follows. Body straight, head on anterior end. Integument with a few spinules on venter of T1-AI. Body hairs 0.1-0.115 mm long, uncinata, 4 on T1, 2 on T2. No head hairs. Chiloscлерes very feeble. Maxillary apex a stout spinulose subcylinder; palp a short knob; galea a skewed cone.

EGG. 0.36 X 1.32 mm to 0.48 X 1.2 mm.

Material studied: numerous larvae from Gentry Highlands (50km N Kuala Lumpur), #275.

*Polyrhachis dives* F. Smith (1953:208).

*Polyrhachis hippomanus* F. Smith (1970:649).

**Polyrhachis hodgsoni** Forel

**MATURE LARVA:** Length (through spiracles) 4.7-5.1 mm. Similar to *P. muelleri* except as follows. Body hairs dense. Of 4 types: (1) 0.038-0.175 mm long, stout shaft, apically lanceolate with denticulate border, on T2-AII and AVIII-AX, few elsewhere; (2) 0.05-0.18 mm long, 2- to 4-branched, dense on AIII-AVII, fewer on T1-AII, none on AIX-AX; (3) 0.05-0.2 mm long, unbranched, whip-like, on ventrolateral surfaces of T1-AIII and dorsum of AVI; (4) ca. 0.075 mm long, uncinuate, on dorsum, 12 on each AVII and AVIII. Head hairs fewer (ca. 54). Of 2 types: (1) ca. 0.2 mm long, unbranched, flexuous; (2) ca. 0.2 mm long, uncinuate. Anterior surface of labrum with fewer hairs (8) and sensilla (8); ventral border with numerous spinules.

**IMMATURE LARVA.** Length (through spiracles) ca. 2.3 mm. Similar to mature larva except as follows. Body hairs numerous on thorax, decreasing in number posteriorly. Of 5 types: (1) 0.025-0.1 mm long, 2- to 5-branched, on all somites, decreasing in number and in number of branches posteriorly; (2) 0.025-0.15 mm long, uncinuate, on T1-T3 and AVII-AX; (3) 0.075-0.2 mm long, unbranched, flexuous, on each somite; (4) 0.025-0.1 mm long, with heavy shaft and denticulate apical portion; (5) at least 0.175 mm long, whip-like on dorsum of AV-AVI. Head hairs fewer (ca. 38), 0.05-0.1 mm long, flexuous or uncinuate. Labrum with 12 hairs and 4 sensilla on anterior surface, ventral surface with 4 sensilla. Mandible with apex turned sharply medially. Maxillary palp a small cylinder with 5 (2 apical, 2 subapical and 1 lateral) sensilla.

**YOUNG LARVA.** Length (through spiracles) 1.4 mm. Similar to immature larva except as follows. Body J-shaped, thorax curved ventrally; head slightly larger in diameter than T1. Body hairs very few. Of 4 types: (1) 0.025-0.11 mm long, uncinuate on T1- AII, longer on AIX-AX; (2) ca. 0.03 mm long, unbranched, slightly curved, ventrolaterally on T1-T3 (ca. 14 on T1, 5 on T2, 4 on T3); (3) 0.038 mm long, 2- to 5-branched, few on dorsum of each T1-T3; (4) ca. 0.05 mm long, with denticulate shaft, very few on T1-T2. Head hairs fewer (ca. 42). Of 2 types: (1) 0.05 mm long, unbranched; (2) ca. 0.063 mm long, uncinuate. Labrum without chiloscleres; anterior surface with 12 hairs and 6 sensilla. Mandible subtriangular, feebly sclerotized, with apex short, sharp and curved medially. Labium lacking spinules; palp a small disc.

**VERY YOUNG LARVA.** Length (through spiracles) ca. 1 mm. Similar to young larva except as follows. Slender, straight, posterior end rounded; head on anterior end and greater in diameter than T1. Integument of T1 and T2 with minute spinules in short rows. Body hairs very few, 0.025-0.06 mm long, uncinuate, 14 on T1, 10 on T2. Cranium subcircular. Head hairs few (ca. 24), 0.025-0.05 mm long, uncinuate. Anterior surface of labrum with 12 hairs and 4 sensilla; ventral surface spinulose and with 4 sensilla. Mandible subtriangular, wider than long, apex short, straight, directed ventromedially. Maxilla with apical portion paraboloidal and spinulose; palp a small disc; galea a short frustum. Labium lacking spinules; palp a small disc; opening of sericteries a short transverse slit.

