

## Two new species of the proceratiine ant genus *Discothyrea* Roger from Yunnan, China, with a key to the known Oriental species

ZHENGHUI XU\*<sup>1</sup>, CHRIS J. BURWELL<sup>2</sup> AND AKIHIRO NAKAMURA<sup>2,3</sup>

<sup>1</sup>Key Laboratory of Forest Disaster Warning and Control in Yunnan Province, College of Forestry, Southwest Forestry University, Kunming, Yunnan Province 650224, China

<sup>2</sup>Natural Environments Programme, Queensland Museum, South Brisbane Qld 4101 and Environmental Futures Centre, Griffith University, Nathan Qld 4111, Australia

<sup>3</sup>Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Kunming, Yunnan Province 650223, China

\*Corresponding author's e-mail: xuzhenghui1962@163.com

**ABSTRACT.** Two new species of the proceratiine ant genus *Discothyrea* Roger, 1863 collected from Yunnan Province in southwestern China are described: *D. banna* sp. nov. and *D. diana* sp. nov. A key, based on the worker caste, to the nine known Oriental species of the genus is provided.

**Keywords:** Hymenoptera, Formicidae, Proceratiinae, *Discothyrea*, new species, Yunnan Province, Oriental species, key

### INTRODUCTION

The proceratiine ant genus *Discothyrea* Roger, 1863 is distributed throughout tropical and subtropical regions of the world (Bolton 1995). Before this study, 32 extant and 2 fossil species were recorded in the world (Bolton 2013). Brown (1958) revised the genus and recognized 26 species in the world, *Pseudosysphincta* Arnold, 1916, *Prodiscothyrea* Wheeler, 1916, and *Pseudosphincta* Wheeler, 1922 were treated as junior synonyms of *Discothyrea* Roger, 1863. Seven extant species are known from Oriental region. The first of these, *D. globa*, was described by Forel (1905) from Java, Indonesia. This was followed by *D. sauteri* from Taiwan, China (Forel, 1912) and has also been recorded from Japan (Imai *et al.* 2003), *D. bryanti* from Malaysia (Wheeler 1917), *D. stumperi* from Bhutan (Baroni Urbani 1977), *D. kamiteta* from Japan (Kubota & Terayama, 1999) and *D. sringerensis* from India (Zacharias & Rajan 2004). Finally, Terayama

(2009) described *D. yueshen*, a second species of *Discothyrea* from Taiwan, China.

Surveys of ants in Yunnan Province, China, conducted during two major biodiversity projects, Ant Diversity Investigations of Southwestern China and the Queensland Chinese Academy of Sciences (QCAS) Biodiversity Project, have discovered two new species of *Discothyrea* Roger, *D. banna* sp. nov. and *D. diana* sp. nov. described below. This brings the number of Oriental *Discothyrea* species to nine. A key, based on the worker caste, separating these nine species is also provided.

### MATERIALS AND METHODS

Workers of the new species obtained during the Ant Diversity Investigations of Southwestern China project were collected by the Sample-plot method outlined in Xu *et al.* (1999) and Xu (2002). Specimens collected during the

QCAS Biodiversity Project were sampled from an altitudinal transect established in tropical rainforest near Bubang Village in Mengla Country, Xishuangbanna Prefecture. The transect consisted of a total of twenty, square (20 m by 20 m), permanent survey plots, five plots (1 – 5) at each of four elevations, roughly 600, 800, 1000, and 1200 metres above sea level. At each plot, ants were sampled with several standardized collecting methods, but only leaf litter extraction ('Berlese') and spraying large living tree trunks with pyrethroid insecticide ('Bark Spray') yielded specimens of *Discothyrea*. Details of the litter extraction and bark spraying methods are identical to those presented in Burwell & Nakamura (2011).

Descriptions and measurements were made under a XTB-1 stereo microscope with a micrometer at 60× magnification. Illustrations of the new species were made under a Motic-700Z stereo microscope with illustrative equipment at 60× magnification. Images were produced using a Zeiss Discovery V20 stereo microscope with Zeiss AxioCam HRC CCD and Axio Vision Release 4.8.2 software.

Standard measurements and indices are as defined in Bolton (1975), with the addition of ED and MSL outlined below:

TL-Total Length: The total outstretched length of the individual, from the mandibular apex to the gastral apex.

