

Two New *Pheidole* Species with a 5-segmented Antennal Club (Hymenoptera: Formicidae)

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Abstract. Two new species, *Pheidole sabahna* and *Pheidole quinata*, are described based on the material from Borneo, Java and Sumatra. These are peculiar among the Oriental and Indo-Australian *Pheidole* in having a distinct 5-segmented antennal club. They are distinguished from each other in the shape of head of the major, and the shape and hair density of alitrunk of the minor.

Key words: *Pheidole sabahna*, *Pheidole quinata*, 5-segmented antennal club, Borneo, Java, Sumatra.

Introduction

The genus *Pheidole* consists of 545 named species in the world (Bolton, 1995), and is one of the largest and the most chaotic genera in the family Formicidae. Oriental and Indo-Australian species of this genus can be distinguished from those of the other myrmicine genera by a combination of the following characters, although synapomorphic ones are still unclear: palp formula 2, 2 or 3, 2; antenna 12-segmented; pronotum and anterior part of mesonotum forming a dome which is much higher than the level of dorsal surface of propodeum; propodeal spine present but varying in size and shape; petiole in profile cuneiform and usually with a distinct node; worker caste dimorphic (the major and the minor), but rarely 'polymorphic' (the major showing a relatively wide range of variation in size, e.g., in *Pheidole smythiesii* Forel). Furthermore the following characters are observed in the major: posterolateral corner of head well developed into an occipital lobe; mandible massive, edentate excluding one apical and one preapical teeth, and 1–2 basal denticles before basal angle; anteroventral margin of head bearing 0–3 median processes; the articulation between head and alitrunk located on posteroventral face of head.

In this paper two new species of this genus are described from Borneo, Java and Sumatra. These species are peculiar among at least the Oriental and Indo-Australian congeners in having a 5-segmented antennal club in the worker. The majority of the species of *Pheidole* have a 3-segmented antennal club in the worker and the queen, but exceptions are found

in '*Ischnomyrmex*' and '*Ceratopheidole*' (Emery, 1921, 1922; both the taxa were treated as synonyms of *Pheidole* by Bolton (1995)). According to Emery (1922), the species of '*Ceratopheidole*' have a 4-segmented club in the worker and the queen, and I confirmed this based on my examination of available specimens, including types, of *P. smythiesii* Forel, its subsp. *bengalensis* Forel, and *P. bluntschlii* Forel, and additionally I found this condition in *P. gatesi* (Wheeler). Emery (1922) stated that the club of '*Ischnomyrmex*' is 5-segmented in the worker and queen, but my inspection of available specimens, including a syntype, of *P. longipes* showed that the part is actually undifferentiated from the rest of flagellum. The present new species are characterized by the following diagnostic characters: apical five antennal segments elongate and forming a distinct club in the worker; anteroventral margin of head of the major bearing three low median processes (in the case of *P. quinata* sp. nov. median one less distinct than lateral ones); anterior margin of clypeus weakly emarginate medially in the minor as well as the major; head of the minor never with an elongate 'neck' as seen in *P. longipes*; the major having a carinate subpetiolar process. The phylogenetic position of the species is still unknown, but the information given in this paper may help the understanding of the concept and diversity of the huge genus *Pheidole*.

Measurements and Indices

The following measurements and indices are given for the major, minor and male, unless otherwise stated.

TL: Total length. Length of out-stretched specimens from mandibular apex to apex of gaster.

HL: Maximum length of head measured in a straight line from the mid-point of anterior margin of clypeus to the mid-point of posterior margin of head in the minor and male. In the major where anterior margin of clypeus and posterior margin of head are concave the measurement is taken from the mid-point of a transverse line spanning the anteriormost or the posteriormost projecting points respectively.

HW: Maximum width of head excluding eyes.

SL: Length of antennal scape, excluding the basal condylar bulb.

AL: Length of alitrunk, measured from anterior margin of pronotum to posterior margin of propodeal lobe. This measurement is given for the minor and the male (anterior margin of alitrunk of the major is hidden by head and invisible).

