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# A review of the subgenus *Polyrhachis (Polyrhachis)* Fr. Smith (Hymenoptera: Formicidae: Formicinae) with keys and description of a new species

Rudolf J. Kohout

Biodiversity Program, Queensland Museum,
PO Box 3300, South Brisbane, Qld 4101, Australia

Corresponding author's e-mail: rudy.kohout@bigpond.com

**ABSTRACT.** The nominal subgenus *Polyrhachis* of the genus *Polyrhachis* Fr. Smith is reviewed. Eleven species of the subgenus are recognised, including ten previously described (*Polyrhachis bellicosa* Fr. Smith, *P. bihamata* (Drury), *P. craddocki* Bingham, *P. erosispina* Emery, *P. olybria* Forel, *P. lamelidens* Fr. Smith, *P. mindanaensis* Emery, *P. montana* Hung, *P. taylori* Kohout and *P. ypsilon* Emery) and one, *P. maliau*, described as new. The worker and the queen of *P. bellicosa* and the worker of *P. erosispina* are redescribed and a case of apparent character displacement between these species is noted. The worker of *P. olybria* and queens of *P. mindanaensis* and *P. ypsilon* are described. A key to the species of the subgenus is provided and all species, including the known queens, are illustrated.

**Keywords.** Formicidae, *Polyrhachis (Polyrhachis)*, taxonomy, new species

## INTRODUCTION

The name *Polyrhachis* was first used for a group of ants by Shuckhard (in Swainson & Shuckhard, 1840, p. 172), however, no diagnosis for the genus was provided and no species were assigned to it, making the name unavailable under their authorship. The genus *Polyrhachis* was established by Frederick Smith (1857, p. 58) with *Formica bihamata* Drury, 1773 as the type species. *Polyrhachis* was first used as a subgeneric name, i.e. *Myrma (Polyrhachis),* by Wheeler (1911) (see Dorow, Kohout & Taylor, 1997) for *P. bihamata* (Drury) and the "small cohort of allied species" (*P. bellicosa* Fr. Smith, *P. ypsilon* Emery, *P. craddocki* Bingham and *P. lamellidens* Fr. Smith), thus essentially replacing the "cohors Polyrhachides hamatae" established earlier by Emery (1896). However, it was not until more than a decade later that Emery (1925) provided a basic diagnosis for the subgenus and divided it into two species-groups based on the presence (*lamellidens*-group) or absence (*bihamata*-group) of lateral mesosomal margins. He recognised three species and three subspecies in the *bihamata*-group and two species in the *lamellidens*-group.

The subgenus *Polyrhachis* was first revised by Hung (1970), who considered it the "best-defined group" of the genus, following his earlier opinion that the subgenus "may be a good genus by itself" (Hung, 1967). He listed four main characters distinguishing it from other *Polyrhachis* subgenera, including the presence of both pronotal and mesonotal spines, a columnar petiole with a pair of hook-shaped spines (quite similar to that in *P. (Myrmhopla) furcata* Fr. Smith) and the presence of a median ocellus in workers of some species (*P. ypsilon*, *P. bihamata* and *P. bellicosa*). The fourth character, the markedly different appearance of queens and workers of the same species, contrasts with the general similarity of workers and queens in species of the other subgenera of *Polyrhachis*.

*Polyrhachis*, notably *P. bellicosa*, but considered it to be a chaotic conglomerate of individual and local variants "without any stable type to be followed". He provided a substantial account on the variability of several species, based mainly on the calculation of taxonomic distance (sensu Sokal, 1961), and recognised *P. bellicosa* as the only valid species in New Guinea. Hung (1970) also described a new species, *P. montana*, from Borneo and raised the former subspecies *P. bihamata mindanaensis* to specific status. He synonymised all the other previously described infraspecific taxa, thus reducing the number of the *bona fide* members of the subgenus to seven.

Following a visit to New Guinea and the islands of Bismarck Archipelago in 1984, Kohout (1988) reviewed the New Guinean and Australian species of the subgenus. He removed *P. bellicosa erosispina* from synonymy with *P. bellicosa* and raised it to specific status based on an apparent case of character displacement (see Brown & Wilson, 1956; Kohout, 1988) between the species. He considered the species closely similar and apparently derived from the same ancestral stock. He stated that "at localities where they are sympatric, morphological and ecological differences are somewhat accentuated and more distinct than those observed in allopatric situations, in which distinctions can become very tenuous" (Kohout, 1988). With special attention given to the location of their nests, the previously unknown association of workers and queens was established for both species and for the newly described *P. taylori*.

As already indicated by Hung (1970), within the subgenus *Polyrhachis* queens are very different to the workers of the same species and, as a result of their dissimilarity, queens of many species were, until more recently, virtually unknown or misidentified. A classic example is that of *P. olybria* Forel, described in 1912 from two queens. Despite having both queen and worker specimens within the single original series, collected by Tritschler at Indrapura on Sumatra, Forel not only considered the workers to represent *P. bellicosa*, but described the queens as a separate species, *P. olybria*. Later, Emery (1925) erroneously placed *P. olybria* into the subgenus *Myrmhopla* Forel. Kohout (1998) finally recognised that the syntype queens of *P. olybria* were conspecific with the workers earlier misidentified as *P. bellicosa* by Forel and correctly placed them in the subgenus *Polyrhachis*.

## METHODS

Publication dates and spelling of species epithets and author's names follow Bolton *et al.* (2007). This study is principally based on the worker caste but diagnoses and notes are provided on the queens of most species.

Images of specimens were taken with a digital camera attached to a stereomicroscope and processed using Auto-Montage (Syncroscopy, Division of Synoptics Ltd, USA) and Adobe CS2 (Adobe Systems Inc, USA) software. Images of *P. maliau* are of the holotype, while those of *P. montana* and *P. taylori* are of syntypes. Images of the remaining species are of type-compared voucher specimens. Photographs were taken by Dr Steve O. Shattuck (ANIC) and Hans Peter Katzmann (UUUG).

Measurements and indices follow those of Kohout (2008) with some additions: TL = Total length (the necessarily composite measurement of the outstretched length of the entire ant measured in profile); HL = Head length (the maximum measurable length of the head in perfect full face view measured from the anterior-most point of the clypeal border or teeth, to the posterior-most point of the occipital margin); HW = Head width (width of the head in perfect full face view, measured immediately in front of the eyes); CI = Cephalic index (HW × 100/HL); SL = Scape length (excluding the condyle); SI = Scape index (SL × 100/HW); PW = Pronotal width (greatest width of the pronotal dorsum); MTL = Metathoracic tibial length (maximum measurable length of the tibia of the hind leg); PeH = Petiolar height (measured from the petiolar spiracle to the tangent point of the petiolar hook in lateral view); PI = Petiolar index (PeH × 100/HL). All measurements were taken using a Zeiss SR stereomicroscope with an eyepiece graticule calibrated against a stage micrometer. All measurements are expressed in millimetres (mm).

Abbreviations used in specimen data are: Agric. – Agricultural; c. – circa; Cons. – Conservation;

Distr. – District; Exp. – Expedition; fog. – fogging; For. – Forest; Gn. – Gunung (= Mountain); Govt. – Government; Kg – Kampung (= village); KBFSC – Kuala Belalong Field Studies Centre; Mt. – Mountain; Mts – Mountains; Nat. – Natural; NP – National Park; nr – near; Pen. – Peninsula; Pk – Park; Pltn – Plantation; Pref. – Prefecture Prov. – Province; Pt – Point; Ra. – Range; Rd – Road; Res. – Reserve; Riv. – River; rf. – rainforest; Sg. – Sungai (= River); Stn – Station; w – worker/s; WS – Wildlife Sanctuary.

Names of most frequently listed collectors are abbreviated as follows: JLG – J.L. Gressitt; NLHK – N.L.H. Krauss; RJK – R.J. Kohout; RWT – R.W. Taylor; TCM – T.C. Maa; WHOD – W.H.O. Dorow.

Institutions and depositories (with the names of cooperating curators) are: ANIC – Australian National Insect Collection, CSIRO, Canberra, ACT, Australia (Dr S.O. Shattuck); BMNH – The Natural History Museum, London, UK (S. Ryder); BPBM – Bernice P. Bishop Museum, Honolulu, Hawaii, USA (K.T. Arakaki); BZUW – Biozentrum Am Hubland, University Würzburg, Germany (Dr Andreas Floren); CASC – California Academy of Sciences, San Francisco, CA, USA (Dr. B.L. Fisher); IRSN – Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (Drs P. Grootaert, P. Dessart); ITBC – Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia (Prof. Datin Dr Maryati Mohamed, Dr Bakhtiar E.Y.); IZAS – Institute of Zoology, Ukrainian Academy of Sciences, Kiev, Ukraine (Dr A.G. Radchenko); MCZC – Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA (Dr S.P. Cover); MHNG – Muséum d'Histoire Naturelle, Geneva, Switzerland (Dr B. Merz); MSNG – Museo Civico di Storia Naturale 'Giacomo Doria', Genova, Italy (Drs R. Poggi, M. Tavano); NHMB – Naturhistorisches Museum, Basel, Switzerland (Dr M. Brancucci); NHMW – Naturhistorisches Museum, Wien, Austria (Drs H. Zettel, D. Zimmermann); OXUM – Hope Entomological Collections, Oxford University Museum of Natural History, Oxford, UK (Dr D.J. Mann, J.E. Hogan); QMBA – Queensland Museum, Brisbane, Qld, Australia (Dr C.J. Burwell); SDEI – Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany (Dr A. Taeger); SMFG – Forschungsinstitut Senckenberg, Frankfurt am Main, Germany (Dr W.H.O. Dorow); UUUG – Universität Ulm, Ulm, Germany (H.P. Katzmann).

## SYSTEMATICS

Genus **Polyrhachis** Fr. Smith, 1857

*Polyrhachis* Fr. Smith, 1857: 58. Type species: *Formica bihamata* Drury, 1773, by original designation.

Subgenus **Polyrhachis** Fr. Smith, 1857

*Polyrhachis* Fr. Smith; Wheeler, 1911: 859 (as subgenus of *Myrma* Billberg). Type species: *Polyrhachis bihamata* (Drury) (by subsequent designation).

*Polyrhachis (Polyrhachis)* Fr. Smith; Wheeler, 1922: 257 (as subgenus of *Polyrhachis* Fr. Smith).

*Polyrhachis (Polyrhachis)* Fr. Smith; Emery, 1925: 181 (diagnosis of the subgenus).

### Characters of the subgenus *Polyrhachis* Fr. Smith

*Worker.* Medium-sized to relatively large ants (HL 1.78 – 2.90) with general characteristics of the genus. Head oval; eyes only moderately convex, in full face view not reaching (as in *P. bihamata* or *P. craddocki*), only touching (as in *P. olybria* or *P. lamellidens*) or clearly exceeding lateral cephalic outline (as in *P. bellicosa* or *P. taylori*); median ocellus distinct (as in *P. bellicosa* or *P. bihamata*) or obscure or absent (as in *P. olybria* or *P. lamellidens*); lateral ocelli present only in some specimens of several species (e.g. *P. bellicosa* and *P. erosispina*). Mesosoma distinctly laterally marginate (*lamellidens*-group) or immarginate (*bihamata*-group); pronotal spines virtually straight (as in *P. bellicosa* or *P. taylori*) or hook-shaped (as in *P. bihamata* or *P. ypsilon*); mesonotum with almost pyramidal or lanceoloate, posteriorly projecting spines in most species (*bihamata*-group) (e.g. Figs. 5, 7),

or with dorsally raised lateral margins (Fig. 31) terminating in short, acute spines (*lamellidens*-group) (Fig. 33). Propodeal dorsum terminating posteriorly in short, upturned spines (as in *P. olybria*) (Fig. 23), medially directed short ridges (as in *P. bellicosa* or *P. erosispina*), or posteriorly directed, dorsally flat, blunt spines (as in *P. craddocki* and *P. lamellidens*) (Figs. 31, 33) (rather similar to those in *P. hexacantha*- or *rastrata*-group species of the subgenus *Campomyrma* Wheeler). Petiole columnar, bearing a pair of hook-shaped, somewhat flattened spines, more-or-less divergent from their bases (Figs. 35 – 37) (as in *P. ypsilon* or *P. lamellidens*), or subparallel (Fig. 34) (as in *P. bihamata* or *P. craddocki*).

*Queen.* In addition to being distinctly larger in size and possessing the usual sexual characters, queens are very dissimilar to workers. Mesonotal spines are absent from the fully developed mesosoma with wings and the petiolar spines are greatly reduced and simply pointed, resembling those of queens of other subgenera (e.g. *Myrmhopla* Forel).

*Male.* Male of only a few species are known and as such, their treatment has not been attempted here. Donisthorpe (1942) described a male of *P. bihamata* and Hung (1970) described the males of *P. bellicosa* and *P. lamellidens*. However, as mentioned by Hung (1970), the single male considered by Donisthorpe to be that of *P. bihamata* was without associated workers and, consequently, its identity is questionable. Also, because Hung's interpretation of *P. bellicosa* encompassed three currently recognised species (*P. bellicosa*, *P. erosisipina* and *P. olybria*), the specific identity of the male specimen he described cannot be confirmed.

*Distribution and biology.* The known distribution of the subgenus *Polyrhachis* extends throughout Southeast Asia, from Japan and China in the east to Myanmar and India in the west, extending south to the Philippines, Borneo, Indonesia and New Guinea where it reaches as far east as the Bismarck Archipelago and to northern Australia in the south. Members of the subgenus are mostly arboreal, building nests of silk and vegetation debris against tree trunks, or lignicolous. Nests of some species (e.g. *P. bellicosa*) are situated relatively high off the ground (often 3 – 5 m), between lianas and other climbers, with the walls of the nest usually supported by a strong network of tendrils from surrounding climbing vines. Some nests, however, are located close the ground, usually against a tree trunk and incorporating the foliage and shoots of climbers and multiple stems of woody lianas (e.g. *P. erosispina*, *P. bihamata*). However, in areas with abundant bamboo, some species evidently prefer to nest inside dead, dry bamboo stems (e.g. *P. erosispina*, *P. taylori*), with the nest usually occupying several internodes (Kohout, 1988, 1998). The only apparent exceptions to the arboreal nesting habits of the subgenus are *P. lamellidens* and *P. olybria*, both of which have been recorded nesting in the ground or in rotten logs (Yano, 1911; Robson & Kohout, 2005, 2007).

## KEY TO WORKERS OF THE SUBGENUS *POLYRHACHIS*

1. Dorsum of mesosoma distinctly laterally marginate along its entire length; propodeal dorsum terminating in a pair of elongated, posteriorly directed, dorsally flattened, blunt spines (Figs. 31, 33) (*lamellidens* species-group) ..... 2.

