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Taxonomic Studies of the Japanese Formicidae, Part 6. Genus *Cardiocondyla* EMERY

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Abstract. Three new species of the genus *Cardiocondyla* are described: *C. tsukuyomi, C. kagutsuchi,* and *C. yamauchii.*

In this paper I describe 3 new species of *Cardiocondyla* EMERY, 1869, belonging to the subfamily Myrmicinae from Japan.

The holotypes are preserved in the collection of the Museum of Nature and Human Activities, Sanda, Hyogo. Measurements and indices used in the paper followed those in TERAYAMA & HASHIMOTO (1996).

Genus *Cardiocondyla* EMERY

[Japanese name: Hadaka-ari-zoku]

Cardiocondyla EMERY, 1869, *Ann. de Acc. Aspi. Nat.*, 2: 20.

Type species: *Cardiocondyla elegans* EMERY, 1869.

For full synonymy see BOLTON (1995).

Diagnosis. Total length of workers around 1.5-3.5 mm. Head rectangular with rounded posterior margin. Mandible triangular, usually with 5 teeth. Clypeus widely projecting anteriorly, covering base of mandible. Eye relatively well-developed. Antenna with 12 segments (11 in some species); the apical 3 segments forming a club. Palpal formula 5:3. Dorsal outline of mesosoma almost straight in profile. Propodeal spine varying from absent to long. Petiole slender in most species, with peduncle and subpetiolar process. Postpetiole depressed in profile, broad in dorsal view, wider than long, wider than petiole. Dorsal areas of head and mesosoma lacking hairs. Legs short; middle and hind legs without tibial spurs.

Remarks. *Cardiocondyla* includes about 40 species distributed mainly in the Old World tropics and subtropics, with some species in the Palaearctic region (BOLTON, 1982, 1995). The genus includes tramp species, such as *C. nuda, C. wroughtonii* and *C. emeryi,* which have ex-

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tended their ranges into North America and the Pacific Islands assisted by human commerce. New World records seem highly likely to have originated from Old World introductions.

Most species inhabit open areas, nesting in the soil; some nest in decaying tree branches or hollow grass stems. Several are known to produce ergatoid (wingless, more or less worker-like) males, either exclusively or dimorphically (where both winged and ergatoid males are produced).

Five species have been previously reported from Japan (TERAYAMA, et al., 1992; YAMAUCHI, 1993; YAMAUCHI & KINOMURA, 1993): two are described and three are nomenclaturally undetermined which are described herein.

Japanese species. *C. kagutsuchi* sp. nov., *C. nuda* (MAYR), *C. tsukuyomi* sp. nov., *C. wroughtonii* (FOREL), *C. yamauchii* sp. nov.

Cardiocondyla kagutsuchi sp. nov.

[Japanese name: Hiyake-hadaka-ari]

(Figs. 1-9)

Cardiocondyla sp. 4: TERAYAMA, YAMAUCHI & MORISITA, 1992, *A Guide for the Identification of Japanese Ants (III)*: 32.

Diagnosis. Total length of workers around 2 mm. Body color blackish brown to black; legs, antenna and mandible brown. Head rectangular, slightly longer than wide. Anterior margin of clypeus convex. Scape long, almost reaching posterior margin of head. Metanotal groove shallow and weak in profile. Propodeal spine weakly developed, almost right-angled in profile. Petiole with a long peduncle. Head and mesosoma shagreened; petiolar node and postpetiole almost smooth; gaster smooth.

Description of holotype (Worker). HL 0.53 mm; HW 0.46 mm; SL 0.39 mm; CI 88; SI 84; WL 0.60 mm; PW 0.28 mm; PL 0.30 mm; PH 0.14 mm; DPW 0.13 mm; TL 2.0 mm.

Head rectangular, 1.15 times as long as wide; with very weakly convex sides and straight posterior margin in full face view; posterodorsal corener dully angulate. Mandible with 5 teeth; apical tooth largest. Anterior margin of clypeus rounded. Antennal scape long, almost reaching posterior margin of head in full face view. Eye moderately produced, 0.11 mm in maximum diameter, with about 15 facets in the largest row.