PW: Pronotal width. This measurement is given for the major and minor.

FL: Length of hind femur.

FWL: Forewing length. This measurement is given for the male.

CI: Cephalic index = $HW/HL \times 100$.

SI: Scape index = $SL/HW \times 100$.

FL: Hind femur index = $FL/HW \times 100$.

Abbreviations of Institutions

BMNH: the Natural History Museum, London,

ENGLAND

MCSN: Museo Civico di Storia Naturale "Giacomo Doria", Genova, ITALY

MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, USA

MHN: Muséum d'Histoire Naturelle, Genève, SWITZERLAND

MNHA: Museum of Nature and Human Activities, Hyogo, JAPAN

NHMW: Naturhistorisches Museum, Wien, AUSTRIA

UMS: the Tropical Biology and Conservation Unit, Universiti Malaysia Sabah, Sabah, MALAYSIA

Descriptions of Species

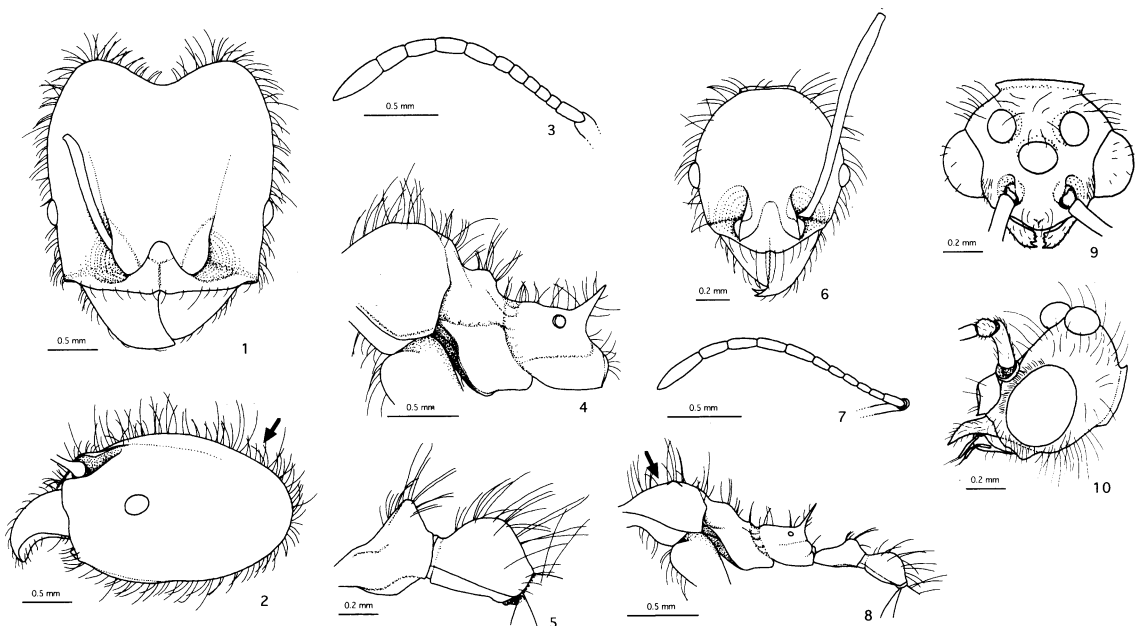
Pheidole sabahna sp. nov.

(Figs. 1–10)

Holotype: major, 30–VI–1998, Logging area nr. Kg. Yoshina, Ranau, Sabah, E. Malaysia (Borneo), colony Eg98-BOR-850, K. Eguchi leg.

Paratypes: 11 minors, 7 majors, 4 males, the same data as the holotype.