- Dorsum of mesosoma immarginate or only partly obtusely marginate; propodeal dorsum terminating in a pair of short, upturned spines or medially directed, short ridges (Figs. 14, 23) (*bihamata* species-group) ..... 3.

2. Petiolar spines widely divergent; extreme tips of mesonotal spines directed outwards; mesosoma and petiole distinctly light to medium reddish-brown (Figs. 32, 33) ..... *P. lamellidens* Fr. Smith

- Petiolar spines parallel for most of their length; extreme tips of mesonotal spines directed posteriorly; whole body black or very dark reddish-brown (Fig. 30) ..... *P. craddocki* Bingham

3. Petiolar spines more-or-less divergent from bases (Figs. 35-37) ..... 4.

- Petiolar spines virtually parallel for most of length (Fig. 34) ..... 8.

4. Smaller species (HL < 1.75); in dorsal view pronotal spines almost straight with tips directed anterolaterally (Figs. 24, 25) (Papua New Guinea) ..... *P. taylori* Kohout (in part)

- Larger species (HL > 2.25); in dorsal view pronotal spines hook-shaped with tips directed posterolaterally or posteriorly (Figs. 13, 15, 17, 26) ..... 5.

5. Pronotal spines massive, black throughout (Fig. 26) ..... *P. ypsilon* Emery

- Pronotal spines slender, reddish-brown with black tips (e.g. Figs. 15, 22) ..... 6.

6. Bases of mesonotal spines closely approximated (Fig. 17) ..... 7.

- Bases of mesonotal spines widely separated (Fig. 15) (Borneo) ..... *P. montana* Hung

7. Smaller, slender species (HL < 2.37); antennal scapes with numerous hairs along leading and inferior edge; propodeal dorsum in profile about 2 × as long as distinctly concave declivity (Borneo) ..... *P. maliau* sp. nov.

- Larger, more stoutly built species (HL > 2.62); antennal scapes with only occasional hairs present; propodeal dorsum in profile only about 1.5 × as long as oblique declivity (Philippines) .... ..... *P. mindanaensis* Emery

8. Smaller species (HL < 1.75) (Papua New Guinea) ..... *P. taylori* Kohout (in part)

- Larger species (HL > 1.78) ..... 9.

9. Propodeal dorsum terminating posteriorly in a pair of dorsoposteriorly directed, short, acute spines (Fig. 23); petiole relatively high (PI 107 – 127); ocelli usually lacking (Fig. 19) ..... ..... *P. olybria* Forel

- Propodeal dorsum terminating posteriorly in a pair of blunt, medially directed, short ridges (Figs. 4, 6); petiole relatively low (PI 87 – 108); median ocellus always present, lateral ocelli often obscure ..... 10.

10. Head and gaster black or very dark reddish-brown (Figs. 4, 5, 8, 9); in dorsal view pronotal spines almost straight with tips projecting anterolaterally (Figs. 4, 8); smaller species (HL < 2.30) ..... 11.

- Head dark reddish-brown or black; gaster light reddish-brown with apex dark brown (Figs. 6, 7); in dorsal view pronotal spines hook-shaped (Fig. 6); with tips projecting posteriorly; larger species (HL > 2.35) ..... *P. bihamata* (Drury)

11. Generally smaller species (HL 1.78 – 2.12); eyes in full face view exceeding lateral cephalic outline (Fig. 1); pronotal dorsum smooth and polished; pilosity and pubescence very sparse over all body surfaces ..... *P. bellicosa* Fr. Smith*

- Generally larger species (HL 2.02 – 2.39); eyes in full face view not reaching or only marginally exceeding lateral cephalic outline (Fig. 3); pronotal dorsum subopaque; pilosity and pubescence abundant over most body surfaces... .....*P. erosispina* Emery*

* *Polyrhachis bellicosa* and *P. erosispina* are very similar but where they are sympatric, their morphological differences are somewhat accentuated. In allopatry, however, the differences are usually less distinct and there is no single diagnostic character that can be relied upon to separate them. A combination of characters has to be considered to differentiate both species successfully. The most reliable character appears to be the form of the petiolar column in some workers of *P. bellicosa*, in which the anterior section at the immediate base of the spines is swollen (see Kohout 1988, fig. 1A, C). However, besides the holotype, only a small percentage of workers in any particular population show this remarkable configuration and specimens intermediate to the more usual unswollen condition (see Kohout 1988, fig. 3E, F), are uncommon. The swollen condition has been observed in populations of *P. bellicosa* from various parts of New Guinea, but only where this species is sympatric with its closely related counterpart, *P. erosispina*. This has been confirmed to be repeated under the same circumstances of contact with *P. erosispina* in populations of *P. bellicosa* in

eastern Indonesia. Presence of this phenomenon on Aru Island is confirmed by the holotype itself and documentation of the presence of *P. erosispina* there by Karavaiev (1927). The Philippine record of *P. bellicosa* is from Mindanao, where a worker with a swollen node was collected with 'normal' specimens at the same locality as *P. olybria*, another species closely related to both, *P. bellicosa* and *P. erosispina*. The swollen node condition has never been observed in the Australian population of *P. bellicosa*, in spite of examination of many hundreds of specimens. This appears to be correlated with the absence of any closely similar species in Australia. It is unfortunate that this remarkable feature is relatively rare, for it is the most reliable character identifying *P. bellicosa*, even when other characters fail to distinguish the species from sympatric *P. erosispina* specimens.

Besides the characters given in the key and the form of the petiolar column, the more reliable diagnostic characters separating *P. bellicosa* from *P. erosispina* are as follows. The pronotal dorsum in *P. bellicosa* is distinctly narrowed anteriorly and more or less broadly rounded posteriorly, with the dorsum of mesonotum in profile, deeply and broadly impressed at the promesonotal suture. The mesonotal spines at their bases are almost pyramidal, with their apical portions more or less horizontal and their dorsal edges entire. In contrast, the pronotal dorsum in *P. erosispina* is only very slightly narrowed anteriorly, with the sides almost parallel. The promesonotal suture is only very narrowly impressed and virtually flat in profile. The mesonotal spines are lanceolate from their bases, with the apical portions usually recurved, and the dorsal edges frequently eroded.

**Polyrhachis bihamata** species-group

**Polyrhachis bellicosa** Fr. Smith, 1859
(Figs 1, 4 - 5, 39, 42 - 43)

*Polyrhachis bellicosus* Fr. Smith, 1859: 142. Holotype worker. Type locality: INDONESIA, ARU I. (A.R. Wallace), OXUM (examined).

*Polyrhachis bellicosa* var. *crudelis* Emery, 1887: 238. Syntype workers. Type locality: INDONESIA, MOROTAI I. (as Morty I.), MSNG (examined). Synonymy by Hung, 1970: 5.

*Polyrhachis (Polyrhachis) bellicosa* Fr. Smith; Hung, 1970: 5 (in part).

*Polyrhachis (Polyrhachis) bellicosa* Fr. Smith; Kohout, 1988: 418. Description of queen.

**ADDITIONAL MATERIAL EXAMINED**

PHILIPPINES, MINDANAO: Agusan, 10 km SE San Francisco, 12.xi.1959 (L.W. Quate & C.M. Yoshimoto) (w). INDONESIA, AMBON: Waai, 11.iii.1965 (A.M.R. Wegner) (w). SERAM: Manusela NP, Wae Mual Plain, 25.vii-9.ix.1987 (M.J.D. Brendell, B.M. 1987 – 2620 (w); Goram, 1872 (D'Albertis) (w). IRIAN JAYA (as NW New Guinea): Nabire, S of Geelwing Bay, 03°22'S, 135°29'E, 10 – 40 m, 2.x.1962 (H. Holtmann). PAPUA NEW GUINEA: West Sepik Prov., Torricelli Mts, Lumi, 03°28'S, 142°02'E, 400 – 550 m, 4-13.viii.1984 (RJK accs 84.243, 260, 284) (w); ditto, x.1984 (D. Waisi) (w); Pes Mission, c. 12 km WSW of Aitape, 03°11'S, 142°15'E, < 50 m, 31.vii-3.viii.1984 (RJK acc. 206). East Sepik Prov., Angoram, 04°04'S, 144°03'E, 10 m, 13.viii.1969 (JLG) (w); Dreikikir, W of Maprik, 03°34'S, 142°44'E, 350 – 400 m, 23.vi.1961 (JLG) (w). Chimbu Prov., Keglsugl, nr Mt Wilhelm, 05°44'S, 145°04'E, 2600 m, 13.xii.1969 (JLG) (w); Madang Prov., Wanuma, Adelbert Mts, 04°36'S, 145°06'E, viii.1968 (NLHK) (w). Morobe Prov., nr Wampit, c. 35 km W of Lae, 06°45'S, 146°40'E, c. 50 m, 24.& 27.viii.1984 (RJK accs 84.345, 365, 377) (w); Lae, 06°43'S, 147°00'E, < 50 m, 17.vi.1972 (RWT acc. 72.371) (w); Mindik, 1200 – 1600 m, ix.1968 (NLHK) (w). Northern Prov., Owen Stanley Ra., Mamba Pltn, c. 7 km WNW of Kokoda, 08°51'S, 147°41'E, 500 m, 31.viii.-1. ix.1984 (RJK acc. 84.403) (w). Central Prov., 25 km NE of Sogeri, Musgrave Riv., 25.x.1984 (T. Mala) (w); Tapini, Owen Stanley Ra., 08°19'S, 147°00'E, 1000-1100 m, 18.v.1961 (JLG & M. Gressitt). New Britain Prov., Gazelle Pen., Baining Mts, nr Gaulim, 04°28'S, 152°07'E, c. 150 m, 13.vii.1984 (RJK accs 84.52, 58, 59) (w); c. 12 km SW of Vudal Agric. College, 04°25'S, 151°57'E, c. 200 m, 15.vii.1984 (RJK acc. 84.83) (w). New Ireland Prov., East Coast, c. 3 km S of Konos,03°09'S, 151°43'E, c. 100 m, 22.vii.1984 (RJK acc. 84.112, 117) (w, ♀). AUSTRALIA,


**Figs. 1 – 9.** *Polyrhachis* (*Polyrhachis*) (*bihamata*-group) spp.: *P. bellicosa* Fr. Smith (1, 4, 5); *P. bihamata* (Drury) (2, 6, 7); *P. erosispina* Emery (3, 8, 9).

QUEENSLAND: Cape York Pen., Bamaga, 10°53'S, 142°23'E, 18-24.iii.1987 (RJK acc. 87.3) (w); Iron Ra., 12°44'14"S, 143°15'43"E, c. 30 m, 26-31.vii.1981 (RJK accs 81.138, 216) (w); ditto, 1-3.vii.1976 (P. Filewood) (w); West Claudie Riv., Iron Ra., 3-10.xii.1985 (G.B. Monteith & D.J. Cook) (w); ditto, 12°44'20"S, 143°15'14"E, c. 40 m, 2-5.x.2000 (RJK & S.K.A. Robson acc.2000.145) (w).

WORKER (redescription) (Figs. 1, 4, 5).

Dimensions (holotype cited first): TL c. 8.98, 7.30 – 8.98; HL 2.06, 1.79 – 2.12; HW 1.75, 1.56 – 1.96; CI 85, 83 – 97; SL (antennae missing), 2.27-2.72; SI -, 132 – 157; PW 1.03, 0.86 – 1.03; PeH 1.78, 1.64 – 2.07; PeI 86, 87 – 108; MTL 3.65, 3.07-3.68 (1+52 measured).
Dimensions (syntype of *crudelis*): TL c. 8.37; HL 2.03; HW 1.72; CI 85; SL 2.71; SI 157; PW 0.94; PeH 2.31; PeI 114; MTL 3.53 (1 measured).

Mandibles with 5 teeth, distinctly reducing in length towards mandibular base. Anterior clypeal margin arcuate. Clypeus with blunt, posteriorly raised, median carina; clypeus convex in profile with moderately impressed basal margin. Frontal triangle distinct. Frontal carinae sinuate with distinctly raised margins; central area with longitudinal carina instead of usual frontal furrow. Sides of head in front of eyes converging into mandibular bases in weakly convex line; behind eyes, sides widely rounding into relatively narrow occipital margin. Eyes convex, in full face view clearly exceeding lateral cephalic outline. Median ocellus present; lateral ocelli obscure or lacking in some specimens. Pronotal humeri armed with relatively long, acute, anterolaterally and weakly ventrally directed spines; outer borders of spines continuous basally with rather blunt, weakly rounded lateral pronotal margins that terminate before reaching strongly impressed promesonotal suture. Mesonotal dorsum with lateral margins strongly raised into pyramidal, rather compressed, dorsoposteriorly projecting spines, with tips mostly subparallel, but sometimes curved outwards or downwards. Metanotal groove indistinct dorsally, weakly impressed laterally. Propodeal dorsum immarginate with posterior angles produced into short, medially unconnected, transverse ridges; propodeal declivity distinctly shorter than propodeal dorsum. Petiole columnar, dorsally with a pair of hook-shaped spines. Anterior face of first gastral segment widely rounding onto dorsum.

Mandibles finely, longitudinally striate with numerous piliferous pits. Head, including clypeus, reticulate-punctate, semipolished. Pronotal dorsum very finely reticulate-punctate, polished; mesonotum, propodeum and petiole finely reticulate-punctate, tips of spines smooth and highly polished. Gaster finely shagreened, moderately polished.

Mandibular masticatory borders with a few golden hairs. Anterior clypeal margin with several medium length, golden setae medially and fringe of shorter setae laterally. A single pair of medium length, golden hairs medially at anterior margin of clypeus. A few, medium length, golden hairs on fore coxae and brush of short, golden hairs, on subpetiolar process. Gaster with numerous, moderately long hairs on venter and around apex. Hairs completely absent from antennal scapes and all dorsal body surfaces. Closely appressed, golden pubescence distributed over most body surfaces, except pronotal dorsum and spines.

*Colour.* Head, including mandibles and antennae, tips of spines, distal ends of femora, tibiae, tarsi and gaster black; pronotal and mesonotal lateral margins narrowly bordered with black or dark brown. Mesosoma, most of petiole, coxae and femora, except their distal ends, light reddish-brown.

QUEEN (not previously described)
(Figs. 39, 42 – 43).

Dimensions: TL c. 9.77-10.08; HL 2.12-2.22; HW 1.56-1.66; CI 74-76; SL 2.95-3.02; SI 181-189; PW 1.41-1.51; MTL 3.93-4.03; PeH 1.11-1.21; PeI 51-57 (10 measured).