HL-Head Length: The straight-line length of the head in perfect full-face view, measured from the mid-point of the anterior clypeal margin to the midpoint of the posterior margin. In species where one or both of these margins is concave, the measurement is taken from the mid-point of a transverse line that spans the apices of the projecting portions.

HW-Head Width: The maximum width of the head in full-face view, excluding the eyes.

CI-Cephalic Index =  $HW \times 100 / HL$ .

SL-Scape Length: The straight-line length of the antennal scape, excluding the basal constriction or neck.

SI-Scape Index =  $SL \times 100 / HW$ .

ED-Eye Diameter: The maximum diameter of the eye.

PW-Pronotal Width: The maximum width of the pronotum measured in dorsal view.

MSL-Mesosoma Length (=AL-Alitrunk Length): The diagonal length of the mesosoma in lateral view, measured from the point at which the pronotum meets the cervical shield to the posterior basal angle of the metapleuron.

PL-Petiole Length: The length of the petiole measured in lateral view from the anterior process to the posteriormost point of the tergite, where it surrounds the gastral articulation.

PH-Petiole Height: The height of the petiole measured in lateral view from the apex of the ventral (subpetiolar) process vertically to a line intersecting the dorsalmost point of the node.

DPW-Dorsal Petiole Width: The maximum width of the petiole in dorsal view.

LPI-Lateral Petiole Index =  $PH \times 100 / PL$ .

DPI-Dorsal Petiole Index =  $DPW \times 100 / PL$ .

All measurements are expressed in millimetres.

The type specimens are deposited in the Insect Collection, Southwest Forestry University (SWFU), Kunming, Yunnan Province, China. In addition, two paratypes of *D. banna* sp. nov. and two paratypes of *D. diana* sp. nov. are deposited in Kunming Natural History Museum of Zoology, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, Yunnan Province, China.

#### KEY TO KNOWN ORIENTAL SPECIES OF *DISCOTHYREA* BASED ON WORKER CASTE

1. In lateral view, posterodorsal corner of propodeum rounded or very bluntly angled, forming an angle much greater than 90°.....2

- In lateral view, posterodorsal corner of propodeum narrowly to acutely toothed, forming an angle equal to or smaller than 90°.....4

2. In full-face view, posterolateral corners of head broadly rounded. Frontal carinae reaching to 2/3 of head-length. Anterior clypeal margin crenulate. Antennae 10-segmented (Malaysia; China: Hainan).....*D. bryanti* (Wheeler 1917)

- In full-face view, posterolateral corners of head narrowly rounded. Frontal carinae reaching to 1/2 of head-length. Anterior clypeal margin not crenulate. Antennae 9-segmented.....3

3. In full-face view, posterior margin of head weakly convex, anterior clypeal margin straight. In lateral view, dorsum of mesosoma strongly convex, posterodorsal corner of propodeum forming an obtuse angle, propodeal lobes bluntly angled. Petiolar node relatively short and thin, height/length ratio = 2:1 (Japan).....  
.....*D. kamiteta* Kubota & Terayama, 1999
- In full-face view, posterior margin of head straight, anterior clypeal margin weakly convex. In lateral view, dorsum of mesosoma weakly convex, posterodorsal corner of propodeum rounded, propodeal lobes rounded. Petiolar node relatively long and thick, height/length ratio = 1.7:1 (China: Yunnan) (Figs. 1–6).....*D. banna* sp. nov.
4. Frontal area much longer than broad, roughly rhombic. Frontal carinae long and well separated, extending posteriorly to 1/2 to 2/3 of head-length.....5
- Frontal area about as broad as long, roughly triangular. Frontal carinae short and close to each other, extending posteriorly to about 1/3 of head-length.....7
5. Frontal carinae extending posteriorly to 2/3 of head-length. Anterior clypeal margin crenulate. In dorsal view, dorsum of petiolar node transversely depressed. Antennae 10-segmented. Total length about 3.1 mm (India).....  
.....*D. sringerensis* Zacharias & Rajan, 2004
- Frontal carinae extending posteriorly to 1/2 of head-length. Anterior clypeal margin not crenulate. In dorsal view, dorsum of petiolar node not transversely depressed. Antennae 8- or 9-segmented. Total length 1.5 – 1.8 mm.....6
6. In full-face view, head distinctly broader than long, posterior margin of head nearly straight. In lateral view, posterodorsal corner of propodeum acutely toothed, subpetiolar process elongate and higher than half its length. In dorsal view, petiolar node thin and scale-form, about 6 times as broad as long. Antennae 9-segmented. Total length about 1.5 mm (Indonesia).....*D. globa* Forel, 1905
- In full-face view, head distinctly longer than broad, posterior margin of head weakly convex. In lateral view, posterodorsal corner of propodeum rightly angled, subpetiolar process short and about half its length. In dorsal view, petiolar node thick and node-form, about 3 times as broad as long. Antennae 8-segmented. Total length 1.6 – 1.8 mm (China: Taiwan; Japan).....  
.....*D. sauteri* Forel, 1912
7. In full-face view, posterior margin of head weakly concave medially. In dorsal view, dorsum of petiolar node transversely depressed. In lateral view, subpetiolar process large and roughly triangular. Antennae 7-segmented (China: Yunnan) (Figs. 7–12).....*D. diana* sp. nov.
- In full-face view, posterior margin of head weakly convex, not concave medially. In dorsal view, dorsum of petiolar node not transversely depressed. In lateral view, subpetiolar process small and short. Antennae 9-segmented.....8
8. In full-face view, head distinctly longer than broad with CI 89, sides strongly convex. In lateral view, posterodorsal corner of propodeum forming a right angle, apex of propodeal lobes bluntly angled. Total length 1.5 mm (Bhutan).....  
.....*D. stumperi* Baroni Urbani, 1977
- In full-face view, head slightly broader than long with CI 119, sides weakly convex. In lateral view, posterodorsal corner of propodeum forming an acute angle, apex of propodeal lobe rounded. Total length 1.7 mm (China: Taiwan).....  
.....*D. yueshen* Terayama, 2009