Other specimens examined: 7 minors, 3 majors, VI–1998, Logging area nr. Kg. Yoshina, colony Eg98-BOR-855, K. Eguchi leg.; 8 minors, 3 majors, VI–1998, logging area nr. Ranau, colony Eg98-BOR-839, K. Eguchi leg.; 1 minor, III–1995, Poring (ca. 550–600 m alt.), Sabah, Sk. Yamane leg.; 2 minors, IV–



Figs. 1–10. *Pheidole sabahna* sp. nov. — 1, major, head in full face view; 2, major, head in profile; 3, major, flagellum of antenna; 4, major, alitrunk in profile; 5, major, waist in profile; 6, minor, head in full face view; 7, minor, flagellum of antenna; 8, minor, alitrunk and waist in profile; 9, male, head in full face view; 10, male, head in profile.

1993, Semengoh N. P., Sarawak, E. Malaysia (Borneo), Sk. Yamane leg.; 1 minor, 1 major, IX-1993, Sg. Segerugok, Song, Sarawak, Abd. Rahman Nona leg.; 1 minor, XII-1993, Kubah N. P., Sarawak, Sk. Yamane leg.; 2 minors, XII-1993, Mulu (lowland), Sarawak, Sk. Yamane leg.; 1 minor, III-1994, Ng. Lelap, Lobang Baya, Sarawak, K. Het leg.; 1 minor, IV-1994, G. Gading N. P., Sarawak, Abd. Rahman Nona leg.; 1 minor, VIII-1995, Lambir N. P., Miri, Sarawak, H. Ôkido leg.

Major. TL 5.5–5.9 mm; HL 2.25–2.62 mm; HW 2.12–2.48 mm; SL 1.33–1.42 mm; PW 1.01–1.12 mm; FL 1.98–2.17 mm; CI 90–96; SI 56–63; FI 86–94.

Head in full face view (Fig. 1) feebly convex laterally, concave posteriorly, broadest about 2/3 distance from anterior margin of head to posterior corner of occipital lobe; in profile upper frons and vertex not concave (arrow in Fig. 2; sometimes slightly concave but less than in *P. quinata* sp. nov.); ventral face of cranium with almost straight anterior margin, which bears three low processes medially, and a low tooth just mesal to each mandibular insertion. Eye situated about 1/3 distance from anterior margin of head to posterior corner of occipital lobe. Clypeus with a longitudinal carina medially; anterior margin weakly emarginate medially. Frontal carina very weak, and antennal scrobe present only near antennal insertion. Antenna 12-segmented, with a distinct 5-segmented antennal club which is longer than the remainder of flagellum (Fig. 3); scape reaching about 2/3 distance from anterior margin of head to posterior corner of occipital lobe; 8th antennal segment approximately 1.7 times as long as 7th; 8–11th subequal in length; apical segment approximately twice as long as preapical one. Both maxillary and labial palpi not examined. Promesonotum unarmed, in profile (Fig. 4) with a dome-like anterior arc followed by a small prominence; mesopleuron weakly divided into upper and lower parts with a transverse furrow ('anepisternum' and 'katepisternum', sensu Bolton, 1994). Metanotal groove weak. Propodeal spine horn-like, straight, approximately 4 times as long as diameter of propodeal spiracle (Fig. 4). Petiole in profile cuneiform, bearing a carinate subpetiolar process (Fig. 5). Postpetiole in dorsal view twice as broad as petiole or slightly less, subpentagonal, in profile strongly convex dorsally and almost flat ventrally. Frons longitudinally rugose; upper frons, vertex and lateral sides of head rugoso-reticulate, and the spaces between rugae indistinctly punctured; mandible smooth, but with scattering piligerous punctures. Alitrunk rugoso-reticulate except on

smooth declivity face of propodeum; petiole (except smooth anterodorsal face) and postpetiole weakly punctured and dull. Gaster smooth and shining. Body with relatively abundant erect or suberect hairs. Body dark brown to brown with darker gaster.

Minor. TL 3.5–3.7 mm; HL 0.88–1.08 mm; HW 0.78–0.93 mm; SL 1.15–1.41 mm; AL 1.30–1.58 mm; PW 0.49–0.58 mm; FL 1.33–1.69 mm; CI 83–89; SI 121–134; FI 165–193.