Distinctly larger than worker and with usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. Mandibles with four teeth; apical tooth much longer than other teeth which are greatly reduced or often vestigal. Eyes distinctly larger; sides of head in front of eyes virtually parallel

towards mandibular bases. Frontal triangle distinct; frontal carinae sinuate with distinctly raised margins; central area concave with finely impressed frontal furrow. Pronotal spines distinctly shorter, only about 2× as long as their basal width. Mesoscutum only marginally wider than long; lateral margins converging anteriorly into moderately rounded anterior margin; median line distinct; parapsides flat; mesoscutum in profile relatively high, anterior face widely rounding onto flat dorsum. Mesoscutellum moderately convex, only marginally elevated above dorsal plane of mesosoma. Propodeal dorsum not marginate, rather flat in outline, marginally longer than declivity; posterior angles forming upturned, medially directed, rounded ridges with propodeal dorsum between them descending into declivity in medially uninterrupted line. Petiole with pair of rather slender, relatively long, widely diverging spines with their extreme tips curved backwards and weakly downwards.

Mandibles finely longitudinally striate with piliferous pits. Head and mesosoma very finely reticulate-punctate; tips of spines smooth and polished. Gaster shagreened.

Mandibles at masticatory borders with several golden hairs. Anterior clypeal margin with several longer setae medially and fringe of shorter setae laterally. A single pair of medium length, golden hairs medially near anterior margin of clypeus. Several longer hairs on fore coxae and brush of short, golden hairs, lining subpetiolar process. Relatively long, golden hairs on venter and around apex of gaster. Very fine, closely appressed, silvery pubescence in various densities over most body surfaces; pubescence somewhat longer on sides of mesosoma and virtually absent from spines of petiole.

*Colour.* Black, with mandibles, pronotal collar, subpetiolar process and legs, except apical tarsal segments, light to medium reddish-brown. Antennae, including condylae, medium to dark reddish-brown, extreme tip of apical funicular segment light, reddish-brown.

Male described by Hung (1970); immature stages in ANIC and QMBA spirit collections.

**REMARKS**

*Polyrhachis bellicosa* is one of three species (the other two are *P. erosispina* and *P. olybria*) which are frequently misidentified. However, *P. olybria* is easily separable by a number of characters of which the most conspicuous is the lightly coloured first gastral segment which ranging from light yellowish-brown to medium reddish-brown (Figs. 22, 23). Additionally, the posterior angles of propodeal dorsum in *P. olybria* are produced into short, acute, dorsoposteriorly directed spines (Fig. 23), which are contiguous at their bases, forming a 'V' when the propodeum is viewed from behind. Ocelli usually lacking in workers of *P. olybria* (Fig. 19), with only their relative position usually marked by shallow depressions in cephalic sculpturation. In contrast, in *P. bellicosa* and *P. erosispina* the gaster is uniformly black, or very dark reddish-brown (Figs. 4, 8), the posterior angles of propodeal dorsum terminate in medially directed, short, transverse ridges and ocelli are always present (Figs. 1, 3), though the lateral pair is sometimes obscure. While the differences separating *P. olybria* from both the other species are clearly defined, those separating *P. bellicosa* and *P. erosispina* can be very tenuous, due to apparent character displacement (see above). Some of the more reliable diagnostic characters of *P. bellicosa* include the more convex eyes which, in full face view, clearly exceed the lateral cephalic outline (Fig. 1), the very fine microsculpture of the body, especially on pronotal dorsum which is very smooth and almost polished, and short or medium length hairs are rather sporadic and virtually absent from all dorsal body surfaces. In contrast, in *P. erosispina* the eyes are only moderately convex and do not or only marginally exceed the lateral cephalic outline in full face view (Fig. 3), the microsculpture of the body is coarser, notably on pronotal dorsum, which is sub-opaque, lacking a polished appearance and there are usually abundant short to long hairs over all body surfaces. Most specimens of *P. bellicosa* and *P. erosispina* differ in size and despite some overlap in their head lengths (HL 1.79 – 2.12 in *P. bellicosa* versus 2.02 – 2.39 in *P. erosispina*) specimens of the former are usually smaller than the latter.

Hung (1970) considered *P. bellicosa* var. *crudelis* a synonym of the nominal species, but after examining the single available syntype, I believe it could be a synonym of *P. erosispina*, rather than *P. bellicosa*. Although the syntype has distinctly convex eyes that clearly exceed the lateral cephalic outline in full face view, like those of *P. bellicosa*, in other characters it resembles specimens of *P. erosispina*. The lanceolate bases of mesonotal spines and distinctly coarser body sculpturation combined with abundant pilosity and pubescence of the specimen of *crudelis* closely resembles specimens of *P. erosispina*, but it does differ somewhat in having a more massive petiolar node. However, having only a single syntype available and no other specimens of *P. bellicosa* var. *crudelis* apparently known, I am reluctant to make any changes to its present status as a synonym of *P. bellicosa*. Considering that at the time of the description of *crudelis, P. erosispina* had not been described, it was logical that Emery has decided to place it as a variety of the closely similar *P. bellicosa*.

*Polyrhachis bellicosa* appears to be a New Guinean species which extended its range into Indonesia, southern Philippines and the northern Australia. It is a relatively common species throughout the New Guinean mainland; however, it becomes relatively rare towards the northern limits of its distribution, where it is mostly replaced by *P. olybria*.

**Polyrhachis bihamata** (Drury, 1773)
(Figs. 2, 6 – 7, 40, 44 – 45)

*Formica bihamata* Drury, 1773: 73, pl. 38, Figs. 7, 8. ?Holotype worker. Type locality: ISLAND OF JOHANNA, near MADAGASCAR (locality evidently in error – see Bolton, 1973: 352) (types/s presumed lost).

*Polyrhachis bihamata* (Drury); Mayr, 1872: 139. Description of queen.

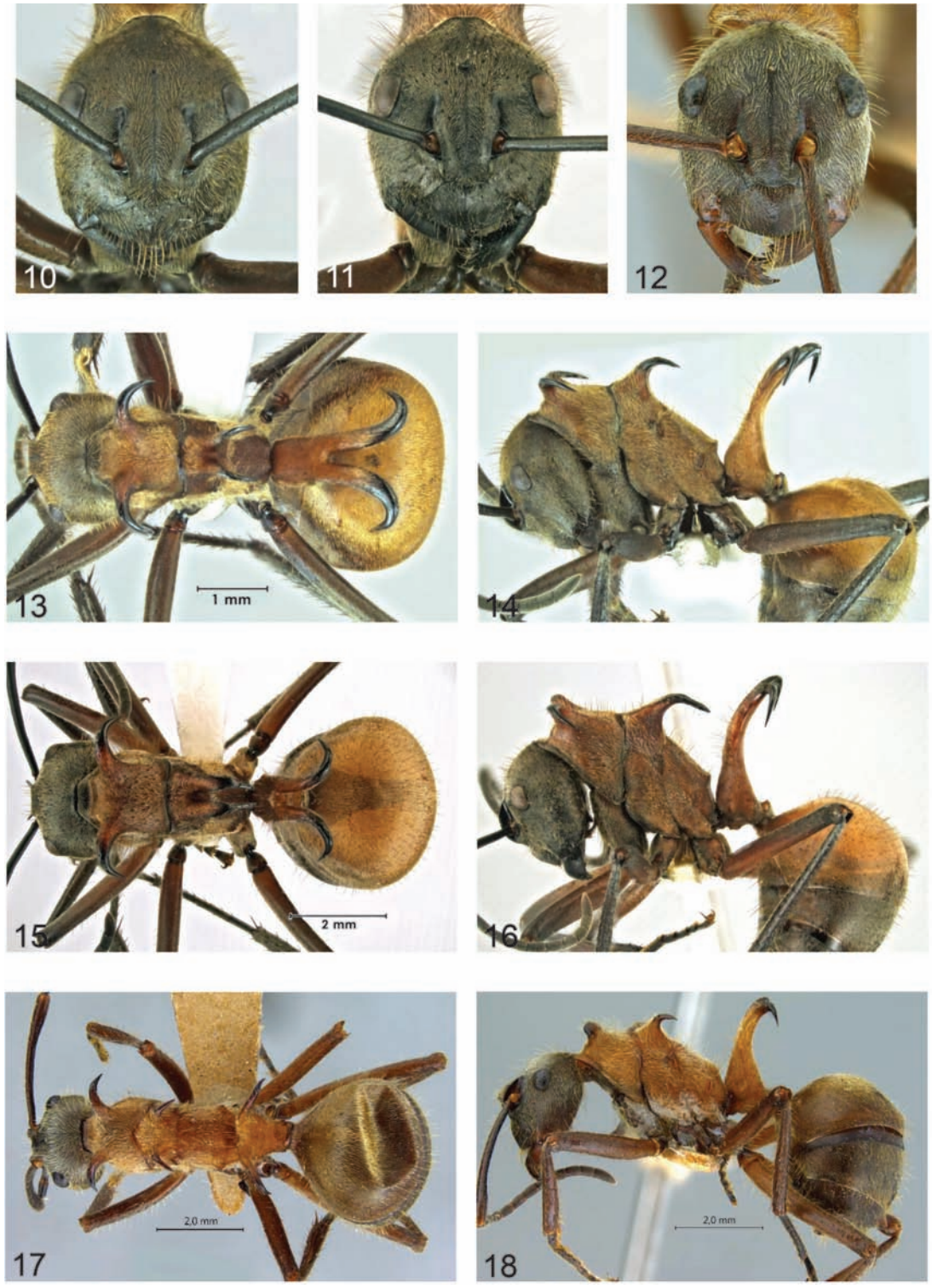
*Polyrhachis (Polyrhachis) bihamata* var. *perplexa* Santschi, 1925: 92. Syntype workers. LAOS, Muong Pek, 29.iii.1918 (V. de Salvaza), NHMB (examined). Synonymy by Hung, 1970: 16.

*Polyrhachis (Polyrhachis) bihamata* Drury var. *minor* Karavaiev, 1927: 12. Holotype worker. Type locality: INDONESIA, JAVA, Tjampea nr Buitenzorg (= Bogor), 2.i.1913 (Karavaiev #2390), IZAS (examined). [Unresolved junior primary homonym of *P. armata* var. *minor* Forel, 1886]. Synonymy by Hung, 1970: 16.

*Polyrhachis (Polyrhachis) bihamata* var. *tonsilis* Santschi, 1928: 133. Syntype workers. Type locality: INDONESIA, SUMATRA, Simbolangit (Corporaal), NHMB (examined). Synonymy by Hung, 1970: 16.

## ADDITIONAL MATERIAL EXAMINED

MYANMAR (as Burma, Tenasserim): Thagata, 1887 (L. Fea) (w). THAILAND (as E. Siam): Udon, 19.iii.1929 (Hugh Smith) (w); Doi Chiang Dau, nr Chiang Mai, 2-8.iv.2005 (Sk. Yamane TH05-SKY-50) (w). VIETNAM: Da-Nang, Mt Son Tra, 25.vii.1966 (H.P. Shurtleff) (w). WEST MALAYSIA: PENANG (no further data) (w); SELANGOR, Genting Highlands, 18.ii.1986 (W.H.O. Dorow, acc. 173) (w); Ulu Gombak Research Centre, sec. for., 8.i.1995 (C. Liefke) (w). PERAK: Belum For. Res., 18.xi.1993 (Maryati Mohamed) (w). NEGERI SEMBILAN: N of Seremban, 7.iii.1989 (U. Maschwitz acc. MU-1008) (w). SABAH (as British Nth Borneo): Ranau, 500 m, 8-18.x.1958 (L.W. Quate) (w); Kinabalu Park, Poring, 06°2’48.37”N, 116°41’56.30”E, 13.ix.2006, 500 m, primary for. (A. Floren) (w); ditto, Poring, 06°02’N, 116°43’E, c. 500 m, 30.x.2000 rf. edge (RJK acc. 2000.186) (w); ditto, c. 600 m, 29.iv.1994 (UMS coll.) (w); Kinabalu Park, Sorinsim, 06°16’59.28”N, 116°42’4.44”E, 5.iii.1997, 280 m (A. Floren) (w); Danum Valley, 1992, fog. (A.Y.C. Chung) (w); Tabin Wildlife Res., 05°00'N, 118°30'E, 23.ix-1.x.1998 (Bakhtiar Effendi) (w); Maliau Basin, Ginseng Camp, 04º44’N, 116º55’E, c. 700 m, 27.ii-11.iii.2005, rf. (RJK & Effazilla Waty, acc. 2005.13) (w); ditto, Maliau Falls, 04º46’N, 116º55’E, c. 470 m, 10.iii.2005, rf. (A. Chung, RJK acc. 05.69) (w). BRUNEI: Temburong Distr., KBFSC, 04°33’N, 115°08’E, xi.1991 (A.N. Andersen) (w, ♀); ditto,




**Figs. 10 – 18.** *Polyrhachis* (*Polyrhachis*) (*bihamata*-group) spp.: *P. maliau* sp. nov. (10, 13, 14); *P. mindanaensis* Emery (11, 15, 16); *P. montana* Hung (12, 17, 18).

15.iv.1993 (RJK accs 93.5, 6) (w); ditto, 21-29. vi.1994 (RJK accs 94.40, 46, 54, 61, 74) (w); ditto, 19.v.2001 (D. Davidson #18, 35) (w); ditto, 14-23.ix.1999 (S.K. Robson #843) (w); Brunei-Muara Distr., Bukit Saeh, c. 3 km ex Kg Ayr on Lumpas Rd., 25.vii.1994 (RJK acc. 94.145) (w); Belait Distr., Bukit Teraja nr Labi, 21.vii.1994 (RJK acc. 94.140) (w). BORNEO, SARAWAK: Bidi, 1908-09 (C.J. Brooks) (w); Bako NP, 20.vi.1991 (Maryati Mohamed) (w); Semenggog For. Res., 15.vi.1991 (Maryati Mohamend) (w). INDONESIA, KALIMANTAN: Nanga, Sg. Belabi, Sg. Sibau, 01°17'N, 113°15'E, c. 150 m, 4-10.vii.1996 (C. Reid) (w); ditto, 250 – 350 m, 6-8.vii.1996 (C. Reid) (w); 5 km NE of Kg Putan, Sg. Sibau, 01°03'N, 113°01'E, c. 70 m, 23-26.vi.1996 (C. Reid) (♀). KALIMANTAN TIMUR: 31 km N of Balikpapan, 21.vi.1972, rf. (W. Brown) (w). KALIMANTAN BARAT: Gn. Palung NP, Cabang Panti Res. Stn, 100 m, 1º15'S, 110º5'E, 15.vi-15.viii.1991 (Malaise traps) (Darling, Rosichon & Sutrisno) (w). SUMATRA: Pematang, Siantar, 1937 (W.M. Mann, NGS SI Exp.) (w); Bangkinang, 1937 (W.M. Mann, NGS SI Exp.) (w); Dolok Silau, 1937 (W.M. Mann, NGS SI Exp.) (w); Alas Valley, Balelutu, c. 320 m, 03°43'N, 97°38'E, 3-8.viii.1972 (J. Krikken #36-40) (w); Sibolangit (= type locality of *tonsilis*) (J.A. Loerzing) (w). W. BALI: Dusun PK, Jelati, Mendaya, 5-6.v.1998 (Sk. Yamane) (w).