Material studied: numerous larvae from Gombak Field Study Center (30 km N Kuala Lumpur), #907.

**Polyrhachis rubiginosa** Le Guillou

**MATURE LARVA.** Length (through spiracles) 6.9-14.8 mm. Similar to *P. muelleri* except as follow. Integument of T1-AIII with numerous long, fine spinules in transverse rows. Body hairs moderately numerous, short. Of 5 types: (1) 0.025-0.225 mm long, with stout shaft, lanceolate with denticulate border, most numerous on T1-AIII and AIX-AX; (2) 0.025-0.075 mm long, 2- to 6-branched, numerous on posterior portion of AIII and all surfaces of AIV-



AVIII; (3) 0.2-0.4 mm long, uncinata, on dorsum (2 on AV, 4 each on AVI-AVIII); (4) ca. 0.6 mm long, whip-like, 2-4 on AV; (5) 0.013-0.023 mm long, unbranched, flexuous, adjacent to praesaepium. Cranium transversely subelliptical, anteroventral portion of integument with numerous arcuate rows of minute spinules. Head hairs slightly more numerous (90); shorter (0.025-0.075 mm long), unbranched, slightly curved.

**SUBMATURE LARVA.** Length (through spiracles) 5 mm. Similar to mature larva except as follows. Body hairs sparse. Of 4 types: (1) 0.025-0.05 mm long, 2- to 6-branched, on T1-AIX, most numerous and longest on T1-T3; (2) 0.025-0.175 mm long, unbranched, longest (and only hairs) on AX; (3) 0.025-0.1 mm long, with stout base and denticulate apex; (4) 0.125-0.25 mm long, uncinata, few on dorsum of AIV-AVI and AIX. Head hairs 0.05-0.113 mm long. Labrum with feeble chiloscleres. Mandible with apical tooth shorter and abruptly turned medially. Maxilla without spinules on basal portion, apex short and stouter; palp a frustum with 5 (1 apical, 3 subapical, 1 lateral) sensilla. Labium without spinules, a slight swelling at each end of opening of sericteries.

**YOUNG LARVA.** Length (through spiracles) ca. 2.3 mm. Similar to submature larva except as follows. Body hairs of 2 types: (1) 0.025-0.1 mm long, unbranched, on dorsum of thorax; (2) 0.075-0.15 mm long, uncinata, on dorsum of T1-T3 and 2 on AI. Anterior surface of labrum with ca. 14 hairs. Maxilla with short rounded apex; palp a slightly raised cluster of sensilla; galea a small cone. Labial palp a cluster of 5 sensilla.

**VERY YOUNG LARVA.** Length (through spiracles) ca. 2 mm. Similar to young larva except as follows. No body hairs. About 8 head hairs, 0.025 mm long, uncinata. Mandible feebly sclerotized, wider than long, short and stout, apex blunt; with numerous fine ridges on anterior and posterior surfaces; medial surface with a few sharp denticles. Maxilla with basal portion not swollen laterally; apex subhemispherical, denticulate.

**EGG.** 0.68 X 1.4 mm.

Material studied: Numerous larvae from Gombak Field Studies Center (30 km N Kuala Lumpur), #1341, #1585.

*Polyrhachis simplex* Mayr (1953:210; 1970:249; 1974:63).

*Polyrhachis wheeleri* Mann (1970:619).