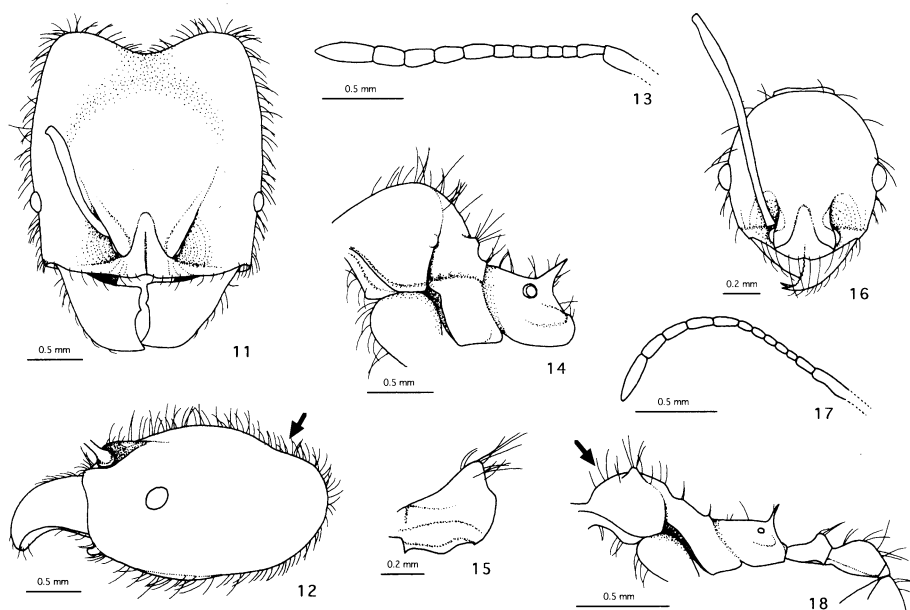
Head in full face view (Fig. 6) oval; occipital carina distinctly flanged. Eye situated at or in front of midlength on the side of head. Anterior margin of clypeus weakly emarginate medially. Frontal carina and antennal scrobe present only near antennal insertion. Antenna 12-segmented, with a conspicuous 5-segmented club which is longer than the remainder of flagellum (Fig. 7, compare with Figs. 19 for *P. smythiesii* and 20 for *P. longipes*); scape well extending beyond posterior margin of head by more than its 1/3 length; 8th antennal segment 1.6–1.8 times as long as 7th; 8–11th subequal in length; apical segment approximately 1.8 times as long as preapical one. Palp formula 2, 2. Promesonotum in profile (Fig. 8) with a relatively low anterior arc, with a pair of low protuberances dorsolaterally (in the specimens from the colony Eg98-BOR-839 promesonotum without protuberances); mesopleuron sometimes with an indistinct transverse impression. Metanotal groove deep (Fig. 8). Propodeal spine horn-like, slender, directed upward, 6–7 times as long as diameter of propodeal spiracle (Fig. 8). Petiole in profile cuneiform, with a low node; postpetiole longer than broad, approximately twice as broad as petiole, in profile hemispherical, convex dorsally and slightly convex ventrally. Head almost smooth and shining. Anterior dome of promesonotum smooth and shining; the remainder of alitrunk punctured distinctly (occasionally smooth and shining dorsally). Petiole smooth and shining except weakly rugose pedicel. Postpetiole and gaster almost smooth and shining over the surface. Head bearing erect or suberect hairs more abundantly than in *P. quinata* sp. nov. (Fig. 6 vs. Fig. 16). Anterior dome of promesonotum bearing more than 20 erect or suberect hairs, and the remainder of alitrunk also bearing more than 20 erect or suberect hairs dorsally (Fig. 8). Body brown to reddish brown.

Male. TL 5.7–5.9 mm; HL 0.71–0.73 mm; HW 0.73–0.76 mm; SL 0.26–0.27 mm; maximum length of eye 0.41–0.42 mm; AL 2.21–2.30 mm; FL 1.80–1.87 mm; FWL 6.0–6.1 mm; CI 100–105; SI 35–37; FI 244–255.