## WORKER

Dimensions: TL c. 9.47 – 11.99; HL 2.17 – 2.77; HW 1.91 – 2.47; CI 81-94; SL 2.82 – 3.53; SI 133 – 149; PW 1.11 – 1.36; PeH 2.37 – 3.12; PeI 100-119; MTL 3.98 – 4.79 (19 measured).

Dimensions (*bihamata perplexa* syntypes): TL c. 10.84 – 12.45; HL 2.50 – 2.71; HW 2.25 – 2.37; CI 87 – 90; SL 3.17 – 3.53; SI 140 – 149; PW 1.16 – 1.26; PeH 2.92 – 3.12; PeI 113 – 119; MTL 4.33 – 4.84 (6 measured).

Dimensions (*bihamata tonsilis* syntypes): TL c. 10.08 – 10.73; HL 2.43 – 2.46; HW 2.15 – 2.21; CI 88 – 90; SL 3.12; SI 141 – 145; PW 1.06; PeH 2.77 – 2.87; PeI 114 – 117; MTL (missing) (2 measured).

Dimensions (*bihamata minor* holotype): TL c. 9.12; HL 2.21; HW 1.96; CI 89; SL (missing); PW 1.06; PeH 2.25; PeI 102; MTL 3.93.

## QUEEN

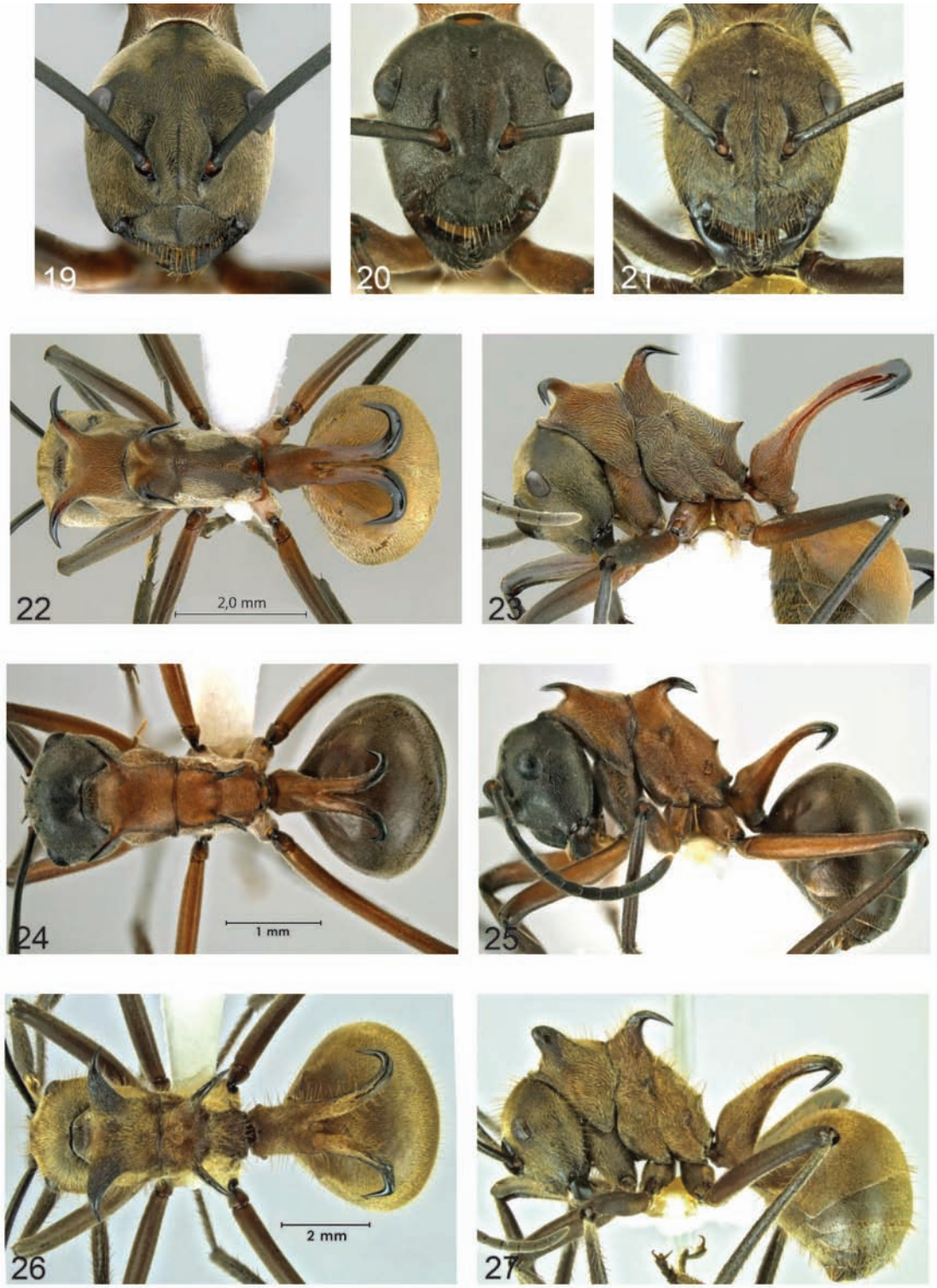
Dimensions: TL c. 13.30; HL 2.77; HW 2.37; CI 85; SL 3.93; SI 166; PW 2.67; PeH 1.31; PeI 47; MTL 4.69 (1 measured).

Queen distinctly larger than worker and with usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. The queen of *P. bihamata* was described by Mayr (1872) and the details are not repeated here. It is somewhat similar to queen of *P. ypsilon*, with both having the pronotal spines reduced to bluntly angular prominences. The mesoscutum in *P. bihamata*, however, is distinctly more slender and the golden pilosity and pubescence shorter and less abundant.

Male and immature stages in SMFG (Dr W.H.O. Dorow coll.); a single male in QMBA.

## REMARKS

*Polyrhachis bihamata* was redescribed by Hung (1970: 16), who also proposed the synonymy of all three subspecific forms with the nominal species. Kohout (1998: 508) accepted Hung's decision regarding the synonymy of *P. bihamata perplexa* but was hesitant to accept the synonymy of *P. bihamata tonsilis*. Similar to Santschi (1928), Kohout considered *P. bihamata tonsilis* to be an intermediate 'form', but between *P. bihamata* and *P. olybria*, rather than between *P. bihamata* and *P. bellicosa*. Kohout (1998) also examined the unique holotype of *P. bihamata minor*, described by Karavaiev from Java, and based on its similarity to *P. bihamata tonsilis* commented that "Judging from the available specimens, I believe that the synonymy of *P. bihamata minor* with *P. bihamata tonsilis*, and elevation of the latter to specific status could be justified". However, the only available specimen besides the types is a topotypical individual (Sumatra, Sibolangit, 1919,




**Figs. 19 – 27.** *Polyrhachis* (*Polyrhachis*) (*bihamata*-group) spp.: *P. olybria* Forel (19, 22, 23); *P. taylori* Kohout (20, 24, 25); *P. ypsilon* Emery (21, 26, 27).

J.A. Loerzing) and I am not prepared to make any nomenclatural changes without additional material. Consequently I have maintained the status quo and adopted Hung's (1970) proposed synonymies.

*Polyrhachis bihamata* has been recorded throughout Southeast Asia, from Vietnam, Laos, Thailand and Myanmar to Malaysia and south to Borneo, Sumatra, possibly Java and Bali. It was also listed by Fr. Smith (1858: 58; 1862: 39; 1863: 126; 1865: 69) variously from India, the Indonesian islands of Waigeo, Bacan, Seram and Sulawesi and from New Guinea, however, I believe that many of these records are based on misidentified specimens, representing mostly *P. olybria* and/or *P. bellicosa* and *P. erosispina*.

**Polyrhachis erosispina** Emery, 1900
(Figs. 3, 8 – 9, 34, 41, 46 – 47)

*Polyrhachis bellicosa* var. *erosispina* Emery, 1900: 713 (footnote). Lectotype and paralectotypes (designated by Kohout, 1988: 419). Type locality: NEW GUINEA: Ramoi (Beccari); INDONESIA: SULAWESI (as Celebes), Kandari (O. Beccari), MSNG (examined).

*Polyrhachis (Polyrhachis) bellicosa* var. *erosispina* Emery; Karavaiev, 1927: 12, fig. 3. Description of queen.

*Polyrhachis (Polyrhachis) bellicosa* Fr. Smith; Hung, 1970: 5 (in part).

*Polyrhachis (Polyrhachis) erosispina* Emery; Kohout, 1988: 419. Revived from synonymy and raised to species.

## ADDITIONAL MATERIAL EXAMINED

INDONESIA, SULAWESI UTARA: Mt Klabat, Air Maddidi slope, 400 – 600 m, wet for., 13-19.vi.1972 (W.L., Brown) (w). SULAWESI TENGGARA: nr Sagona, Base Camp I, Watuwilla, c. 200 m, 15.x-5.xi.1989 (Malaise trap) (C.van Achterberg) (w); 1 – 2 km E of Wolasi, 42 km S of Kendari, c. 350 m, rf., 13-14.vii.1972 (W.L. Brown) (w); SULAWESI SELATAN: Cagar Alam Karaenta, Kabupaten Maros, c. 265 – 315 m, iii.1996 (B. Gobin) (w). ARU I.: Kobror, 1913 (V. Karavaiev #2540, 2548) (w). AMBON I.: Amboina, 1913 (V. Karavaiev #2467, 2492) (w, ♀). WEST IRIAN: Nabire, S of Geelvink Bay, 03°22'E, 135°29'E, < 20 m, 1-9.vii.1962 (JLG) (w); Vogelkop, Fak Fak, S coast of Bomberai, 02°55'S, 132°18'E, 10 – 100 m, 10.vi.1959 (TCM) (w); Nabire, S of Geelvink Bay, 03°22'S, 135°29'E, 2.x.1962 (H. Holtman) (w); Ifar, Cyclops Mts, 02°34'S, 140°31'E, 400 – 450 m, 27.vi.1962 (JLG) (w); ditto, 300 – 500 m, 28-30.vi.1962 (JLG) (w). PAPUA NEW GUINEA: West Sepik Prov., Torricelli Mts, Lumi, 03°28'S, 142°02'E, 400 – 550 m, 4-13.viii.1984 (RJK accs 84.223, 228, 243, 248, 249, 267, 279, 284, 286) (w); ditto, x.1984 (D. Waisi) (w, ♀); Pes Mission, c. 12 km WSW of Aitape, 03°11'S, 142°15'E, < 50 m, 31.vii.-3.viii.1984 (RJK acc. 160) (W); Oenake Ra., c. 10 km WNW of Vanimo, 03°40'S, 141°12'E, 200 – 300 m, 15.viii.1984 (RJK acc. 84.288) (w). East Sepik Prov., c. 2-3 km S of Wirui, S of Wewak, 03°36'S, 143°37'E, 50 – 100 m, 8.viii.1984 (RJK acc. 84.256) (w); Bainyik, S of Maprik, 03°48'S, 143°02'E, 225 m, 20-21.vi.1961 (JLG) (w); Angoram, 04°04'S, 144°03'E, 10 m, 13.viii.1969 (JLG) (w). Madang Prov., Wanuma, Adelbert Mts, 04°36'S, 145°06'E, viii.1968 (NLHK) (w); Karkar I., Kurum, 100 m, viii.1968 (NLHK) (w); Morobe Prov., nr Wampit, c. 35 km W of Lae, 06°45'S, 146°40'E, c. 50 m, 24.& 27.viii.1984 (RJK accs 84.345, 348, 349, 350, 353, 365) (w); Sarawaget Ra., 3 km of Gain, 06°25'S, 146°46'E, 1000 – 1200 m, 26.viii.1984 (RJK acc. 84.363) (w); Etep, 600 – 700 m, ix.1968 (NLHK) (w); Kalalo, 06°04'S, 147°11'E, 750 m, 20-30.viii.1966 (G.A. Samuelson) (w); Bulolo, iii.1935 (F.H. Taylor) (w). Western Prov., Oriomo Govt. Stn, 08°48'S, 143°05'E, 26-28.x.1960 (JLG) (w). Gulf Prov., Murua Riv., nr Kerema, 07°50'S, 145°52'E, 0 – 3 m, 17-18,xii.1964 (J. Sedláček) (w). Northern Prov., Owen Stanley Ra., Mamba Pltn, c. 7 km WNW of Kokoda, 08°51'S, 147°41'E, 500 m, 31.viii.-1.ix.1984 (RJK acc. 84.403) (w); Pongani Riv., Boikiki Pltn, c. 8 km NNE of Afore, 09°06'S, 148°25'E, c. 500 m, 29-30.viii.1984 (RJK accs 84.382, 386) (w); Kokoda, 08°53'S, 147°45'E, 400 m, 22.iii.1956 (JLG) (w); Keparra-Sengi, nr Kokoda, 500 m, 26.iii.1956 (JLG) (w); Cape Killerton, 08°36'S, 148°23'E, 0 – 5 m, 6-13.v.1965 (W.A. Steffan) (w). Central Prov., Mamai Pltn, 10°16'S,


**Figs. 28 – 33.** *Polyrhachis* (*Polyrhachis*) (*lamellidens*-group) spp.: *P. craddocki* Bingham (28, 30, 31); *P. lamellidens* Fr. Smith (29, 32, 33).

149°30'E, 60 m, 17.ii.1965 (P. Shanahan) (w); Iongai, Owen Stanley Ra., 08°30'S, 147°33'E, 1450 m, 9.xi.1965 (J. Sedláček) (w); Nunumai, via Amazon Bay, vii.1969 (R. Pullen) (w).

**WORKER**

Dimensions (lectotype cited first): TL c. 9.07, 8.01 – 9.37; HL 2.18, 2.02 – 2.39; HW 1.93, 1.69 – 2.09; CI 89, 82 – 91; SL 2.81, 2.52 – 3.02; SI 146, 135 – 150; PW 1.15, 0.93 – 1.16; PeH 2.09, 1.81 – 2.17; PeI 96, 84 – 97; MTL 3.69, 3.43 – 4.08 (1+53 measured).