#### Subgenus *MYRMOTHRINAX* Forel

#### *Polyrhachis thrinax* Roger

**MATURE LARVA.** Length (through spiracles) 3.3-6 mm. Similar to *P. muelleri* except as follows. Body hairs moderately abundant. Of 3 types: (1) 0.025-0.088 mm long, unbranched, denticulate, on all somites; (2) about 0.18 mm long, uncinata, on T2-AII and AIX-AX; (3) ca. 0.175 mm long, whip-like, on AIII-AVI, few; (4) 0.025-0.037 mm long, 2- to 4-branched, on T1-AVII, very few. Head hairs fewer (ca. 85) and shorter. Of 2 types: (1) 0.025-0.05 mm long, uncinata; (2) ca. 0.025 mm long, slightly curved, denticulate apically. Labrum with feeble small chiloscleres; anterior surface with 8 hairs and 6 sensilla. Mandible with apex short, acuminate and turned medially; anterior and posterior surfaces finely rugose, medial border with small denticles. Maxillary palp a frustum, galea subconical. Labial palp a short frustum; opening of sericteries with a rounded knob at each end.

**SUBMATURE LARVA.** Length (through spiracles) ca. 2.3 mm. Similar to mature larva except as follows. Body hairs sparse. Of 4 types: (1) 0.025-0.075 mm long, unbranched, slightly curved, on all somites; (2) 0.025-0.125 mm long, uncinata, on T2-AII and AIX-AX; (3) ca. 0.175 mm long, whip-like, on AIII-AVI, few; (4) 0.025-0.037 mm long, 2- to 4-branched, on T1-AVII, very few. Head hairs fewer (ca. 85) and shorter. Of 2 types: (1) 0.025-0.05 mm long, uncinata; (2) ca. 0.025 mm long, slightly curved, denticulate apically. Labrum with feeble small chiloscleres; anterior surface with 8 hairs and 6 sensilla. Mandible with apex short, acuminate and turned medially; anterior and posterior surfaces finely rugose, medial border with small denticles. Maxillary palp a frustum, galea subconical. Labial palp a short frustum; opening of sericteries with a rounded knob at each end.

YOUNG LARVA. Length (through spiracles) 1.6-1.7 mm. Similar to submature larva except as follows. Body hairs 0.025-0.075 mm long, uncinata, confined to dorsum (4 on T1, 2 on T2, more numerous and longer on AVIII-AX). Head hairs fewer (ca. 58), 0.025-0.05 mm long, uncinata. Labrum lacking chiloscleres; anterior surface with 10 hairs 0.013-0.025 mm long and 10 sensilla; ventral surface with 6 sensilla. Mandible small and stout, apex short, acuminate and curved medially; anterior and posterior surfaces with fine ridges. Maxilla with apex stout, subcylindrical, denticulate; palp a frustum; galea a skewed subcone. Labial palp a small knob; opening of sericteries with a small elevation at each end.

VERY YOUNG LARVA. Length (through spiracles) 1.4-1.5 mm. Similar to young larva except as follows. Body hairs shorter (0.025-0.05 mm long), uncinata, confined to dorsum (14 on AVIII, 12 on AIX, 20 on AX). Cranium subquadrangular. Head hairs fewer (ca. 16). Of 2 types: (1) ca. 0.038 mm long, uncinata; (2) ca. 0.13 mm long, unbranched, slightly curved. Mandible wider than long, apex short, acuminate.

EGG. 0.46 X 1.1 mm.

Material studied: numerous larvae, Pasoh Field Studies Center, #885; Gentung Highlands (50 km N Kuala Lumpur), #932; Gombak Field Studies Center (30 km N Kuala Lumpur), #956; Bukit Renggit Field Studies Center (N of Lanchang), #1437.

Subgenus *POLYRHACHIS* F. Smith

*Polyrhachis bellicosa* F. Smith

Figure 8

MATURE LARVA. Length (through spiracles) 8.1-9.3 mm. Similar to *P. muelleri* except as follows. Body hairs moderately numerous. Of 4 types: (1) 0.05-0.1 mm long, longest ventrally, 3- to 8-branched, base short and erect, branches bent to ca. 90°; (2) 0.05-0.2 mm long, with stout base, apically lanceolate with denticulate border, few on each somite, most numerous and longest anteriorly; (3) 0.3-0.8 mm long, whip-like, longest anteriorly; (4) 0.175-0.325 mm long, uncinata, 6-9 on AII, 8-10 on AVIII, 4-5 on AIX, 2 on AX. Head hairs moderately numerous (ca. 54). Of 2 types: (1) 0.05-0.15 mm long, unbranched and smooth to finely denticulate; (2) ca. 0.05 mm long, 3- or 4-branched, few. Anterior surface of labrum with ca. 10 hairs and 6 sensilla; posterior surface with spinules long and in rather long subparallel rows. Integument of basal portion of maxilla lacking spinules; palp a frustum. Labial palp a short knob.