Head in full face view narrowed behind eyes (Fig. 9); in profile vertex strongly convex (Fig. 6); occipital carina distinct. Eye elliptical, large, situated anterolaterally. Three ocelli well developed (Figs. 9 and 10); the maximum diameter of median ocellus 0.9–1.0 times as long as distance between lateral ocelli. Clypeus in profile strongly convex anterodorsally; its anterior margin convex and entire; median portion with a longitudinal carina; clypeo-frontal suture indistinct. Distance between antennal insertions almost as long as maximum diameter of median ocellus. Antenna 13-segmented; scape cylindrical and slightly swollen apically, 3.0–3.2 times as long as broad; pedicel slightly longer than broad, 0.5 times as long as scape; 3rd antennal segment slightly narrower apically than basally, approximately 2.5 times as long as maximum width; 4–12th segments cylindrical and slender; terminal segment tapering apically, 1.3 times as long as scape. Mandible narrow, with a large apical tooth followed by several small teeth or denticles. Palp formula 2, 2. Alitrunk weakly sclerotized, sometimes deformed in dried specimens. Pronotum in dorsal view without humeri. Mesoscutum with very weak parapsidal furrows on its posterior half; axilla cuneiform; scuto-scutellar furrow broad and deep; mesoscutellum in dorsal view almost straight anteriorly, strongly convex posteriorly; mesopleuron divided into upper and lower parts by a weak transverse fullow. Metanotum located under the level of mesoscutellum, transverse. In profile dorsal and declivitous faces of propodeum meeting each other at an angle of 120–130°;

propodeal spine absent; propodeal spiracle rounded, situated just in front of midlength and just above midheight of propodeum, directed posterolaterally. Metapleural lobe rounded. Forewing with radial, discoidal and two cubital cells; radial cell completely closed. Hindwing with 9–12 hamuli. Legs very long; hind femur 1.2–1.3 times as long as hind tibia; hind basitarsus almost as long as hind tibia. Petiole in dorsal view long, weakly widened in its posterior half, in profile weakly convex posterodorsally as a node, almost straight ventrally, without any indication of subpetiolar process. In dorsal view postpetiole slightly longer than broad; its anterior portion narrowed forward; in profile postpetiole weakly convex dorsally and almost straight ventrally; 2 out of 6 specimens examined with a long, slender, ventrally directed process on postpetiole, but the remainder without it. Gaster elliptical. Frons smooth and shining; the remainder of head finely rugose. Pronotum, most part of mesoscutum, upper part of mesopleuron smooth and shining; lower part of mesopleuron finely rugose; mesoscutellum reticulate; propodeum rugose, and punctured between rugae. Petiole and postpetiole weakly punctured and dull; gaster smooth and shining. Body with sparse erect or suberect hairs. Body yellow; vertex and dorsum of alitrunk weakly blackish.

Remarks. Three colonies collected from Ranau nested in the soil along logging roads.



Figs. 11–18. *Pheidole quinata* sp. nov. — 11, major, head in full face view; 12, major, head in profile; 13, major, flagellum of antenna; 14, major, alitrunk in profile; 15, major, petiole in profile; 16, minor, head in full face view; 17, minor, flagellum of antenna; 18, minor, alitrunk and waist in profile.

Specimen depositories. The holotype and 2 paratypes (1 minor and 1 male) are deposited in the collection of UMS. Two paratypes (1 major and 1 minor) will be deposited in the collection of MCSN, MCZ, MHN, MNHA and NHMW, respectively.

***Pheidole quinata* sp. nov.**

(Figs. 11–18)

Holotype: major, 15–VII–1996, Sayap Kinabalu (ca. 1000 m alt.), Sabah, E. Malaysia (Borneo), honey bait HD-109, K. Eguchi leg.

Paratypes: 1 minor, the same data as the holotype; 9 minors, same date, locality and collector as the holotype, but from different baits HD-102, HD-105, HD-106, HD-117, HD-127, HN-150 and HN-159; 6 minors, 14–VII–1996, same locality, litter samples LS-4 and LS-5, Sk. Yamane leg.