Mandibles with 5 teeth, distinctly reducing in length towards mandibular base. Anterior clypeal margin arcuate. Clypeus with blunt, posteriorly raised, median carina; clypeus convex in profile with moderately impressed

basal margin. Frontal triangle distinct. Frontal carinae sinuate with distinctly raised margins; central area relatively flat with frontal furrow almost reaching median ocellus. Sides of head in front of eyes converging into mandibular bases in convex line; behind eyes, sides widely rounding into relatively narrow occipital margin. Eyes only moderately convex; in full face view usually not or only marginally exceeding lateral cephalic outline. Median ocellus present; lateral ocelli often obscure or lacking in some specimens. Pronotal humeri armed with relatively long, acute, anterolaterally and weakly ventrally directed spines; outer borders of spines continuous basally with rather blunt, weakly rounded lateral margins that terminate before reaching strongly impressed promesonotal suture. Mesonotal dorsum with lateral margins strongly raised into lanceolate, somewhat dorsomedially compressed, dorsoposteriorly projecting spines with tips often variously 'gnawed' and curved outwards or downwards. Metanotal groove weakly impressed. Propodeal dorsum immarginate with posterior angles produced into short, medially unconnected, transverse ridges; propodeal declivity shallowly concave, distinctly shorter than propodeal dorsum. Petiole columnar, bearing a pair of subparallel, hook-shaped spines. Anterior face of first gastral segment widely rounding onto dorsum.

Mandibles finely, longitudinally striate with numerous piliferous pits. Head, mesosoma and petiole reticulate-punctate, opaque; tips of spines smooth and highly polished. Gaster finely shagreened.

Mandibular masticatory borders with a few, curved, golden hairs. Anterior clypeal margin with several medium length, golden setae medially and fringe of shorter setae laterally. A few paired, relatively short, golden hairs on clypeus, along frontal carinae and on vertex; brush of short erect hairs behind eyes towards occipital margin, clearly exceeding cephalic outline in full face view. Numerous medium length, golden hairs on fore coxae, anterior face of petiole and brush of extremely short, golden hairs on subpetiolar process; occasionally short hairs present on bases and along pronotal and mesonotal spines. Gaster with numerous, short hairs on anterior face of first gastral tergite; abundant moderately long hairs on venter and around apex of gaster. Hairs completely absent from antennal scapes. Closely appressed, golden pubescence distributed over most body surfaces, except tips of spines.

*Colour.* Head, including mandibles and antennae, apical half of spines, distal ends of femora, tibiae, tarsi and gaster black; pronotal and mesonotal lateral margins narrowly bordered with black or dark brown. Mesosoma, most of petiole, coxae and most of femora light reddish-brown.

**QUEEN**

Dimensions: TL c. 10.98 – 12.14; HL 2.52 – 2.72; HW 2.07 – 2.32; CI 80 – 85; SL 3.38 – 3.78; SI 156 – 176; PW 1.56 – 1.79; MTL 4.23 – 4.69; PeH 1.16 – 1.41; PeI 43 – 51 (20 measured).

Queen distinctly larger than worker with usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. It was described at length by Karavaiev (1927: 12) and Kohout (1988: 419) and details are not repeated here. The queen of *P. erosispina* is somewhat similar to that of *P. bellicosa*, but they are easily separated by their size (HL 2.52 – 2.72 in *erosispina* versus HL 2.12 – 2.22 in *bellicosa*) and the shape of their head and petiole (Figs. 41, 47, *erosispina*; Figs. 39, 43, *bellicosa*).

Male in ANIC and QMBA spirit collections; immature stages unknown.

**REMARKS**

*Polyrhachis erosispina* is very similar to *P. bellicosa* and their distinguishing characters are discussed in the remarks section of the latter species. The known distribution of *P. erosispina* encompasses only the New Guinean mainland and several eastern Indonesian islands, including Sulawesi. To date it is unknown from the Bismarck Archipelago and Cape York Peninsula in Queensland.

**Polyrhachis maliau** sp. nov.
(Figs. 10, 13 – 14)

## MATERIAL EXAMINED

HOLOTYPE: BORNEO, SABAH, Maliau Basin, Ginseng Camp, 04º44'N, 116º55'E, c. 700 m, 27.ii.-11.iii.2005, rf., strays on ground & low vegetation, R.J. Kohout & Effazilla Waty, acc. 2005.64 (worker). PARATYPES: data as for holotype (83 workers) Type distribution: Holotype and 3 paratypes in ITBC; most paratypes in QMBA; 2 paratypes each in ANIC, BMNH, CASC, MCZC and NMNH.

## WORKER

Dimensions (holotype cited first): TL c. 9.42, 9.17 – 9.93; HL 2.28, 2.21 – 2.37; HW 1.96, 1.91 – 2.02; CI 86, 82-88; SL 2.87, 2.77 – 2.92; SI 146, 141 – 150; PW 1.01, 0.87 – 1.06; PeH 2.29, 2.25 – 2.47; PeI 100, 98 – 109; MTL 3.93, 3.76 – 3.98 (1+16 measured).

Mandibles with 5 teeth. Anterior clypeal margin arcuate, entire. Clypeus with posteriorly raised, median carina; clypeus convex in profile with basal margin strongly impressed medially, laterally basal margin indicated by thin, sculpture-breaking line. Frontal triangle distinct. Frontal carinae sinuate with distinctly raised margins; frontal furrow well impressed. Sides of head in front of eyes converging into mandibular bases in weakly convex line; behind eyes, sides rounding into relatively narrow occipital margin. Eyes moderately convex, in full face view not, or only marginally reaching lateral cephalic outline. Median ocellus obscure, lateral ocelli lacking. Mesosomal dorsum immarginate; pronotum armed with long, hook-shaped spines. Mesonotal dorsum bearing a pair of pyramidal, somewhat dorsomedially flattened spines that are strongly curved posteriorly and weakly bent ventrally from midlength. Metanotal groove indistinct dorsally, weakly impressed laterally. Propodeal dorsum immarginate with posterior corners produced into short, medially unconnected, transverse ridges; weakly concave declivity distinctly shorter than propodeal dorsum. Petiole columnar, bearing a pair of hook-shaped spines, distinctly divergent from bases. Anterior face of first gastral segment flat at base, widely rounding onto dorsum.

Mandibles finely, longitudinally striate. Head, mesosoma and petiole very finely reticulate-punctate, semi-polished; tips of spines smooth and highly polished. Gaster finely shagreened, moderately polished.

Mandibular masticatory borders with numerous curved golden hairs and closely appressed short hairs towards bases. Anterior clypeal margin medially with several long, golden setae and few shorter setae fringing margin laterally. Mostly medium length, semierect to erect, golden hairs over most body surfaces; hairs distinctly shorter and less abundant along inferior surfaces of antennal scapes and completely absent from antennal funiculi, tips of spines, propodeal declivity, posterior face of petiole and dorsal surfaces of femora. Appressed to suberect, golden pubescence rather abundant over entire body and appendages, without obscuring underlying sculpturation.

Head, including mandibles and antennae, tips of spines and legs, except coxae and bases of femora, black. Mesosoma and petiole light reddish-brown. First gastral segment light reddish-brown with subsequent segments and venter of gaster black; margins of segments diffusely and narrowly lined reddish-brown. Coxae, trochanters and bases of femora dark to very dark reddish-brown.

Sexuals and immature stages unknown.

## REMARKS

*Polyrhachis maliau* is characterised by moderately divergent petiolar spines, similar to those in *P. mindanaensis*, *P. montana* and *P. ypsilon*. It is most similar to *P. mindanaensis* but differs a number of characters including its distinctly smaller size (HL 2.21 – 2.37 in *maliau* versus 2.62 – 2.77 in *mindanaensis*), more slender body, pyramidal rather than lanceolate mesonotal spines and the presence of numerous hairs lining the antennal scapes, that are virtually absent in *P. mindanaensis*. In addition, the body in *P. maliau* is generally more polished, in contrast to rather dull and opaque *P. mindanaensis*. The type specimens of *Polyrhachis maliau* were collected from a single trail of workers foraging over low vegetation along a creek. At the type

locality it was found sympatric with *P. bihamata*. *Polyrhachis maliau* was listed as a new species "*P. (Polyrhachis)* sp. 01" by Kohout & Maryati Mohamed (2008).

**Polyrhachis mindanaensis** Emery, 1923
(Figs 12, 17 – 18, 36, 48, 51 – 52)

*Polyrhachis (Polyrhachis) ypsilon* var. *mindanaensis* Emery, 1923: 62. Syntype workers (lectotype and paralectotypes designated by Hung, 1970: 20). Type locality: PHILIPPINES, MINDANAO, Zamboanga (W. Schultze), MSNG, DEIE (examined).

*Polyrhachis (Polyrhachis) mindanaensis* Emery; Hung, 1970: 20. Raised to species.

**ADDITIONAL MATERIAL EXAMINED**

PHILIPPINES, LUZON: Laguna Prov., Los Baños, Mt Makiling, nr Mud Spring, 400 m, 22-23.iv.1981 (W.L. Brown) (w); Mt Makiling (F.X. Williams) (w); Mt Makiling (Baker) (w); Mt Makiling (O.H. Swezey) (w); Mountain Prov., Mayoyao, Ifugao, 1200 – 1500 m, 9.viii.1966 (H.M. Torrevillas) (w); Ifugao Prov., Jacmal Bunhian, 24 km E Mayouao, 800 – 1000 m, 9-12.iv.1967 (H.M. Torrevillas) (w); Laguna, Mt Makiling, 16.ix.1959 (C.M. Yoshimoto) (w); ditto, above Los Baños, 1984 (C.K. Starr) (w); ditto, Mud Springs area, 2-3.iii.1984 (C.K. Starr) (w); Camarines Sur, Mt Isarog, 750-800 m, 18.iv.1963 (H.M. Torrevillas) (w); Mt Isarog, Pili, 600 m, 3-5.iv.1965 (H.M. Torrevillas) (w); Mt Iriga, 500-600 m, 4.iv.1962 (H.M. Torrevillas) (w); ditto, 1-6.v.1962 (H.M. Torrevillas) (♀). SAMAR: 25.vii.1945 (K.S. Hagen) (w). NEGROS: Dumaguete (D. Empeso & J.W. Chapman) (w). MINDANAO: (no further data) (C. Danes); 20.iv.1952 (D. Empeso) (w); Agusan Prov., Bayugan Esperanza, Maytibog Ck, 300 m, 8.xi.1959 (C.M. Yoshimoto) (w); Lanao, Butig Mts, 24 km NE of Butig, 1080 m, 21.vi.1958 (H.E. Milliron) (w); Lanao, 4.8 km E of Dansalan, 750 m, 17.vi.1958 (H.E. Milliron) (w); Agusan, San Francisco, 10 km SE, 18.xi.1959 (C.M. Yoshimoto) (w); Misamis Oriental, Mt Empagatao, 22-26.iv.1961 (H.M. Torrevillas) (w); ditto, 9-18.iv.1961 (H.M. Torrevillas) (w); Minalwang, 24.iii-4.iv.1961 (H.M. Torrevillas) (w); Mt Balatukan, 15 km SW of Gingoog, 21.iv.1960 (H.M. Torrevillas) (w); Bukidnon, Malignon Riv., 15 km NW Valencia, above 2500 ft, 22.iv.1968 (Mt View College coll.) (w); Zamboanga del Sur, 32 km NW of Milbuk, 900 m, 6.viii.1958 (H.E. Milliron) (w).

**WORKER**

Dimensions (paralectotypes cited first): TL c. 11.44 – 11.89, 10.94-12.10; HL 2.67 – 2.70, 2.62 – 2.77; HW 2.32, 2.32 – 2.47; CI 86 – 87, 85 – 91; SL 3.43 – 3.58, 3.28 – 3.63; SI 148 – 154, 141 – 154; PW 1.31, 1.16 – 1.31; PeH 2.57, 2.57 – 2.97; PeI 95 – 96, 95 – 107; MTL 4.89 – 4.99, 4.74 – 5.19 (3+12 measured).

**QUEEN** (not previously described)
Dimensions: TL c. 13.91; HL 2.87*; HW 2.62*; CI 91*; SL 4.28; SI 163; PW 2.97; PeH 1.21; PeI 42; MTL 5.34 (1 measured) (* measurements only approximate due to the partly damaged head of the single available queen).

Queen distinctly larger than worker and with usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. Mandibles with four teeth; apical tooth much longer than subapical tooth, with 3rd and 4th teeth rather vestigal. Clypeus damaged in single available specimen. Eyes larger than in worker; sides of head in front of eyes weakly converging towards mandibular bases; behind eyes, sides widely rounding into occipital margin. Frontal carinae sinuate with distinctly raised margins; central area with distinct frontal furrow. Pronotal humeri rounded without indication of pronotal spines. Mesoscutum virtually wide as long; lateral margins converging anteriorly into only moderately rounded anterior margin; median line distinct; parapsides flat; mesoscutum in profile rather high, anterior face widely rounding onto almost flat, relatively short dorsum. Mesoscutellum moderately convex, only marginally elevated above dorsal plane of mesosoma. Propodeal dorsum immarginate,


**Figs. 34 – 38.** Variability of the petiole in *Polyrhachis* (*Polyrhachis*) spp.: *P. erosispina* Emery (34); *P. taylori* Kohout (35); *P. mindanaensis* Emery (36); *P. ypsilon* Emery (37); *P. lamellidens* Fr. Smith (38).

convex in outline, about 2× as long as weakly concave declivity; posterior angles only poorly raised as medially directed, blunt ridges, propodeal dorsum between them descending into declivity in medially uninterrupted line. Petiole with pair of relatively short, widely diverging, dorsoposteriorly directed spines with extreme tips curved backwards.

Mandibles finely longitudinal striate with piliferous pits. Head, mesosoma and petiole very finely reticulate-punctate; extreme tips of petiolar spines smooth and polished. Gaster shagreened.

Mandibles at masticatory borders with several curved golden hairs. Anterior clypeal margin with a few longer setae medially and fringe of marginally shorter setae laterally. Generally abundant, moderately long, golden hairs on all dorsal body surfaces, including petiole and appendages; antennal scapes with a few, rather short, hairs along leading edge. Closely appressed, rich golden pubescence in various densities over most body surfaces, except tips of petiolar spines; pubescence on dorsum of gaster with distinct reddish tint.

*Colour.* Black, with only light reddish-brown blotch along pronotal margin; dorsal margins of femora and gaster medium to dark reddish-brown.

Male and immature stages unknown.

## REMARKS

Hung (1970) raised *P. mindanaensis* to specific status, considering it to be a morphological intermediate between *P. bihamata* and *P. ypsilon*. It features a combination of characters from both species but, apart from the widely divergent petiolar spines, most of the characters suggest it to be closer to *P. bihamata*. *Polyrhachis mindanaensis* also somewhat resembles *P. maliau*, with distinguishing characters given in the remarks section under the latter.