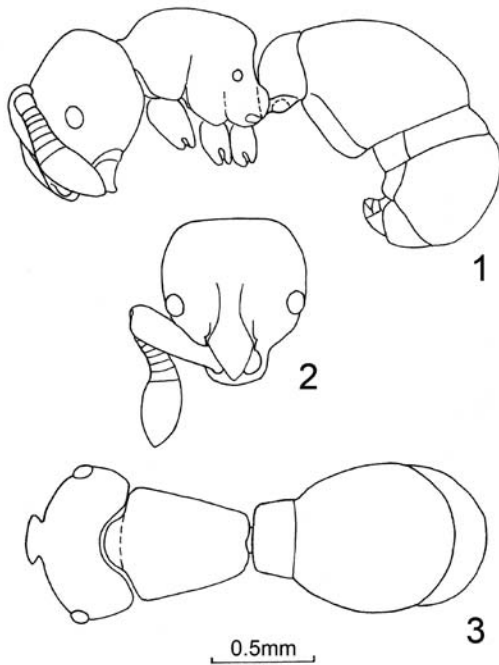
## DESCRIPTIONS OF NEW SPECIES

### *Discothyrea banna* sp. nov.

**Holotype worker:** TL 2.8, HL 0.78, HW 0.68, CI 87, SL 0.55, SI 81, ED 0.10, PW 0.53, MSL 0.83, PL 0.20, PH 0.38, DPW 0.30, LPI 188, DPI 150.

In full-face view, head longer than broad, roughly trapezoidal and narrowed anteriorly. Posterior margin nearly straight, posterolateral corners rounded. Sides evenly convex, deeply notched in front of mandibular

insertions. Mandibles triangular, masticatory margin edentate, apical tooth acute. Anterior margin of clypeus weakly convex. Frontal lobes confused each other and formed a large roughly rhombic frontal area, distinctly longer than broad, lateral corners bluntly angled and more than  $90^\circ$ , anterolateral margins straight, posterolateral margins weakly concave. Frontal carinae relatively long and well separated, extending posteriorly to  $1/2$  of head-length. Antennae 9-segmented, apices of scapes reaching to  $2/3$  of distance from antennal sockets to posterolateral corners. Eyes moderately large and convex, with 6 ommatidia on maximum diameter, located at mid-length of sides. In posterior view, frontal area weakly elevated and roughly rhombic, with a broad base, anterior margin weakly convex, lateral corners acutely angled.