Other specimens examined: 1 major, 5 minors, 26–VIII–1996, Juanda Park (ca. 880 m alt.), Bandung, Java, Indonesia, colony No. FI96–221, F. Ito leg; 2 minors, VIII–1982, Cibodas, Java, Sk. Yamane leg.; 6 minors, VIII–1985, Ulu Gadut, near Padang, W. Sumatra, Indonesia, Sk. Yamane leg. (Sumatra Nature Study Collection).

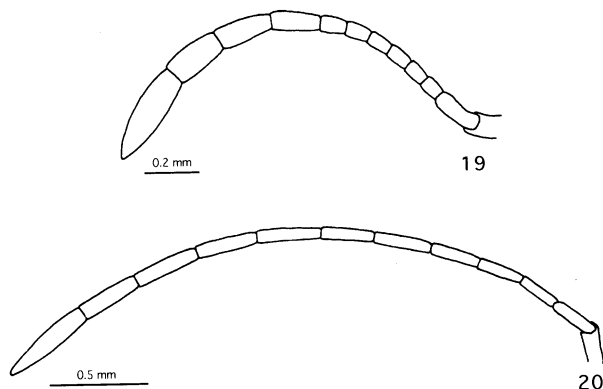
Major. TL 5.0–5.1 mm; HL 2.40–2.43 mm; HW 2.24–2.28 mm; SL 1.11–1.24 mm; PW 1.02–1.13 mm; FL 1.77–1.91 mm; CI 93–94; SI 49–55; FI 78–85.

Head in full face view (Fig. 11) weakly convex laterally, concave posteriorly, broadest just behind midlength of head; in profile upper frons and vertex concave (arrow in Fig. 12); ventral face of cranium with almost straight anterior margin, which bears a low and indistinct median process between a pair of processes, and with a low tooth just mesal to each mandibular insertion. Eye situated at 1/3 distance from anterior margin of head to posterior corner of occipital lobe. Clypeus with a median longitudinal carina, shallowly emarginate anteromedially. Frontal carina very weak, just reaching 1/3 distance from anterior margin of head to posterior corner of occipital lobe. Antennal scrobe present only near antennal insertion. Antenna 12-segmented, with a 5-segmented club which is longer than the remainder of flagellum (Fig. 13); scape reaching 3/5 distance from anterior margin of head to posterior corner of occipital lobe; 8th antennal segment approximately 1.6 times as long as 7th; 8–11th subequal in length; apical segment twice as long as preapical one. Both maxillary and labial palpi not examined. Promesonotum unarmed, in profile (Fig. 14) with a dome-like anterior arc follow-

ed by a small prominence, in dorsal view weakly swollen laterally; mesopleuron weakly divided into upper and lower parts with a transverse furrow. Metanotal groove weak. Propodeal spine horn-like, straight, 3 times as long as diameter of propodeal spiracle (Fig. 14). Petiole in profile (Fig. 15) cuneiform, bearing a carinate subpetiolar process; postpetiole in dorsal view more than twice as broad as petiole, subpentagonal, in profile strongly convex dorsally and almost flat ventrally. Frons longitudinally rugose; upper frons, vertex and lateral sides of head rugosoreticulate, and the spaces between rugae indistinctly punctured; mandible smooth, but with scattering piligerous punctures. Promesonotum with transverse but irregular rugae; mesopleuron partially smooth and shining; propodeum rugose except smooth declivity face; petiole smooth and shining dorsally, finely punctured laterally and ventrally; postpetiole and the anterior part of first gastral segment finely punctured. Body with relatively abundant erect or suberect hairs. Body blackish brown; flagellar segments and legs paler.

Minor. TL 2.4–2.7 mm; HL 0.72–0.88 mm; HW 0.64–0.78 mm; SL 0.91–1.13 mm; AL 1.05–1.28 mm; PW 0.42–0.50 mm; FL 0.98–1.25 mm; CI 0.84–0.92; SI 1.37–1.54; FI 1.49–1.68.