Promesonotal dorsum almost flat; metanotal groove shallow and weak; propodeal dorsum almost straight, very weakly convex in profile. Propodeal spine weakly developed, right-angled in profile. Petiole with a

long peduncle; dorsal and ventral margins of peduncle subparallel in profile; node inverted U-shape in profile; in dorsal view node thin, with weakly convex sides as in Fig. 2. Subpetiolar process small and spinose, situated on anteroventral portion of petiole. Postpetiole flat, 1.3 times as long as high, slightly lower than petiole, and with weakly convex dorsal margin in profile; in dorsal view 0.8 times as wide as long, and 1.7 times dorsal petiole width; sides each with a blunt angle at midlength.

Head and mesosoma shagreened; petiolar node and postpetiole rather smooth, but very weakly shagreened; gaster smooth.

Body color blackish brown to black; legs and mandible brown; antenna brown excepting a club dark brown.

Males. In full face view head of alate male as in Figs. 3 and 4, and of ergatoid male as in Fig. 5. Mesosoma, petiole and postpetiole in profile of alate male as in Figs 6 and 7, and of ergatoid male as in Fig. 9. Alate male with 13- or 12-segmeted antennae. Ergatiod male with triangular mandibles, 12-segmented antennae, distinct promesonotal suture dorsally, and no ocelli on vertex.

Holotype. Worker, Omoto-dake, Ishigaki-jima, Okinawa Pref., VI. 1988, K. YAMAUCHI leg.

Paratypes. 18 workers, 2 queens, 3 males, same data as holotype.

Remarks This species closely resembles *C. nuda* (MAYR). It is very difficult to distinguish the two in workers morphologically. Petiolar node in dorsal view tend to much longer, and sides tend to much weakly convex compared to that of *C. nuda*. However, the male caste system of the species differs from that of *C. nuda*. The former is dimorphic, with both alate and ergatoid males, while *C. nuda* has only ergatoid males (SHINDO, 1980; YAMAUCHI, 1993). The ergatoid males of *kagutsuchi* has a distinct promesonotal suture dorsally, while that of *nuda* is obscure. Also, *kagutsuchi* sp. nov. has 27 chromosomes, while *C. nuda* has 28 (TERAYAMA, et al., 1992), and the former has different karyotype (YAMAUCHI, 1993).

Distribution. Ishigaki I.

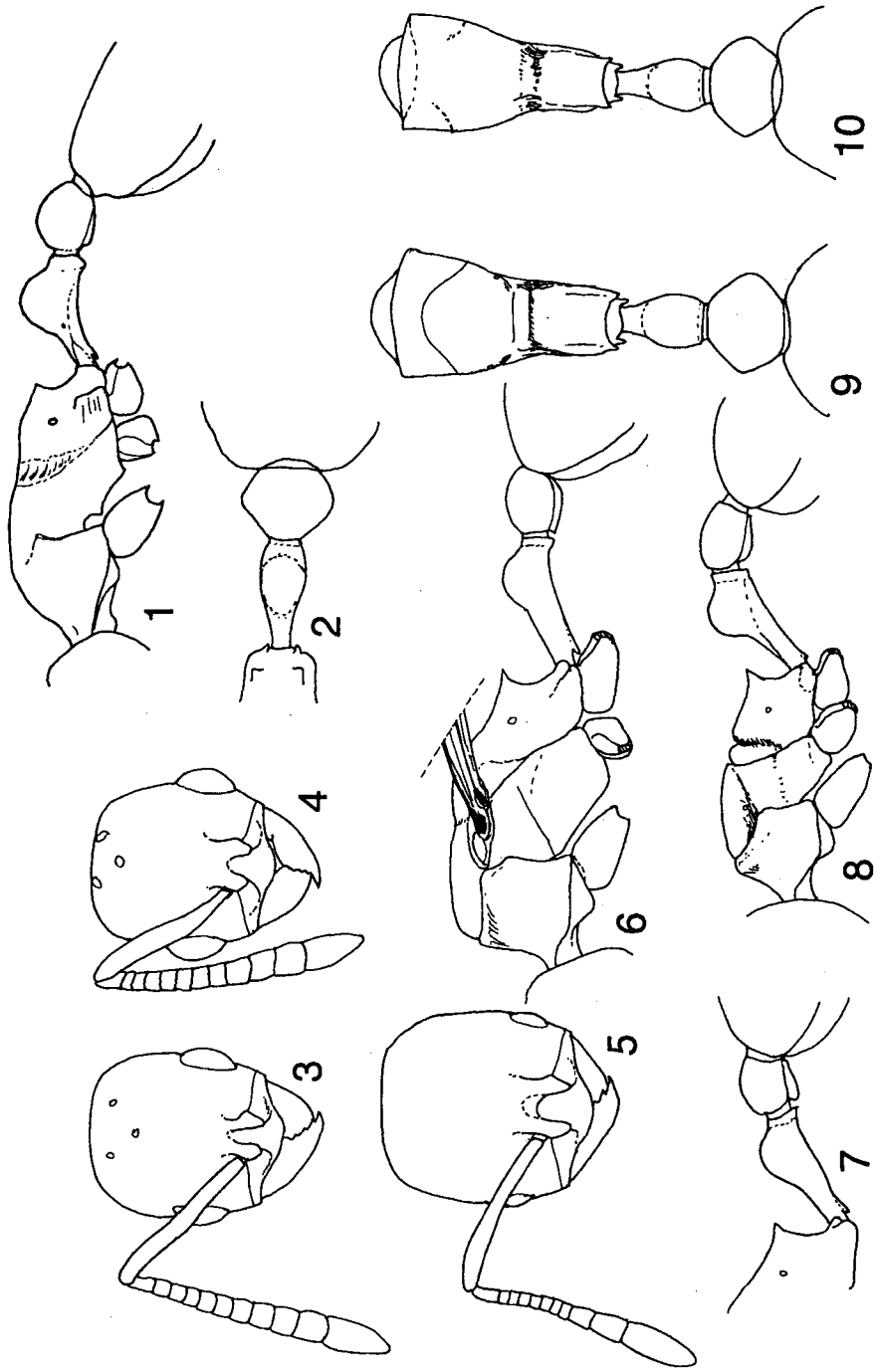
Cardiocondyla tsukuyomi sp. nov.