YOUNG LARVA. Length (through spiracles) 3.5-4 mm. Similar to mature larva except as follows. Spinules on integument limited to ventral and ventrolateral surfaces of T1-AIII and all surfaces of AVIII-AX. Body hairs of 4 types: (1) 0.05-0.275 mm long, 2- to 5-branched, on all somites; (2) at least 0.3 mm long, whip-like, on dorsum of AI-AVIII; (3) 0.15-0.275 mm long, uncinata, on T1-AI and AVII-AX; (4) 0.05-0.15 mm long, with stout base and denticulate apex, a few on each somite, longest on T1 and AX. Cranium lacking integumentary spinules. Head hairs less numerous (ca. 43), 0.05-0.15 mm long, unbranched, smooth, flexuous. Labrum with shorter rows of spinules. Mandible stouter; anterior and posterior surfaces with finer ridges; medial surface erose. Maxilla with apex subcylindrical; galea a skewed projection. Labium with very fine ridges on anterior surface; palp a slight elevation; opening of sericteries with slight elevation at each end.

VERY YOUNG LARVA. Length (through spiracles) ca. 1.9 mm. Similar to young larva except as follows. Body J-shaped; head slightly greater in diameter than T1. Body hairs very few. Of 2 types: (1) 0.05-0.3 mm long, uncinata, 12 on T1, 16 on T2, 14 on T3, 4 on each AI and AVII-AIX, 8 on AX; (2) 0.1-0.4 mm long, whip-like, 4 on each T1, AIV, 2 on each T2, AI, AV, AVI. Head hairs fewer (ca. 20), length similar to young larva. Mandible slightly wider than long; apex very short and acute. Apex of maxilla hemispherical; palp represented

by a raised cluster of sensilla; galea a slight elevation. Labial palp a raised cluster of sensilla.

Material studied: Numerous larvae from near Gombak Field Studies Center (30 km N Kuala Lumpur), #139.

### ***Polyrhachis bihamata* (Drury)**

#### Figure 9

FIFTH INSTAR (=MATURE) LARVA. Length (through spiracles) ca. 11.5 mm. Similar to *P. muelleri* except as follows. Body hairs moderately numerous. Of 6 types: (1) 0.05-0.175 mm long, 5- to 10-branched, branches all in same plane, few on T1 and AX, numerous elsewhere; (2) 0.05-0.26 mm long, unbranched on dorsal and lateral surfaces of T1 and all surfaces of AX, on ventrolateral surfaces of T2-AIX; (3) 0.05-0.18 mm long, with stout basal portion, lanceolate with denticulate border, a few on each somite; (4) up to ca. 1.56 mm long, whip-like, on ventrolateral surfaces of T1-AIV and dorsal surfaces of AII-AVI (14 on AII, 16 on each AIII-AIV, 12 on each AV-AVI); (5) ca. 1.0 mm long, 2- to 5-branched, adjacent to type 4 hairs; (6) ca. 0.33 mm long, uncinuate, on dorsum, 14 on AVII, 8 on each AVIII-AIX, 6 on AX. Cranium subhexagonal, integument with short arcuate ridges and short rows of minute spinules; a small elevated area dorsolateral to each antenna. Head hairs moderately abundant (ca. 72), 0.05-0.26 mm long. Labrum with ca. 10 hairs and 6 sensilla on anterior surface. Labial palp a low knob.

FOURTH INSTAR LARVA. Length (through spiracles) ca. 8.6 mm. Similar to mature larva except as follows. Head hairs fewer (ca. 50), shorter (0.038-0.1 mm long), denticulate. Maxillary palp a short rounded peg; galea shorter but still digitiform. Labial palp similar to maxillary palp.