**Figs. 1 – 3.** Illustration of holotype worker of *Discothyrea banna* sp. nov.; 1. Body in lateral view; 2. Head in full-face view; 3. Body in dorsal view

In lateral view, dorsum of mesosoma weakly convex and sloping down posteriorly, promesonotal suture and metanotal groove absent. Posterodorsal corner of propodeum rounded, declivity weakly concave. Propodeal

lobes large and rounded. Petiolar node high, roughly triangular and narrowed upward, anterior and dorsal faces forming a single arch, strongly convex, anterodorsal corner indistinct. Subpetiolar process short, very bluntly angled ventrally and translucent. First gastral segment large, about  $2/3$  of the total length of gaster. Constriction between the two basal gastral segments broad and deep.



**Fig. 4.** Full-face image of holotype worker of *Discothyrea banna* sp. nov.



**Fig. 5.** Lateral image of holotype worker of *Discothyrea banna* sp. nov.

In dorsal view, mesosoma trapezoidal and narrowed posteriorly, humeral corners bluntly angled, lateral margins nearly straight, posterior margin weakly concave medially. Petiolar node transverse and trapezoidal, length/width ratio = 1:1.5, widening posteriorly, anterior margin



nearly straight, lateral and posterior margins straight, anterolateral corners bluntly angled.



**Fig. 6.** Dorsal image of holotype worker of *Discothyrea banna* sp. nov.

Mandibles finely punctured. Head, mesosoma, petiole, and first gastral segment densely and coarsely punctured, interstice much smaller than puncture diameter. Punctures on first gastral segment even larger, and foveolate on its sides. Rest gastral segments finely punctured and relatively shining. Whole body covered with dense, suberect to subdecumbent short pubescence, without standing hairs. Scapes and tibiae with dense decumbent short pubescence, without standing hairs. Colour reddish brown. Apical antennal segments, legs, and gastral apex yellowish brown. Eyes black.

**Paratype workers:** TL 2.5 – 2.9, HL 0.78 – 0.85, HW 0.65 – 0.70, CI 81 – 85, SL 0.53 – 0.58, SI 79 – 85, ED 0.09 – 0.10, PW 0.48 – 0.58, MSL 0.80 – 0.90, PL 0.20 – 0.25, PH 0.35 – 0.40, DPW 0.28 – 0.35, LPI 156 – 178, DPI 122 – 163 (10 individuals measured). As holotype.

**Holotype:** worker, China: Yunnan Province, Mengla County, Shangyong Town, Manzhuang Village, 21°25.119'N, 101°41.191'E, 980 m, 23. III. 2012, collected from a ground sample in semi-evergreen monsoon forest, Wenxia Cui leg., No. A12-311.

**Paratypes:** 3 workers, same data as holotype; 1 worker, same data as holotype but collected from a soil sample, No. A12-330; 9 workers, same data as holotype but 21° 25.174' N, 101° 41.033' E, 1000 m, 22. III. 2012, Congfeng Luo leg., Nos. A12-208 (7 workers), A12-209 (1 worker), A12-200 (1 worker); 1 worker, same data as holotype but 21° 25.718' N, 101° 41.169' E, 900 m, 14. VIII. 1997, Yunfeng He leg., No. A97-1672; 2 workers, same data as No. A97-1672 but 10. III. 1998, Taiyong Liu leg., Nos. A98-321 and A98-413; 1 worker, China: Yunnan Province, Mengla County, Mengla Town, Bubang Village, QCAS site 1000-4, 21.621° N, 101.571° E, 995 m, July 2012, collected in rainforest by Berlese method, Akihiro Nakamura & Chris J. Burwell leg., No. A12-1808; 1 worker, same data as No. A12-1808 but QCAS site 1000-5, 21.621° N, 101.574° E, 985m, No. A12-1809; 2 workers, same data as No. A12-1808 but QCAS site 1200-5, 21.594° N, 101.561° E, 1212 m, collected in rainforest by bark spray method, Nos. A12-1810 and A12-1811.