*Polyrhachis mindanaensis* appears to be endemic to the Philippines, with its occurrence confirmed from nine islands; Batan, Leyte, Luzon, Mindoro, Mindanao, Negros, Palawan, Panay, Samar (Dave General, pers. com.).

**Polyrhachis montana** Hung, 1970
(Figs 11, 15-16)

*Polyrhachis montana* Hung, 1970: 23, figs. 16 – 22. Holotype and paratype workers. Type locality: BORNEO, SARAWAK, Mt Murud, (E. Mjöberg), MCZC (Type 31773), NMNH, BPBM (examined).

## ADDITIONAL MATERIAL EXAMINED

BORNEO, SARAWAK: Mt Dulit (E. Mjöberg) (11 paratype workers in MCZC).

## WORKER

Dimensions (paratypes): TL c. 10.73 – 10.99; HL 2.37 – 2.52; HW 2.12 – 2.24; CI 89 – 90; SL 2.87 – 3.17; SI 135 – 141; PW 1.10 – 1.16; PeH 2.07 – 2.17; PeI 86-89; MTL 4.03 – 4.38 (4 measured).

Sexuals and immature stages unknown.

## REMARKS

This species is undoubtedly endemic to Borneo and is known only from the original collections made by E. Mjöberg at Mt Murud and Mt Dulit in Sarawak.

**Polyrhachis olybria** Forel, 1912
(Figs. 19, 22 – 23, 49, 53 – 54)

*Polyrhachis olybrius* Forel, 1912: 73. Syntype queens. Type locality: INDONESIA, SUMATRA, Indrapura (Tritschler), MHNG, QMBA (examined).

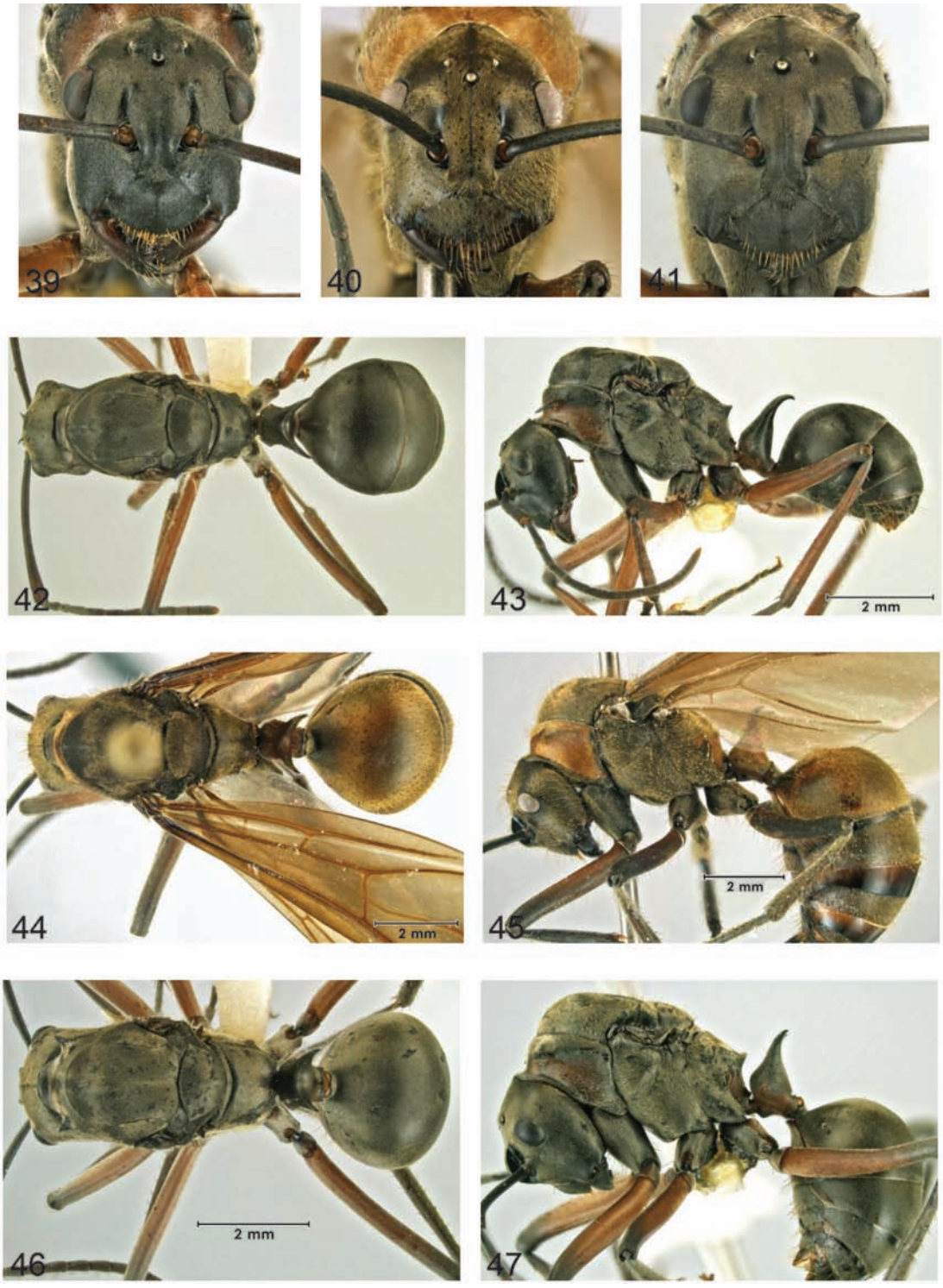
*Polyrhachis (Myrmhopla) olybria* Forel; Emery, 1925: 197. Combination in *P. (Myrmhopla)*.

*Polyrhachis (Polyrhachis) bellicosa* Fr. Smith; Hung, 1970: 5 (in part).

*Polyrhachis (Polyrhachis) olybria* Forel; Kohout, 1998: 508. Combination in *P. (Polyrhachis).*

## ADDITIONAL MATERIAL EXAMINED

THAILAND: Ratchasima Prov., Khao Yai NP, 780 m, hill for. 13.iv.1981 (I. Bubrikam & W.L. Brown) (w, ♀); Thao Sok NP, 10.iii.1988 (A.N. Andersen) (w). MALAYSIA, SELANGOR: Ulu Gombak Research Centre, 18.i.1986 (WHOD) (w, ♀); ditto, i-ii.1989 (E. Edmunds) (w); ditto, 14.i.1986 (U. Maschwitz) (w); ditto, 2. & 8.ii.1994, (also 8.i, 14.i, 30.i, 9.ii. and 8.iii.1996) (C. Liefke) (w, ♂); ditto, 28.iv.1962 (H.E. McClure) (w). N. SEMBILAN: Pasoh For. Research Centre, 26.ii.1986 (WHOD) (w). PAHANG: Pulau Tioman (Maryati Mohamed) (w). JOHOR: Mawai, xi.1960 (D.H. Murphy) (w). SINGAPORE: Bukit Timah Nat. Res., 30.iv.1967 (D.H. Murphy) (w); BORNEO, SABAH (as British Nth. Borneo): Ranau, 8 mi N Poring Hot Springs, 500 m, 8-18.x.1958 (TCM) (w); Tunku Abdul Rahman NP, 13.x.1978, rf. (B.B. Lowery) (w); Danum Valley, 1992, fog. (A.Y.C. Chung) (w); Tabin Wildlife Res., 05°00'N, 118°30'E, 23.ix.-1.x.1998 (Bakhtiar Effendi) (w); nr. Long Pa Sia (East), c. 1000 m, 1-13.iv.1987, Malaise trap (C.v. Achterberg) (w); Kinabalu Park, Poring, 06°2'48.37"N, 116°41'56.30"E, 13.ix.2006, 500 m, primary for. (A. Floren) (w); ditto, 640 m, 9.iv.1992, primary for. (A. Floren) (w); ditto, 22.iii.1995 (ITBC coll.) (w); ditto, 600 m, 24.ix.1998 (ITBC coll.) (w, ♀); ditto, Poring, c. 600 m, vi.1991 (M. Dill) (w); ditto, Poring, 23.x.1978 (B.B. Lowery) (w); Kinabalu Park, 5.xi.1996, rf. (Jens & Kerstin) (w); Kinabalu



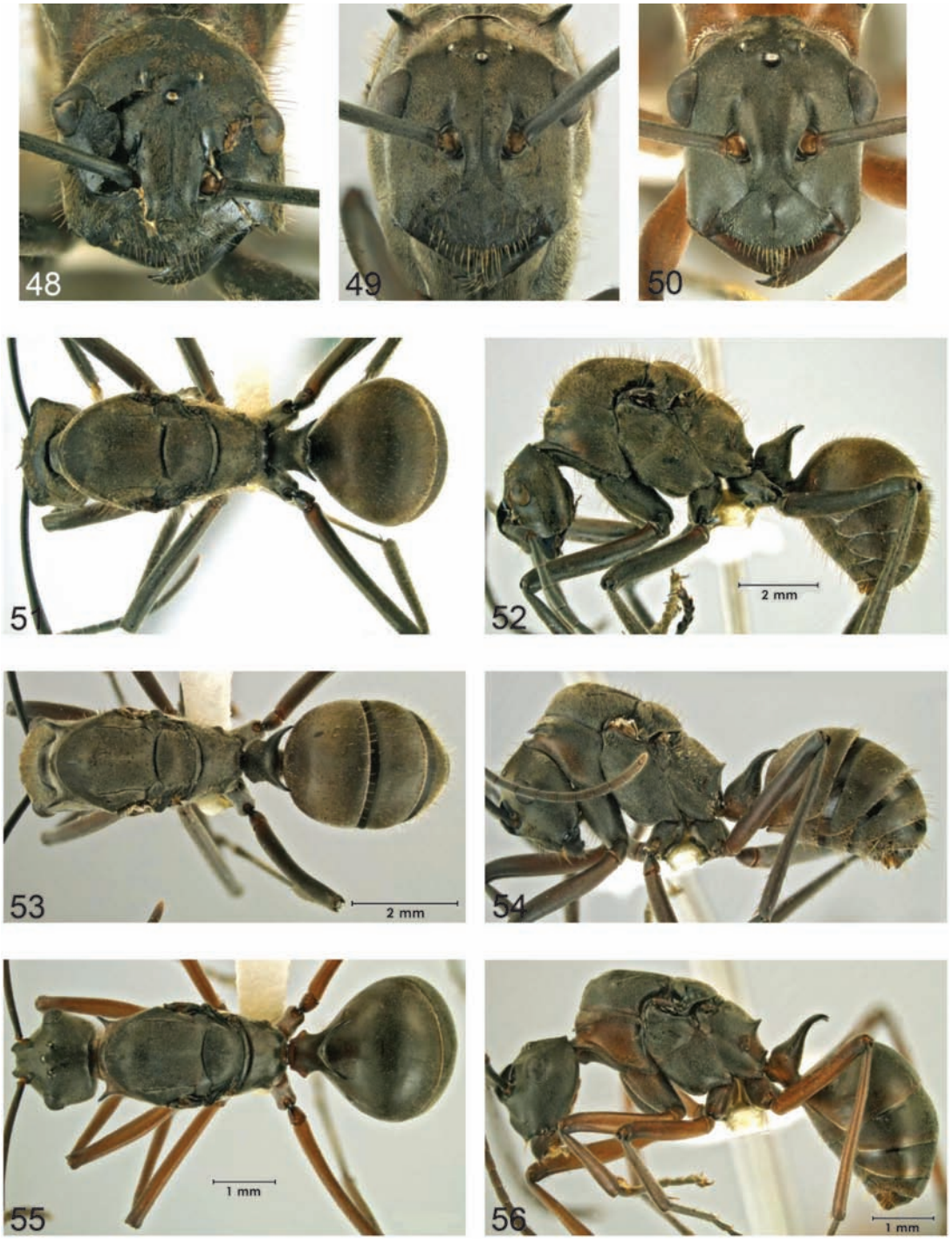

**Figs. 39 – 47.** *Polyrhachis* (*Polyrhachis*) (*bihamata*-group) spp. (queens): *P. bellicosa* Fr. Smith (39, 42, 43); *P. bihamata* (Drury) (40, 44, 45); *P. erosispina* Emery (41, 46, 47).

Park, Monggis, 06°13’13.10”N, 116°44’12.78”E, 300 m, 23.ix.2006, primary for. (A. Floren) (w); Sepilok For. Res., nr Sandakan, 11-12.vi.1968, rf. (RWT acc. 68.441) (w); Tawau, Quoin Hill, 750 ft, 16-18.vi.1968, rf. (RWT acc. 68.574) (w); Tunku Abdul Rahman NP, < 250 m, 13.x.1978, rf. (B.B. Lowery) (w); Kinabalu Park, Poring, c. 550 m, rf. (B.B. Lowery) (w, ♀); Crocker Ra., Mahua Falls, 05°47’N, 116°24’E, c. 950 m, 4.xi.2000 (RJK acc. 2000.199) (w); Maliau Basin Cons. Area, Ginseng Camp, 04º44’N, 116º55’E, c. 700 m, 27.ii.-11.iii.2005 (RJK & Effazilla Waty acc. 2005.55) (w); ditto, Agathis Camp, 04º41’N, 116º54’E, c.500 m, 16-19.iii.2005 (RJK & Lina Thomas acc. 2005.97) (w). SARAWAK: Bako NP, 20.vi.1991 (Maryati Mohamed #Ba2) (w); ditto, Telok Paku, cliff for., 26.vi.1996 (WHOD) (w); ditto, Lintang Trail, 17.vi.1996 (WHOD) (w); ditto, Tajor Trail, 28.vi.1996 (WHOD) (w); Semengok For. Res. 15.vi.1991 (Maryati Mohamed #Se96) (w); Kuching, Santubong, 797-1500 m, 26.vi.1958 (TCM) (w). BRUNEI: Temburong Distr., KBFSC, 04°33’N, 115°08’E, xi.1991 (A.N. Andersen) (w); ditto, 21-29.vi.1994 (RJK accs 94.42, 52, 64) (w); ditto, 14-23.ix.1999 (S.K. Robson #842, 844, 846) (w). Tutong Distr., Bukit Sulang, nr Lamunin, 20.& 23.vii.1994 (RJK accs 94.135, 142) (w). Belait Distr., Bukit Teraja, nr Labi, 21.vii.1994 (RJK acc. 94.140) (w); Belait Distr., Melilas Longhouse school yard, 20.iv.1993, strays on structural timber (RJK acc. 93.31) (w); ditto, 0.5 km S of Melilas Longhouse, sec. rf., 20.iv.1993 (RJK acc. 93.23) (w); ditto, c. 1-2 km SE of Melilas Longhouse, 16.vii.1994, disturbed rf. (RJK acc. 94.123) (w). INDONESIA, KALIMANTAN: Nanga, Sg. Belabi, Sg. Sibau, 01°17’N, 113°15’E, c. 150 m, 4-10.vii.1996 (C. Reid) (w); Nanga Menyakan, Sg. Menyakan, 01°13’N, 113°03’E, c. 100 m, 28.vi.-1.vii.1996 (C. Reid) (w); KALIMANTAN TENGAH: Barito Ulu, 00°03’S, 113°58’E, 150 m, 29.viii.2001 (Syaukani) (w). SUMATRA: Indrapura (Tritschler) (w, ♀); Kota Nopan, 1937 (W.M. Mann, NGS SI Exp.) (w, ♀); Bandar – Kwala, 1905 (V. Auer) (w); Siboga, iv.1886 (Modigliani) (w); Danau Ranau, 4 – 7 km NW Wisma Pusri, disturb. for., c. 700 m, 18.xii.’2001 (C. Reid) (w); Bt Lawanag, G. Leuser N P, 18.viii.2002 (Sk. Yamane) (w). PHILIPPINES: LUZON: Laguna Prov., Mt Makiling, above Los Baños, 2-11.iii.1984 (C.K. Starr) (w); ditto, Mud Springs area, 2-3.iii.1984 (C.K. Starr, nest series 784) (w); MINDANAO: Bukidnon Prov., Impalutao, Impasugong, 4.i.1985 (Starr & Pinto) (w).