THIRD INSTAR LARVA. Length (through spiracles) ca. 7.6 mm. Similar to fourth instar except as follows. Head hairs of 2 types: (1) 0.05-0.11 mm long, unbranched, denticulate apically; (2) 0.125-0.16 mm long, 2- to 5-branched. Labrum with ca. 18 hairs (0.03-0.06 mm long), unbranched, with heavy base and slender tip. Maxillary apex digitiform, spinulose; palp a short frustum. Labial integument with short ridges, palp a short rounded knob.

SECOND INSTAR LARVA. Length (through spiracles) 4.9-5.1 mm. Similar to third instar larva except as follows. Integument sparsely spinulose. Body hairs sparse. Of 4 types: (1) 0.038-0.175 mm long, deeply 2- to 7-branched, on all somites; (2) 0.05-0.18 mm long, with stout shaft and denticulate apex, especially numerous of T1 and AX; (3) at least 0.8 mm long, whip-like, on all somites; (4) 0.25-0.33 mm long, uncinuate, on T2-AI and AVI-AX. Cranium subtrapezoidal, widest ventrally. Head hairs moderately numerous (ca. 53), 0.125-0.175 mm long, slightly curved shaft and sparsely to densely denticulate apex.

FIRST INSTAR LARVA. Length (through spiracles) 2.3-3 mm. Similar to second instar except as follows. A ventrolateral swelling on each side of T1. Body integument with minute spinules, those on venter of anterior somites and AIX, AX more prominent. Body hairs largely confined to area dorsal to spiracles, sparse. Of 2 types: (1) 0.075-0.8 mm long, uncinuate, shortest of T1 and AX; (2) up to at least 0.8 mm long, whip-like. Head hairs less numerous (ca. 32). Of 2 types: (1) 0.05-0.25 mm long, longest flexuous; (2) 0.05-0.075 mm long, uncinuate. Labrum with rugose integument; ca. 14 hairs (0.012-0.025 mm long) and 14 sensilla on anterior surface; ventral surface rugose; posterior surface rugose, with 12 sensilla. Mandible subtriangular, wider than long. Maxillary apex short paraboloidal, with short rows of minute spinules; palp a low knob, galea a short cone. Labial palp a small knob.

Material studied: Several larvae from Fenting Highlands (50 km N Kuala Lumpur) #173.

*Polyrhachis lamellidens* F. Smith (1970:649)

***Polyrhachis ypsilon* Emery**

FIFTH INSTAR (=MATURE) LARVA. Length (through spiracles) 9- 13.1 mm. Similar to *P. muelleri* except as follows. Integumentary spinules coarse and short to long and slender, isolated or in short arcuate rows. Body hairs moderately numerous, except few on T1. Of 4 types: (1) 0.088-0.3 mm long, 3- to 5-branched, on T2-AV; (2) 0.05-0.238 mm long, with stout base, lanceolate with denticulate border, on posterior portion of T1 and on T2-AX; (3) up to at least 1.1 mm long, whip-like, on ventrolateral portions of T1-AIV and dorsum of AII-AVI; (4) 0.25-0.4 mm long, uncinata, few, on dorsum of AVII-AX. Cranium transversely subelliptical. Head hairs fewer (ca. 60), 0.038-0.1 mm long, lanceolate with denticulate border. Labrum with ca. 16 hairs (0.075 mm long) and 10 sensilla on anterior surface; ventral surface spinulose but lacking sensilla. Mandible with apex moderately sclerotized, slender. Maxillary integument with a few spinules, isolated or in short rows. Labial palp a small knob.

FOURTH INSTAR LARVA. Length (through spiracles) ca. 5.3 mm. Similar to mature larva except as follows. Body hairs sparse. Of 4 types: (1) 0.05-0.25 mm long, 2- to 5-branched, on T1-AVIII; (2) at least 0.67 mm long, whip-like, on AI-AVII; (3) 0.175-0.325 mm long, uncinata, on T3-AII and AVII-AX; (4) 0.025-0.125 mm long, lanceolate, with denticulate border. Cranium subtrapezoidal, widest ventrally. Labrum with 4 sensilla on ventral surface. Maxillary apex stout, subcylindrical, directed ventromedially. Labial palp a slight elevation; opening of sericteries with a small knob at each end.