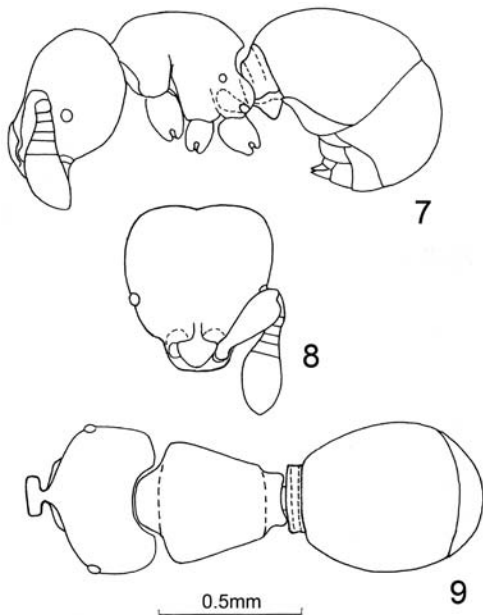
**Comparative notes:** This new species is close to *D. kamiteta* Kubota & Terayama, 1999, but in full-face view, posterior margin of head straight, anterior clypeal margin weakly convex; in lateral view, dorsum of mesosoma weakly convex, posterodorsal corner of propodeum rounded, propodeal lobes rounded; petiolar node relatively long and thick, height/length ratio = 1.7:1. This new species is also close to *D. bryanti* (Wheeler, 1917), but in full-face view, posterolateral corners of head narrowly rounded; frontal carinae reaching to 1/2 of head-length; anterior clypeal margin not crenulate; antennae 9-segmented.

**Habitat:** To date this species has only been collected in Mengla County of Xishuangbanna Prefecture in closed forest at 900 metres above sea level or higher. *Discothyrea banna* is sympatric with *D. diana* and they have even been collected together within a single 20 m by 20 m survey plot.

**Discussion:** The *Discothyrea* specimens from Yunnan Province, that were formerly identified as *D. sauteri* Forel (Xu, 1999) and *Discothyrea* sp.1 (Xu, 2002), present the same species, here described as *D. banna* sp. nov.

**Etymology:** The specific epithet refers to “Banna”, an abbreviation of Xishuangbanna, the prefecture within which the type locality of this species is situated.

***Discothyrea diana* sp. nov.**



**Figs. 7 – 9.** Illustration of holotype worker of *Discothyrea diana* sp. nov.; 1. Body in lateral view; 2. Head in full-face view; 3. Body in dorsal view

**Holotype worker:** TL 1.8, HL 0.58, HW 0.50, CI 87, SL 0.33, SI 65, ED 0.05, PW 0.40, MSL 0.58, PL 0.10, PH 0.26, DPW 0.21, LPI 263, DPI 213.

In full-face view, head longer than broad, roughly trapezoidal, narrowed anteriorly. Posterior margin weakly concave medially, posterolateral corners rounded. Sides evenly convex, deeply notched in front of mandibular insertions. Mandibles triangular, masticatory margins edentate, apical tooth acute. Anterior margin of clypeus weakly convex, anterolateral

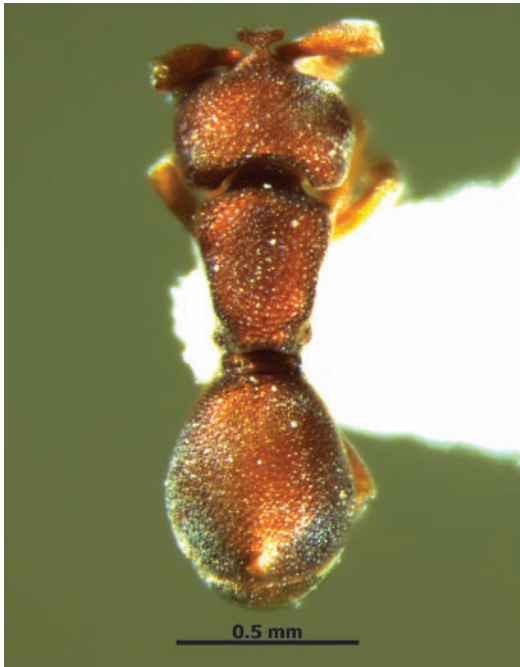
corners rounded. Frontal lobes fused each other and formed a roughly triangular area, about as broad as long, lateral corners acutely angled and less than 90°, anterolateral margins weakly convex. Frontal carinae short and close to each other, extending posteriorly to about 1/3 of head-length. Antennae 7-segmented, apices of scapes reaching to 3/5 of distance from antennal sockets to posterolateral corners. Eyes small and convex, consisting of about 6 ommatidia, located slightly in front of mid-length of sides. In posterior view, frontal area strongly elevated and rectangular, with a narrow base, anterior and lateral margins nearly straight.