Head in full face view (Fig. 16) oval; occipital carina distinctly flanged. Eye situated about midlength on the side of head. Anterior margin of clypeus weakly emarginate medially. Frontal carina and antennal scrobe present only near antennal insertion. Antenna 12-segmented, with a conspicuous 5-segmented club which is longer than the remainder of flagellum (Fig. 17, compare with Figs. 19 and 20); scape well extending beyond posterior margin of head by more than its 1/3 length; 8th antennal segment 1.6–1.8



Figs. 19–20. Flagellum of antenna—19, *Pheidole mythesii* Forel, minor (specimen from Tam Dao, N. Vietnam); 20, *Pheidole longipes* (Fr. Smith), minor (specimen from Ulu Gombak, W. Malaysia).

Table 1. Specific differences between the two species.

	<i>P. sabahna</i> sp. nov.	<i>P. quinata</i> sp. nov.
Upper frons & vertex (major)	not concave (Fig. 2)	concave (Fig. 12)
Promesonotal convexity (minor)	low (Fig. 8)	high (Fig. 18)
Metanotal groove (minor)	distinct (Fig. 8)	indistinct (Fig. 18)
No. of erect or suberect hairs on dorsal surface of alitrunk except promesonotal dome (minor)	>20 (Fig. 8)	ca. 10 (Fig. 18)

times as long as 7th; 8–11th subequal in length; apical segment approximately 1.8 times as long as preapical one. Palp formula 2, 2. Promesonotum in profile (Fig. 18) with a relatively high anterior arc, with a pair of low protuberances dorsolaterally; mesopleuron without any furrow. Metanotal groove shallow and indistinct (Fig. 18). Propodeal spine horn-like, slender, directed dorsally, at most 5 times as long as diameter of propodeal spiracle (Fig. 18). Petiole in profile cuneiform, with a low node; postpetiole longer than broad, twice as broad as petiole, in profile hemispherical, convex dorsally and slightly convex ventrally. Head almost smooth and shining. Anterior dome of promesonotum smooth and shining; the remainder of alitrunk distinctly punctured. Petiole smooth and shining except weakly reticulate lateral faces. Postpetiole and gaster almost smooth and shining over the surface. Head bearing fewer erect or suberect hairs than that of the preceding species (Fig. 16 vs. Fig. 6). Anterior dome of promesonotum bearing approximately 20 erect or suberect hairs dorsally; the remainder of alitrunk bearing approximately 10 hairs dorsally (Fig. 18). Body yellowish brown (specimens from Sumatra and Java), or brown to dark brown (specimens from Borneo); flagellar segments, petiole, postpetiole, gaster, and legs paler.

Remarks. Specimens from Sayap were collected by bait trapping and soil sifting on the forest floor along a trail. Nest sites were not confirmed.

Specific differences between this and the preceding species are listed in Table 1.

Specimen depositories. The holotype and 1 paratype (minor) are deposited in the collection of UMS. One paratype (minor) will be deposited in the collection of MCSN, MCZ, MHN, MNHA and NHMW, respectively.

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References

- Bolton, B. 1994. Identification Guide to the Ant Genera of the World. Harvard University Press, Cambridge, Massachusetts.
- Bolton, B. 1995. A taxonomic and zoogeographical census of the extant ant taxa (Hymenoptera: Formicidae). *Journal of Natural History*, **29**: 1037–1056.
- Emery, C. 1921. Hymenoptera, Fam. Formicidae, Subfam. Myrmicinae, In Wytzman, P. (ed.), *Genera Insectorum*. Fasc. **174A**: 1–94. Bruxelles.
- Emery, C. 1922. Hymenoptera, Fam. Formicidae, Subfam. Myrmicinae. In Wytzman, P., (ed.), *Genera Insectorum*. Fasc. **174B**: 95–206. Bruxelles.
- Mayr, G. 1862. Myrmecologische Studien. *Verhandlungen der k. k. Zoologisch-Botanischen Gesellschaft in Wien*, **12**: 649–776.
- Pergande, T. 1896. Mexican Formicidae. *Proceedings of the California Academy of Sciences* (2) **5**: 858–896.

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