THIRD INSTAR LARVA. Length (through spiracles) ca. 2.4 mm. Similar to fourth instar except as follows. Body hairs of 2 types: (1) up to at least 0.725 mm long, whip-like, on T1-AVIII; (2) 0.05-0.225 mm long, uncinata, on T1-T3 and AVII-AX. Cranium transversely subelliptical. Head hairs fewer (ca. 22), 0.04-0.33 mm long, unbranched, longest whip-like. Mandible with short acuminate apex. Maxillary and labial palps small knobs; galea a short subcone.

SECOND INSTAR LARVA. Length (through spiracles) ca. 1.8 mm. Similar to third instar except as follows. Body hairs very sparse, most dorsal to spiracles. Of 2 types: (1) 0.075-0.275 mm long, uncinata, on all somites; (2) 0.15-0.5 mm long, whip-like, on T1-AVII. Anterior surface of labrum with ca. 10 hairs and 8 sensilla. Apex of maxilla a stout subcylinder. Anterior surface of labrum with a few short rows of minute spinules medially.

FIRST INSTAR LARVA. Length (through spiracles) ca. 1.6 mm. Similar to second instar except as follows. Body hairs very few, 0.425 mm long, whip-like, 6 on T1, 4 on T2, 2 on each T2-AII. Head hairs sparse (ca. 26). Labrum shorter; anterior surface with ca. 6 hairs. Mandible smaller, apex short acuminate; anterior and posterior surfaces with a few short ridges; medial surface with a few small denticles apically. Maxillary apex paraboloidal, denticulate. Opening of sericteries a short transverse slit without adjacent elevations.

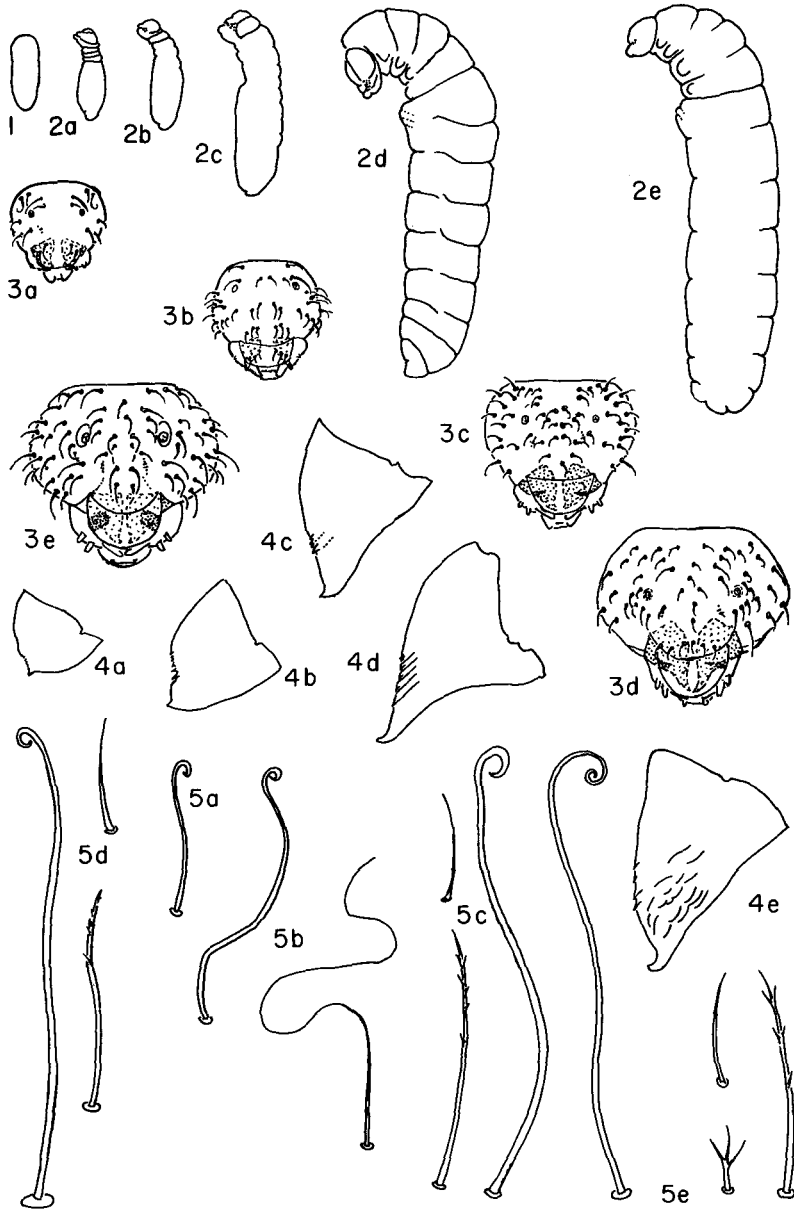
EGG. 0.51 X 1.14-1.6 mm.