**Fig. 10.** Full-face image of holotype worker of *Discothyrea diana* sp. nov.



**Fig. 11.** Lateral image of holotype worker of *Discothyrea diana* sp. nov.



**Fig. 12.** Dorsal image of holotype worker of *Discothyrea diana* sp. nov.

In lateral view, dorsum of mesosoma evenly convex, and sloping down posteriorly, promesonotal suture and metanotal groove absent. Posterodorsal corner of propodeum rightly angled, declivity evenly concave. Propodeal lobe large and rounded. Petiolar node short and low, dorsal face sloping down anteriorly and weakly concave, anterodorsal corner bluntly angled. Subpetiolar process large, roughly triangular, ventrally pointed and translucent. First gastral segment about 2/3 of the total length of gaster. Constriction between the two basal gastral segments narrow and weak.

In dorsal view, mesosoma roughly trapezoidal, narrowed posteriorly, humeral corners bluntly angled, lateral margins straight, propodeum more strongly narrowed, posterior margin weakly concave, posterolateral corners bluntly angled. Petiolar node transverse and rectangular, length/width ratio = 1:3.5, transversely depressed, anterior margin nearly straight, posterior margin weakly concave, anterolateral corners right-angled.

Head, mesosoma, petiole, and first gastral segment densely and coarsely punctured, interface much smaller than puncture diameter, punctures on sides of head and first gastral segment even larger. Rest of gastral segments densely finely punctured. Whole body covered with dense sub-decumbent to decumbent short pubescence, without standing hairs. Scapes and tibiae with dense decumbent pubescence, without standing hairs. Colour reddish brown. Apical antennal segments, legs, and gastral apex yellowish brown. Eyes black.

**Paratype workers:** TL 1.8 – 1.9, HL 0.55 – 0.58, HW 0.48 – 0.50, CI 86 – 91, SL 0.30 – 0.33, SI 60 – 68, ED 0.04 – 0.05, PW 0.35 – 0.40, MSL 0.55 – 0.63, PL 0.09 – 0.11, PH 0.25 – 0.28, DPW 0.21 – 0.23, LPI 244 – 286, DPI 200 – 243 (8 individuals measured). As holotype, but color reddish brown to yellowish brown, apical antennal segments, legs, and gastral apex yellowish brown to yellowish.

**Holotype:** worker, China: Yunnan Province, Mengla County, Mengla Town, Bubang Village, QCAS site 800-2, 21.613° N, 101.578° E, 741 m, July 2012, collected in rainforest by Berlese method, Akihiro Nakamura & Chris J. Burwell leg., No. A12-1812.

**Paratypes:** 2 workers, same data as holotype but QCAS site 800-4, 21.615° N, 101.580° E, 728 m, Nos. A12-1813 and A12-1814; 2 workers, same data as holotype but QCAS site 1000-3, 21.620° N, 101.572° E, 995 m, Nos. A12-1815 and A12-1816; 2 workers, same data as holotype but QCAS site 1000-4, 21.621° N, 101.571° E, 995 m, Nos. A12-1817 and A12-1818; 1 worker, same data as holotype but QCAS site 1200-3, 21.595° N, 101.558° E, 1209 m, No. A12-1819; 1 worker, China: Yunnan Province, Hekou County, Nanxi Town, Laodoutian Village, 22° 48.090' N, 104° 02.944' E, 730 m, 05. IV. 2010, collected from a ground sample in monsoon forest, Huiqin Zhu leg., No. A10-2521.

**Comparative notes:** This new species is close to *D. stumperi* Baroni Urbani, 1977 and *D. yueshen* Terayama, 2009, but in full-face view, posterior margin of head weakly concave medially; in

dorsal view, dorsum of petiolar node transversely depressed; in lateral view, subpetiolar process large and roughly triangular; antennae 7-segmented.

**Habitat:** This species has only been collected from closed forest in southern Yunnan (Mengla and Hekou Counties) at elevations of around 700 and 1200 meters above sea level.

**Etymology:** The specific epithet refers to an abbreviation for Yunnan Province “Dian”, within which the type locality of this species is situated.