[Japanese name: Hime-hadaka-ari]

(Figs. 11-13)

Cardiocondyla sp. 3: TERAYAMA, YAMAUCHI & MORISITA, 1992, *A Guide for the Identification of Japanese Ants (III)*: 32.

Diagnosis. Total length of workers around 1.5 mm. Body color blackish brown. Head long and rectangular, 1.3 times as long as wide.



Figs. 1-10. *Cardiocondyla kagutsuchi* sp. nov. and *C. nuda* (MAYR) — 1-9, *C. kagutsuchi* sp. nov.; 10, *C. nuda* (MAYR). 1, Body in profile, worker; 2, petiole and postpetiole in dorsal view, worker; 3, head in full face view, alate male (12-segmented antenna); 4, *ditto*, alate male (13-segment antenna); 5, *ditto*, ergatoid male; 6, mesosoma, petiole and postpetiole in profile, alate male (12-segmented antenna); 7, *ditto*, alate male (13-segmented antenna); 8, *ditto*, ergatoid male; 9, mesosoma, petiole and postpetiole pedicel segments in dorsal view, ergatoid male; 10, *ditto*.

Eye feebly convex. Scape short, not reaching posterior margin. Metanotal groove absent. Dorsal outline of propodeum broadly rounded in profile; propodeal teeth triangular. Petiolar peduncle short. Head, mesosoma, petiole and postpetiole shagreened; gaster smooth.

Description of holotype (Worker). HL 0.46 mm; HW 0.35 mm; SL 0.30 mm; CI 76; SI 86; WL 0.50 mm; PW 0.25 mm; PL 0.23 mm; PH 0.14 mm; DPW 0.08 mm; TL 1.7 mm.

Head long and rectangular, 1.31 times as long as wide, with subparallel sides and almost straight posterior margin in full face view; posterolateral corners dully angulate. Mandible with 5 teeth. Anterior margin of clypeus rounded. Scape short, not reaching posterior margin of head in full face view. Eye feebly convex, 0.10 mm in maximum diameter, with about 15 ommatidia in the largest row.

Promesonotal dorsum depressed, almost straight in profile. Metanotal groove absent. Dorsal outline of propodeum broadly rounded in profile; propodeal teeth triangular; as long as its basal width. Petiole with short peduncle and concave ventral margin in profile; node wide, with broadly convex dorsal margin. Subpetiolar process small, with an obtuse ventral angle, and situated on anteroventral portion of petiole. Postpetiole longer than high, with weakly convex dorsal margin in profile; in dorsal view 0.8 times as long as wide, with strongly convex sides, and 2.2 times dorsal petiole width.

Head, mesosoma, petiole and postpetiole shagreened; gaster smooth.

Body color blackish brown; mandible and legs brown; antennal scape and pedicel brown; 3rd to terminal segments blackish brown.