**WORKER** (not previously described)

Dimensions (topotype cited first): TL c. 8.87, 8.11 – 9.88; HL 2.06, 1.96 – 2.46; HW 1.78, 1.75 – 2.06; CI 86, 84 – 89; SL 2.71, 2.34 – 3.09; SI 152, 144-155; PW 0.97, 0.94 – 1.15; PeH 2.29, 2.12 – 2.56; PeI 111, 107 – 121; MTL 3.58, 3.43 – 3.78 (1+22 measured).

Mandibles with 5 teeth, distinctly reducing in length towards mandibular base. Anterior clypeal border arcuate. Clypeus with blunt, posteriorly raised, median carina; clypeus convex in profile with only weakly impressed basal margin. Frontal triangle distinct. Frontal carinae sinuate with distinctly raised margins; central area relatively flat with frontal furrow. Sides of head in front of eyes converging into mandibular bases in weakly convex line; behind eyes, sides weakly convex before converging into relatively narrow occipital margin in virtually straight line. Eyes only moderately convex, in full face view usually not or only marginally exceeding lateral cephalic outline in some specimens. Median ocellus present in some specimens but usually obscure or lacking; lateral ocelli lacking with relative positions indicated by minutely raised cephalic sculpturation (Fig. 19). Pronotal humeri armed with moderately long, acute, anterolaterally and somewhat ventrally directed spines; outer borders of spines continuous basally with rather blunt, weakly rounded lateral margins that terminate before reaching well impressed promesonotal suture. Mesonotal dorsum with lateral margins strongly raised into almost pyramidal, rather compressed, posterodorsally projecting spines, with tips subparallel or weakly curved outwards. Metanotal groove poorly indicated. Propodeal dorsum without any traces of lateral margins, posterior angles produced as short, acute, dorsoposteriorly directed spines (Fig. 23), that are contiguous at bases and form a ‘V’ when viewed from behind; propodeal dorsum about 1.5× longer




**Figs. 48 – 56.** *Polyrhachis* (*Polyrhachis*) (*bihamata*-group) spp. (queens): *P. mindanaensis* Emery (head damaged) (48, 51, 52); *P. olybria* Forel (49, 53, 54); *P. taylori* Kohout (50, 55, 56).

than weakly concave declivity. Petiole columnar, bearing a pair of slender, subparallel, dorsally hook-shaped spines. Anterior face of first gastral segment widely rounding onto dorsum.

Mandibles finely, longitudinally striate with numerous piliferous pits. Head, mesosoma and petiole reticulate-punctate, opaque; tips of spines smooth and highly polished. Gaster finely shagreened.

Mandibular masticatory borders with a few golden hairs. Anterior clypeal margin with several medium length, golden setae medially and a fringe of only marginally shorter setae laterally. A few pairs of medium length, golden hairs on clypeus, along frontal carinae and on vertex and occipital corners. A few, medium length, golden hairs on fore coxae; gaster with numerous, moderately long hairs on venter and around apex. Hairs completely absent from antennal scapes and all dorsal body surfaces. Closely appressed, golden pubescence distributed over most body surfaces, except spines; pubescence somewhat longer and semierect at bases of spines and on propodeal dorsum.

*Colour.* Head, including mandibles and antennae, tips of spines and tarsi black; tibiae very dark reddish-brown; pronotal and mesonotal lateral margins narrowly bordered with black or dark brown. Mesosoma, most of petiole and coxae light to medium reddish-brown with femora darker towards distal ends. Gaster with first tergite yellowish or reddish-brown; subsequent tergites progressively darker, somewhat infuscated reddish-brown; posterior margins narrowly lined with black.

## QUEEN

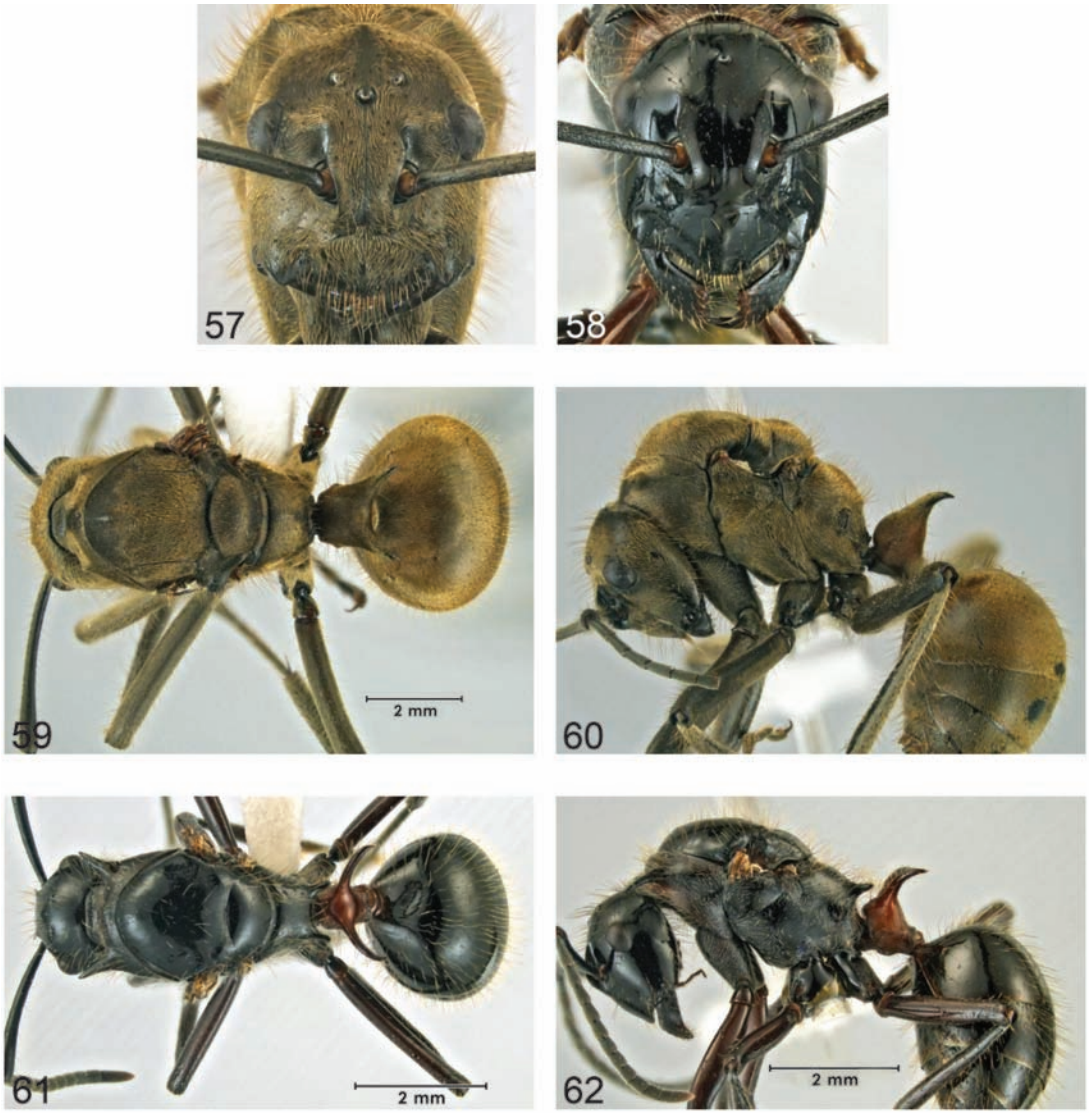
Dimensions (syntypes cited first): TL c. 10.33 – 10.58, 10.08 – 11.24; HL 2.27 – 2.34, 2.18 – 2.34; HW 1.75 – 1.81, 1.72 – 1.81; CI 77, 77 – 80; SL 3.03 – 3.22, 2.93 – 3.22; SI 173 – 178, 166 – 180; PW 2.09, 1.96 – 2.12; PeH 1.22 – 1.34, 1.18 – 1.34; PeI 52 – 59, 50-61, MTL 3.67 – 4.03, 3.63 – 4.03 (2+9 measured).

Queen larger than worker with usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. It was described at length by Forel (1912: 73) and discussed by Kohout (1998: 508) with details not repeated here. Similarly to the worker, the queen of *P. olybria* closely resembles those of *P. bellicosa* and *P. erosispina*, with their distinguishing characters given in the remarks section below.

## REMARKS

Workers of *P. olybria* are relatively similar to those of *P. bellicosa* and *P. erosispina* with their relationship and distinguishing characters discussed in remarks section of *P. bellicosa* and also in detail by Kohout (1998: 508). *Polyrhachis olybria* differs from both other species by its reddish-brown first gastral tergite and the acute, dorsoposteriorly projecting, propodeal spines (Fig. 23). Also, the outline of clypeus in profile of *P. olybria* is evenly convex, while the summit of convexity in the other two species is distinctly higher and closer to the base of clypeus. The sides of head behind the eyes in *P. olybria* are only weakly convex before converging towards the occipital margin in virtually straight line, while in other two species, the sides of the head behind the eyes are distinctly convex throughout their length. With respect to queens, the dorsa of the mesoscutum and mesoscutellum in *P. olybria* are covered with numerous short to medium length hairs, which are distinctly less abundant in *P. erosispina* and completely absent in *P. bellicosa*.

*Polyrhachis olybria* is a relatively common species known from Thailand, peninsular Malaysia and Singapore, south to Borneo, Sumatra and Java and as far east as the Philippines. Specimens from Sumatra are rather similar to those from peninsular Malaysia in being generally darker in colour and having their pronotal spines relatively straight and only weakly bent downwards. In contrast, specimens from Sabah are distinctly lighter in colour and have the tips of their pronotal spines usually curved downwards and weakly backwards. Despite this variation, specimens from across the entire distribution are closely similar in most other aspects and I believe all are conspecific.




**Figs. 57 – 62.** *Polyrhachis* (*Polyrhachis*) (*bihamata*-group) (queen): *P. ypsilon* Emery (57, 59, 60). *Polyrhachis* (*Polyrhachis*) (*lamellidens*-group) (queen): *P. lamellidens* Fr. Smith (58, 61, 62).

**Polyrhachis taylori** Kohout, 1988
(Figs. 20, 24, 25, 35, 50, 55, 56)

*Polyrhachis taylori* Kohout, 1988: 422, fig. 4. Holotype and paratype workers, queens. Type locality: PAPUA NEW GUINEA, West Sepik Prov., Torricelli Mts, Lumi, 03°28'S, 142°02'E, 400 – 550 m, 4-13. viii.1984 (R.J. Kohout acc. 84.247, 249), ANIC, BMNH, MCZC, QMBA (examined).

**WORKER**

Dimensions (holotype cited first): TL c. 7.08, 6.18 – 7.36; HL 1.70, 1.50 – 1.75; HW 1.45, 1.29 – 1.50; CI 85, 82 – 87; SL 2.21, 1.93 – 2.34; SI 152, 146 – 159; PW 0.76, 0.67 – 0.78; MTL 2.93, 2.56 – 3.06; PeH 1.40, 1.15 – 1.50; PeI 82, 77 – 85 (1+49 measured).

## QUEEN

Dimensions: TL c. 8.92 – 9.47; HL 1.92 – 1.96; HW 1.43 – 1.48; CI 73 – 76; SL 2.71 – 2.82; SI 185 – 196; PW 1.18 – 1.26; MTL 3.43 – 3.65; PeH 0.94 – 1.06; PeI 49 – 54 (16 measured).

Male unknown. Immature stages (eggs, larvae in various stages of development and pupae of workers and queens) present in QMBA spirit collection.

## REMARKS

*Polyrhachis taylori* is very similar to the sympatric species *P. bellicosa* and *P. erosispina*. All feature similar, anterolaterally and weakly ventrally directed pronotal spines, and a virtually identical colour scheme with a black head, distinctly reddish-brown mesosoma and petiole, and a dark reddish-brown or almost black gaster in fully pigmented specimens. However, *P. taylori* is easily separated by its small size (HL < 1.75), which is well below the size of the smallest *P. bellicosa* and *P. erosispina* workers (HL >1.80). Also, the petiolar index in *P. taylori* is relatively low (PeI < 85) and the petiolar spines in most specimens are more-or-less divergent from their bases (Figs. 24, 35). In contrast, the petiolar index in the other two species is always higher (PeI > 85) and the petiolar spines are parallel for most of their length (Fig. 34).

The type series comprises the only known specimens of this species. They were collected from a nest in a bamboo stick marker in a native garden situated at the margin of primary forest. The nest occupied three adjoining internodes of the bamboo stick, with the only silk employed in its construction forming the lining of the walls and a small opening. A second nest was located under much the same circumstances nearby.

**Polyrhachis ypsilon** Emery, 1887
(Figs. 21, 26, 27, 37, 57, 59, 60)

*Polyrhachis ypsilon* Emery, 1887: 239. Syntype workers (lectotype and paralectotypes designated by Hung, 1970: 19). Type locality: SINGAPORE (L.M. D'Albertis), MSNG (examined).

*Polyrhachis ypsilon* var. *victoris* Santschi, 1925: 93. Holotype worker. Type locality: INDONESIA, SUMATRA, Labuang Bilik (V. Surbek) NHMB (examined).