### ACKNOWLEDGMENTS

This study was supported by the National Natural Science Foundation of China (Nos. 39500118, 31260521), the QCAS Joint Biotechnology Projects 2010 (No. GJHZ1130), and the Key Subject of Forest Protection of Yunnan Province. We thank the following students of the Forest Protection Class, Southwest Forestry University, Kunming, who collected type specimens: Yunfeng He and Taiyong Liu (Class of 1994), Huiqin Zhu (Class of 2006), and Wenxia Cui and Congfeng Luo (Class of 2008). We also thank Dr. Xinmin Zhang (Key Laboratory of Forest Disaster Warning and Control in Yunnan Province, Southwest Forestry University, Kunming) for producing images of the new species. We are grateful to our colleagues in the QCAS Biodiversity Project for their assistance in organizing and conducting fieldwork in southern Yunnan: Prof. Min Cao, Prof. Yong Tang and Dr Zhenhua Sun (Xishuangbanna Tropical Botanical Garden) and Prof. Roger Kitching (Griffith University). Our thanks also to Dr Wenzhi Wang (Kunming Institute of Zoology) for his help in the field and for financial and logistical support, and Mr Zongxu Li (Kunming Institute of Zoology) for his help in the laboratory. Finally, we thank Herbert Zettel (Natural History Museum, Vienna, Austria) and Francisco Hita Garcia (Zoological Research Museum A. Koenig, Bonn, Germany) for reviewing the manuscript.

### REFERENCES

- Baroni Urbani C, 1977. *Discothyrea stumperi* n. sp. de Bhoutan, premier représentant du genre dans le subcontinent Indien. Archives. Institut Grand-Ducal de Luxembourg (N.S.) 37 (1974 – 1976): 97 – 100.
- Bolton B, 1975. A revision of the ant genus *Leptogenys* Roger in the Ethiopian region, with a review of the Malagasy species. Bulletin of the British Museum (Natural History) (Entomology) 31: 235 – 305.
- Bolton B, 1995. A New General Catalogue of the Ants of the World: 504 pp. Harvard University Press, Cambridge, Mass.
- Bolton B, 2013. An Online Catalog of the Ants of the World. <http://www.antcat.org/>. Retrieved on 1 January 2013.
- Brown WL Jr, 1958. Contributions toward a reclassification of the Formicidae. 2. Tribe Ectatommini. Bulletin of the Museum of Comparative Zoology at Harvard College 118: 175 – 362.
- Burwell CJ and Nakamura A, 2011. Distribution of ant species along an altitudinal transect in continuous rainforest in subtropical Queensland, Australia. Memoirs of the Queensland Museum – Nature 55: 391 – 411.
- Forel A, 1905. Ameisen aus Java. Gesammelt von Prof. Karl Kraepelin, 1904. Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten [Mitteilungen aus dem Naturhistorischen Museum] 22: 1 – 26.
- Forel A, 1912. H. Sauter’s Formosa-Ausbeute: Formicidae. Entomologische Mitteilungen 1: 45 – 81.
- Imai HT, Kihara A, Kondoh M, Kubota M, Kuribayashi S, Ogata K, Onoyama K, Taylor RW, Terayama M, Yoshimura M and Ugawa Y, 2003. Ants of Japan: 224 pp. Gakken, Japan.
- Kubota M and Terayama M, 1999. A description of a new species of the genus *Discothyrea* Roger from the Ryukyus, Japan. Memoirs of the Myrmecological Society of Japan 1: 1 – 5.
- Roger J, 1863. Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses nebst Ergänzung einiger früher gegebenen Beschreibungen. Berliner Entomologische Zeitschrift 7: 131 – 214.
- Terayama M, 2009. A synopsis of the family Formicidae of Taiwan. Research Bulletin of Kanto Gakuen University 17: 81 – 266.
- Wheeler WM, 1917. A new Malayan ant of the genus *Prodiscothyrea*. Psyche (Cambridge) 24: 29 – 30.



- Xu Z, 1999. An analysis on the ant fauna of the tropical rain forest in Xishuangbanna of China. *Zoological Research* 20: 379 – 384.
- Xu Z, 2002. A Study on the Biodiversity of Formicidae Ants of Xishuangbanna Nature Reserve: 181 pp. Yunnan Science and Technology Press, Kunming, Yunnan Province.
- Xu Z, Zeng G, Liu T and He Y, 1999. A study on communities of Formicidae ants in different subtypes of vegetation in Xishuangbanna District of China. *Zoological Research* 20: 118 – 125.
- Zacharias M, and Rajan PD, 2004. *Discothyrea sringerensis*, a new ant species from India. *Zootaxa* 484: 1 – 4.