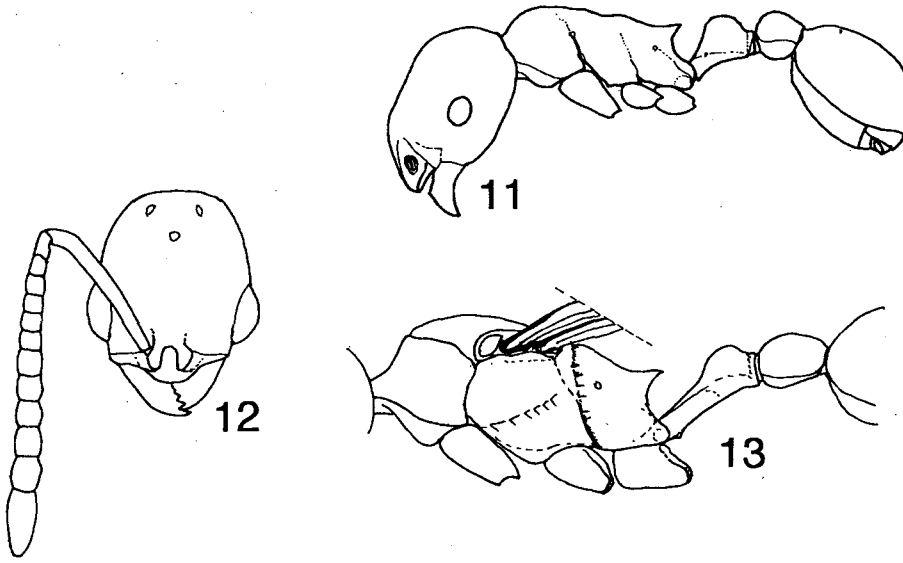
Males. In full face view head of alate male as in Figs. 12; mesosoma, petiole and postpetiole in profile as in Fig. 13. Ergatiod male with triangular mandibles, 12-segmented antennae, obscure promesonotal suture dorsally, and no ocelli on vertex.

Holotype. Worker, Ada, Okinawa-jima, Okinawa Pref., VI. 1988, K. YAMAUCHI leg.

Paratypes. 19 workers, 4 queens, 10 males, same data as holotype; 7 workers, 3 queens, Kuruma-jima, Miyako Is., Okinawa Pref., 2. I. 1984, H. TAKAMINE leg.

Remarks. The males are dimorphic, alate and ergatoid. Ergatoid males fight one another until all but one are killed (YAMAUCHI & KINOMURA, 1993). This species is similar to *C. nuda* (MAYR) and *C. kagutsuchi* sp. nov., but distinguished from the latters by its more angulate propodeal spines and shorter petiolar peduncle. Chromosome number 2n = 30 (TERAYAMA, et al., 1992). The ergatoid male is figured in YAMAUCHI & KINOMURA (1993).

Distribution. Nansei Is., Ogasawara Is.



Figs. 11-13. *Cardiocondyla tsukuyomi* sp. nov. — 11, Body in profile, worker; 12, head in full face view, alate male; 13, mesosoma, petiole and postpetiole in profile, alate male.

***Cardiocondyla yamauchii* sp. nov.**
[Japanese name: Usukiiro-hadaka-ari]
(Figs. 14-19)

Cardiocondyla sp. 5: TERAYAMA, YAMAUCHI & MORISITA, 1992, *A Guide for the Identification of Japanese Ants (III)* : 32.

Diagnosis. Total length of workers around 1.5-2 mm. Body yellow, essentially uniformly colored, except for a pair of brownish spots on the gaster. Antennal scape not reaching posterior margin of head; pronotal humeri slightly angulate in dorsal view; metanotal groove distinct; propodeal spine longer than its basal width.

Althoug the morphology of this species in worker is the same as *C. wroughtonii* except for coloration, *yamauchii* produces two types of males (alate and ergatoid).

Description of holotype (Worker). HL 0.46 mm; HW 0.40 mm; SL 0.34 mm; CI 85; SI 84; WL 0.50 mm; PW 0.25 mm; PL 0.25 mm; PH 0.14 mm; DPW 0.11 mm; TL 1.8 mm.

Head rectangular, longer than wide, with almost straight, but slightly concave in the middle posterior margin in full face view; posterolateral corner rounded. Mandible with 5 teeth; apical tooth largest, the others gradually smaller. Anterior margin of clypeus weakly

concave. Antennal scape not reaching posterior margin of head in full face view. Eye relatively large and produced, maximum diameter 0.10 mm, with about 20 ommatidia in the longest row.