*Polyrhachis (Polyrhachis) ypsilon* ab. *synacantha* Santschi, 1933: 2. Holotype worker. Type locality: BORNEO, Kp. Makoendjoeng (Baritoe R.), 6.v.1932, (Prince Léopold), IRSN (examined). Synonymy by Hung.

*Polyrhachis ypsilon* var. *vecticortis* Santschi; Chapman & Capko, 1951: 304 (misspelling of *Polyrhachis ypsilon* var. *victoris*).

*Polyrhachis (Polyrhachis) ypsilon* ab. *synacantha* Santschi; Kohout, 1998: 509 (anomalous specimen).

## ADDITIONAL MATERIAL EXAMINED

WEST MALAYSIA, PAHANG: Kuala Lompat Nat. Park, 26.viii.1992 (D.G. Furth) (w); Pahang, below The Gap, c. 850 m, hill for., 17.viii.1967 (R. Crozier) (w). SELANGOR: Ulu Gombak Research Centre, 28.i.1986 (W.H.O. Dorow acc. 156) (w); NEGERI SEMBILAN: Pasoh For. Reserve, 25.ii.1971 (M. Kondoh) (w); ditto, xi.1994, fog. (M. Brendell, K. Jackson & S. Lewis) (w); Sungei Menyala For. Res., nr Port Dickson, 25.iii.1981, lowl. rf. (W.L. Brown & Tho Yow Pong) (w). SINGAPORE: x.1875 (L.M. D'Albertis) (w). BORNEO, SABAH: Kinabalu Park, 29.x.1996, lower montane mixed dipterocarp for. (Jens & Kerstin) (w); Kinabalu Park, Poring, 06°3'47.90"N, 116°42'30.94"E, 24.x.1996, 770 m, primary for., fog. (A. Floren) (w); ditto, 6°3'8.18"N, 116°41'41.63"E, 18.iii.1996, 680 m, primary for., fog. (A. Floren) (w); ditto, 9.ii.1997, 680 m, primary for., fog. (A. Floren) (w); Kinabalu Park, Poring, 600 m, 24.ix.1998 (ITBC coll.) (w); ditto, 1995 (Shanmuga Sundram) (w); Danum Valley, 75 km W of Lahad Datu, 04°57'N, 117°41'E, c. 200 m, lowland rf., 23-25.x.1987 (at light) (J. Huisman & R.de Jong RMNH) (♀); ditto, 1991/1992, fog. (A.Y.C. Chung) (w); Maliau Basin, Ginseng Camp, 04º44'N, 116º55'E, c. 700 m, 27.ii-11. iii.2005, rf., strays on ground & low vegetation (RJK & Effazilla Waty acc. 2005.108) (♀); Agathis Camp, 04º41'N, 116º54'E, c. 500 m, 16-19.iii.2005 (RJK & Lina Thomas acc. 2005.80)

(♀); Tawau Hills, 04°24'N, 117°53'E, 287 m, 6.ix.2009, fog. (A. Floren) (w). SARAWAK: Kuching (Harrison Smith) (w); Pajan (E. Mjöberg) (w); Bako NP, 20.vi.1991 (Maryati Mohamed #Ba6) (w). BRUNEI: Temburong Distr., KBFSC, 04°33'N, 115°08'E, 50 m, 23.ix.1999 (S.K. Robson #845) (w); Belait Distr.: Bukit Teraja, nr Labi, 21.vii.1994 (RJK acc. 94.140) (w); Sadong (H. Smith) (w). INDONESIA, KALIMANTAN: Kampung Putan, Sg. Sibau 01°02'N, 112°58'E, 60-75 m, 21-27.vi.1996 (C. Reid) (w); Nanga, Sg. Belabi, Sg. Sibau, 01°17'N, 113°15'E, 4-10. vii.1996 (C. Reid) (w). KALIMANTAN BARAT: Gn. Palung NP, Cabang Panti Res. Stn, 100 m, 1º15'S, 110º5'E, 15.vi-15.viii.1991 (Malaise traps) (Darling, Rosichon & Sutrisno) (w); ditto, i.1966, rf. (Marty Fujita) (w). KALIMANTAN TIMUR: 17-46 km W Batulitjin, lowl. rf., 28.vi-2.vii.1972 (W.L. Brown) (w); 31 km N of Balikpapan, 21.vi.1972, rf. (W.L. Brown) (w). SUMATRA: Wai Lima, Lampongs, 12.xi.1921 (Karny) (w); Sumatra (Bedot) (no further data).

**WORKER**

Dimensions (lectotype cited first): TL c. 12.85, 12.10 – 13.10; HL 2.97, 2.67 – 2.97; HW 2.57, 2.32 – 2.68; CI 86, 86 – 93; SL 3.83, 3.43 – 3.93; SI 149, 139 – 150; PW 1.71, 1.40 – 1.71; PeH 3.07, 3.02 – 3.61; PeI 103, 103 – 124; MTL 5.44, 4.74 – 5.44 (1+15 measured).

Dimensions (holotype of *synacantha*): TL c. 13.71; HL 3.02; HW 2.67; CI 88; SL 3.93; SI 147; PW 1.71; PeH 3.83; PeI 129; MTL 5.39 (1 measured).

Dimensions (syntypes of *victoris*): TL c. 12.65 – 12.75; HL 2.84 – 2.90; HW 2.53-2.60; CI 89 – 90; SL 3.63 – 3.73; SI 143 – 144; PW 1.31 – 1.41; PeH 3.43 – 3.58; PeI 119 – 123; MTL 4.84 – 5.04 (3 measured).

**QUEEN** (not previously described)

Dimensions: TL c. 13.25 – 14.82; HL 2.82 – 3.22; HW 2.42 – 2.82; CI 86 – 87; SL 3.78 – 4.23; SI 150 – 156; PW 2.87 – 3.12; PeH 1.31 – 1.56; PeI 46 – 48; MTL 4.79 – 5.44 (2 measured).

Queen larger than worker and with usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. Mandibles with four teeth; apical tooth much longer than other teeth which are greatly reduced or often vestigal. Eyes only moderately larger than in worker; sides of head in front of eyes virtually parallel towards mandibular bases. Frontal triangle distinct; frontal carinae sinuate with distinctly raised margins; central area concave with frontal furrow almost reaching median ocellus. Pronotal spines reduced to blunt angles. Mesoscutum wider than long; lateral margins converging anteriorly into moderately rounded anterior margin; median line distinct; parapsides flat; mesoscutum in profile relatively high, with anterior face widely rounding onto moderately convex, relatively short dorsum. Mesoscutellum moderately convex, only marginally elevated above dorsal plane of mesosoma. Propodeal dorsum not marginate, convex in outline, longer than declivity; posterior angles only poorly raised as medially directed, blunt ridges with propodeal dorsum between them descending into declivity in medially uninterrupted line. Petiole with pair of basally stout, relatively short, widely diverging spines with extreme tips curved backwards.

Mandibles finely longitudinally striate with piliferous pits. Head, mesosoma and petiole very finely reticulate-punctate; sides of mesosoma and coxae distinctly more coarsely sculptured; extreme tips of petiolar spines smooth and polished. Gaster shagreened.

Mandibles at masticatory borders with several curved golden hairs. Anterior clypeal margin with numerous, rather long setae medially and fringe of marginally shorter setae laterally. Generally abundant, relatively long, golden hairs on all dorsal body surfaces, including appendages, some hairs almost as long as greatest diameter of eyes. Closely appressed, rather long, rich golden pubescence in various densities over most body surfaces; pubescence somewhat longer on sides of head and mesosoma and virtually absent from tips of petiolar spines.

*Colour.* Black, with only base of petiole, subpetiolar process and most of first gastral tergite medium reddish-brown.

Male and immature stages unknown.

## REMARKS

*Polyrhachis ypsilon* is easily recognised by its large size, rather massive pronotal spines, petiolar spines that widely diverge from their bases and the abundant hairs and rich golden pubescence covering the body. Morphologically it is a relatively stable species with specimens from throughout its range being closely similar. Only two subspecific forms have been described, *P. ypsilon* var. *victoris* Santschi from Sumatra and *P. ypsilon* ab. *synacantha* from Borneo, by Santschi in 1925 and 1933 respectively. Both were synonymised with the nominal form by Hung (1970: 20), who considered the former to be a geographical variant while he was unable to locate the type of the latter. I have previously examined the unique holotype of *P. ypsilon* ab. *synacantha* in the collection of Prince Léopold (IRSN). Based on its extremely aberrant petiolar node, a huge, pillar-like structure terminating dorsolaterally in rather asymmetrical, dentiform angles, bearing two minute, posteriorly directed, uneven, acute spines, I considered it an undoubtedly anomalous variant (Kohout 1998: 509) and concurred with Hung's (1970) opinion that it is a synonym of *P. ypsilon*.

*Polyrhachis ypsilon* is known from peninsular Malaysia, Singapore, Borneo and Sumatra.

**Polyrhachis lamellidens** species-group

**Polyrhachis craddocki** Bingham, 1903
(Figs. 28, 30, 31)

*Polyrhachis craddocki* Bingham, 1903: 403, fig. 138. Syntype workers. Type locality: MYANMAR (= Burma), Trans-Salween Shan States (Craddock), BMNH, MHNG, QMBA (examined).

## ADDITIONAL MATERIAL EXAMINED

BRUNEI: Temburong Distr., Batu Apoid For., KBFSC, 04°32'N, 115°09'E, 50 – 60 m, 15.iv.1993, lowland mixed dipterocarp forest (RJK acc. 93.7) (w); ditto, 21-29.vi.1994 (RJK accs 94.24, 26, 34, 57, 72) (w).

## WORKER

Dimensions (syntypes cited first): TL c. 6.89 – 7.31, 7.36 – 8.16; HL 1.72 – 1.84, 1.81 – 2.00; HW 1.56 – 1.65, 1.65 – 1.78; CI 90 – 91, 88 – 92; SL 1.87 – 2.12, 2.12 – 2.31; SI 120 – 128, 126 – 131; PW 0.97 – 1.12, 1.18 – 1.34; PeH 1.76 – 2.09, 2.09 – 2.25; PeI 102 – 113, 109 – 115; MTL 2.28 – 2.53, 2.59 – 2.90 (3+15 measured).

## REMARKS

*Polyrhachis craddocki* is so far known only from two localities separated by a distance of over 2600 km, with no material known from areas in between. However, in spite of this geographical separation, specimens from both areas are very similar and, apart from the generally larger size of specimens from Brunei (HL 1.81 – 2.00 versus HL 1.72 – 1.84 in syntypes from Myanmar), they are closely comparable in all other aspects. All specimens from Brunei were collected during two successive visits to the KBFSC, apparently from a single colony trail on a tree trunk and surrounding vegetation just a few hundred metres from the base accommodation units. A thorough search of the surrounding areas to locate another *P. craddocki* colony was conducted on both occasions, with the help of the entomology staff of the Brunei Museum, but without success.

**Polyrhachis lamellidens** Fr. Smith, 1874
(Figs. 29, 32, 33, 38, 58, 61, 62)

*Polyrhachis lamellidens* Fr. Smith, 1874: 403. Syntype workers. Type locality: JAPAN, BMNH (B.M. TYPE HYM 11.262) (examined).

## ADDITIONAL MATERIAL EXAMINED

JAPAN: Tachikawa, 2.v.1931 (J.L. Gressitt) (w); Mt Takao, 7.vi.1930 (J.L. Gressitt) (w); Yakushima, Amboo-Kosugidani, 16.vii.1950 (T. Shirozu) (w); Toyama Pref., Kamiichi, 10.v.1992 (D.G. Furth) (w); Kanagawa Pref., Odawara, 27.vii.19080 (M. Kubota) (w); Shizuoka Pref., Nirayama, 3.x.1979 (H. Imai) (w, ♀, ♂); Yakushima I., Kagoshima,

23.iv.2001 (Sk. Yamane) (w); Honshu, Hyogo Pref., Izuschi-cho, 6.ix.1987 (N. Tsurusaki) (w). CHINA: Mokanshan (N. Gist Gee) (w); Soochow (N. Gist Gee) (w). TAIWAN: Yehliu Pk, 10 km NW of Keelung, 25.iv.1981 (S. Shattuck) (w); Santioling, 19.xi.1957 (TCM) (w). CHINA: Chusan Is (J.J. Walker) (w); Da-laen-saen (J.J. Walker) (w); North Guangxi Zhuang Autonomous Province, Dashapo, nr. Mulun Nature Reserve, 25°12'N, 108°05'E, 440 m, 20.vii.1998, low open forest, foraging on logs (J. Fellowes) (w); Northeast Guangxi Zhuang Autonomous Region, Jiuwu, Qingshitan Headwater Forest Nature Reserve, 25°26'N, 110°09'E, 280 – 300 m, 26.viii.1998, broadleaf forest, ex nest in dead tree stump (J. Fellowes) (w). NORTH KOREA: 1987 (Kravchenko) (w). SOUTH KOREA: Miruk-san, 1.v.1992 (B.-J. Kim) (w).

## WORKER

Dimensions (syntype cited first): TL c. 8.82, 7.31 – 9.07; HL 2.18 (head detached from the body), 1.78 – 2.18; HW 1.96, 1.56 – 1.96; CI 90, 88-90; SL 2.56, 2.09 – 2.65; SI 131, 130 – 136; PW 1.36, 1.03 – 1.36; PeH 1.76, 1.53 – 2.03; PeI 81, 81 – 94; MTL 3.02, 2.81 – 3.21 (1+18 measured).

## QUEEN

Dimensions: TL c. 10.08 – 10.63; HL 2.12 – 2.28; HW 1.75 – 1.87; CI 82 – 83; SL 2.31 – 2.40; SI 128 – 132; PW 2.03 – 2.18; PeH 1.18 – 1.31; PeI 53 – 62; MTL 2.87 – 3.12 (4 measured).

Male described by Hung (1970: 29); immature stages by Koriba (1963: 200) and Wheeler & Wheeler (1970: 649).

## REMARKS

*Polyrhachis lamellidens* is perhaps the best known and most studied of all members of the subgenus, probably due to its occurrence in a densely populated country with easy access to colonies (see Hung, 1970: 28 – 29). Like *P. craddocki*, it is a very morphologically stable species with no significant variation between populations. *Polyrhachis lamellidens* is known from Japan, Korea, Taiwan and China, including Hong Kong.

The nesting habits of *P. lamellidens* are different from those of other species of the subgenus with their nests usually found in rotten logs (Yano, 1911) and tree stumps (J. Fellowes, pers. comm.), but also in the ground. Their parasitic lifestyle, in relation to *Camponotus japonicus* Mayr (as *C. herculeanus japonicus*) was observed under laboratory conditions by Kohriba (1963).

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