Material studied: Numerous larvae, near Gombak Field Studies Center (30 km N Kuala Lumpur), #157.

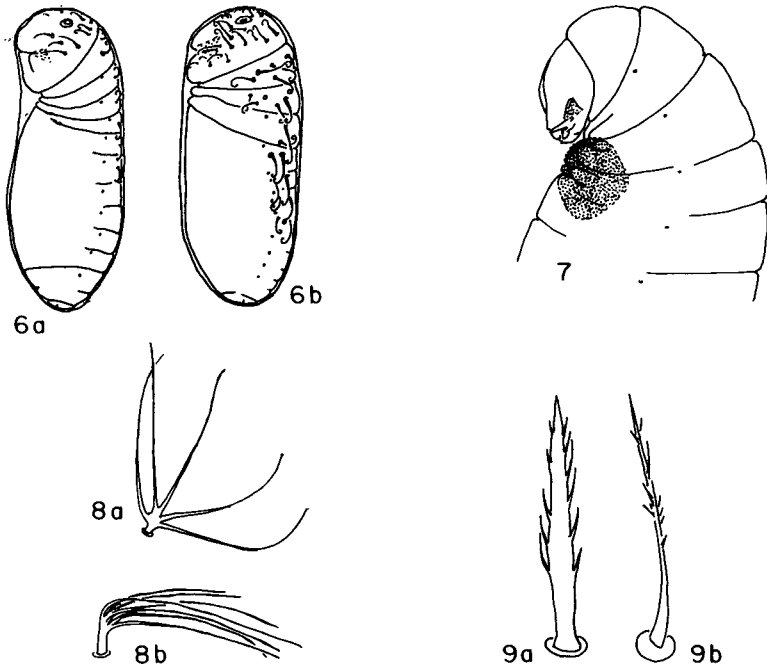
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FIGURES 1 - 5, *Polyrhachis muelleri*. 1, egg, X8. 2, Larva in side view, X8. 3, Head in anterior view, X33. 4, Left mandible in anterior view, X100. 5, Body hairs, X200. 1, EGG. 2a, First instar larva; 2b, second instar larva; 2c, third instar larva; 2d, fourth instar larva; 2e, fifth instar (=mature) larva. 3a, First instar larva; 3b, second instar larva; 3c, third instar larva; 3d, fourth instar larva; 3e, fifth instar (=mature) larva. 4a, First instar larva; 4b, second instar larva; 4c, third instar larva; 4d, fourth instar larva; 4e, fifth instar (=mature) larva. 5a, First instar body hair; 5b, second instar, 2 types of body hairs; 5c, third instar, three types of body hairs; 5d, fourth instar, three types of body hairs; 5e, fifth instar (=mature) larva, four types of body hairs.



FIGURES 6 - 9. *Polyrhachis muelleri*. **6a**, Larva in egg (coil. No. 936), X37; **6b**, larva in egg (coll. No. 937), X 37. **7**, *P. rastellata*. Anterior portion of larva with food in praesepium, X21. **8**, *P. bellicosa*. **8a**, Surface view of branched hair, X400; **8b**, side view of branched hair, X400. **9**, *P. bihamata*. **9a**, Surface view of lanceolate hair, X400; **9b**, edge view of lanceolate hair, X400.