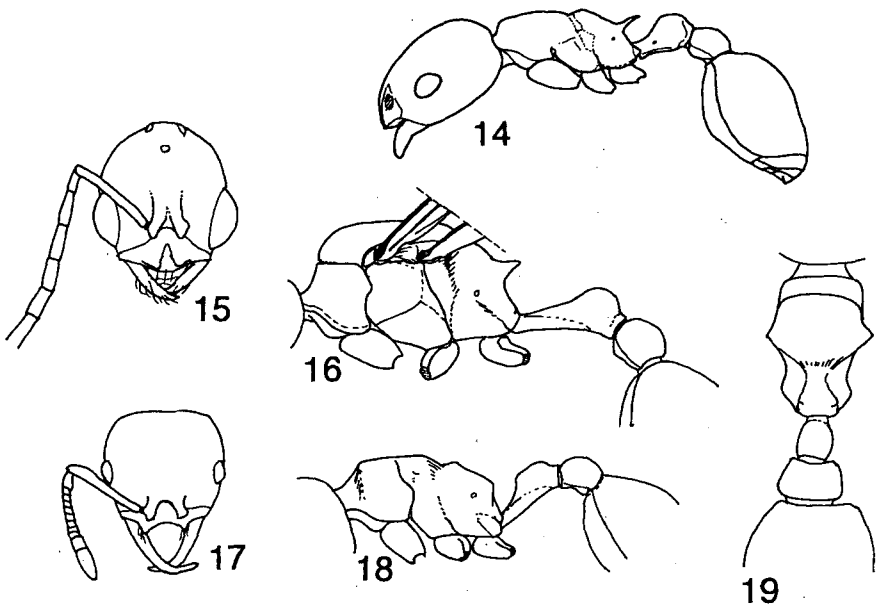
Promesonotal area depressed, almost straight in profile; pronotal humeri slightly angulate in dorsal view. Metanotal groove distinct. Dorsal outline of propodeum roundly convex in profile, highest at anterior third; propodeal spine longer than its basal width. Petiole with a relatively long peduncle and high node. Postpetiole slightly longer than high, lower than petiolar node, with concave anterior margin in dorsal view; in dorsal view 0.8 times as long as high, and 1.6 times dorsal petiolar width.

Head, mesosoma, petiole and postpetiole shagreened; gaster smooth and shining.

Body yellow, essentially uniformly colored, except for a pair of brownish spots on the gaster.

Males. In full face view head of alate male as in Fig. 15, and of ergatoid male in Fig. 17. Mesosoma, petiole and postpetiole in profile of alate male as in Fig. 16, and of ergatoid male in Fig. 18. Alate male with falcate mandibles and 13-segmented antennae. Ergatiod male with remarkbly long falcate mandibles, 12-segmented antennae, distinct promesonotal suture dorsally, and no ocelli on vertex.

Holotype. Worker, Ada, Okinawa-jima, Okinawa Pref., 12. VI. 1991,



Figs. 14-19. *Cardiocondyla yamauchii* sp. nov. — 14, Body in profile, worker; 15, head in full face view, alate male; 16, mesosoma, petiole and postpetiole in profile, alate male; 17, head in full face view, ergatoid male; 18, mesosoma, petiole and postpetiole in profile, ergatoid male; 19, mesosoma, petiole and postpetiole in dorsal view, ergatoid male.

K. YAMAUCHI leg.

Paratypes. 9 workers, 8 queens, 3 males, same data as holotype.

Remarks. This species resembles *C. wroughtonii* (FOREL), but the differences in coloration between them are consistent. Indeed, the worker descriptions applicable here are otherwise identical. The males are dimorphic; alate and ergatoid. The latter have remarkably long sickle-shaped mandibles like those of *C. wroughtonii*. It is known that the ergatoid males of *wroughtonii* is able to kill other males in the nest by cutting the appendages, neck, or petiole with his mandibles (KINOMURA & YAMAUCHI, 1987; STUART et al., 1987) and by using a bite-inducing pheromone (YAMAUCHI & KAWASE, 1992). The nests of *C. yamauchii* are found in plant cavities, like grass stems, in open areas, grassland and forest margins. To date, the species is known only from the northern part of Okinawa Island.

Distribution. Okinawa I.

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