Taxonomic notes on the genus Protanilla (Hymenoptera: Formicidae: Leptanillinae) from Taiwan

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Abstract

A new species of Protanilla Taylor, 1990, P. jongi sp. nov., from Taiwan is described and illustrated, along with a supplementary description of the queen morphology of P. lini Terayama, 2009 and biological notes of Protanilla species. Furthermore, Furcotanilla Xu, 2012 is considered a junior synonym of Protanilla on reanalysis of purported diagnostic characters. A key to the world fauna of genus Protanilla based on the worker caste is provided.

Key words: Leptanillinae, Protanilla, Furcotanilla, new species, new synonym, key to species

Introduction

The genus Protanilla Taylor, 1990 was originally published in Bolton (1990), in Bolton's revision of Leptanillinae Emery, 1910. To date the genus comprises 9 valid species and 1 undescribed species (appearing in the literature under the unavailable name P. wallacei). All of these species are distributed in Asia, including India, Sri Lanka, Singapore, Malaysia, China, Japan, and Taiwan. Most of the natural history of Leptanillinae remains unclear. The only well studied member, Leptanilla japonica Baroni Urbani, 1977, has a specialized diet consisting of ground-dwelling centipedes; moreover, the gynes of this hypogaeic species obtain nutrients exclusively from the larval hemolymph through a tube-like structure on the fourth abdominal somite of the larva, which induces physogastry and egg-laying (Masuko 1989, 1990). In the genera Anomalomyrma Taylor, 1990 and Protanilla of the tribe Anomalomyrmini, gynes are deciduously winged and resemble workers in the waist segments; by contrast, gynes of Leptanilla Emery, 1870 are dichthadiiform and the structure of their abdomens differs from that in workers (Bolton 1990; Borowiec et al. 2011; Terayama 2013). However, multiple ergatoid gynes were observed in a “P. wallacei” colony. These gynes were morphologically similar to workers except for the variations in their compound eyes, body/abdominal size and spermathecal gland (Billen et al. 2013; F. Ito personal communication).

Furcotanilla Xu, 2012 is a monotypic genus that was established by separating a unique Protanilla species characterized by massive furcated mandibles and other characters (Xu 2012). In the present paper, we describe a new species, Protanilla jongi sp. nov., which appears to be a morphological intermediate between Protanilla and Furcotanilla; therefore, we suggest that Furcotanilla should be considered a junior synonym of Protanilla. Furthermore, a key to the world fauna of Protanilla based on the worker caste, and the first description of the P. lini Terayama, 2009 queen was provided.
Material and methods

One colony of *P. lini* (comprising approximately 100 workers, 30 larvae, and 5 dealated gynes) was collected from the Lienhuachih Forest Dynamics Plot in Nantou, central Taiwan, in December 2015. Three months later, one colony of *P. jongi* sp. nov. (comprising approximately 25 workers, 15 larvae, and 1 dealated gyne) was collected from the Fenghuang Education Area, also in Nantou, in March 2016. The two colonies were brought to the laboratory, which was temperature controlled below 25°C, and were raised in round containers that were 21 cm in diameter, 8 cm in height, and paved with 3 cm deep plaster at the bottom. We created a shallow nesting area near the center of the container, which was covered with a piece of transparent glass and a red plastic filter. Initially, the colonies were provided with live arthropod prey that lives in the typical habitat of *Protanilla* (including centipedes, cockroaches, meal worms, termites, springtails, and woodlice) to test their food preferences, and the unwanted or unconsumed prey was removed 1 day later. After the tests were done, we fed the colonies twice a week with appropriate prey and observed their behaviors. The total observation period was approximately 6 months for *P. lini* and 2 months for *P. jongi*, until each colony died. All of the members were preserved in 75% alcohol for further examination.

The material examined in this study will be deposited in the following institutions: the National Museum of Natural Science, Taichung, Taiwan (NMNS); the Insect Collections at the Entomology Department of National Taiwan University, Taipei, Taiwan (NTU); the Social Insect Laboratory of National Changhua University of Education, Changhua, Taiwan (NCUE); Kyoto University Museum, Kyoto, Japan (KUM); British Museum of Natural History, London, United Kingdom (BMNH); and the Field Museum of Natural History, Chicago, United States (FMNH).

All measurements were recorded using a Leica M205C stereomicroscope and are reported in millimeters. Specimen images were recorded using a Panasonic DMC-GH1 digital camera, and were overlaid by using the Helicon Focus 5.3 software; other images were captured from a video that was filmed using Panasonic DMC-GH1 digital camera. All images were then processed with Adobe Photoshop CC. The distribution map was prepared using the SimpleMappr program (Shorthouse 2010).

The terminology used follows that of Terayama (2009) and Xu (2012).

**HL**  Head length: The length of the head proper in full-face view, from the midpoint of the anterior clypeus margin to the midpoint of the posterior margin (when the clypeus margin or the posterior margin is concave, to the transverse line connecting its anterior-most or posterior-most extensions).

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

**CI**  Cephalic index: (HW × 100) / HL.

**SL**  Scape length: The maximum length of the antenna scape excluding the radical.

**SI**  Scape index: (SL × 100) / HW.

**ML**  Mandible length: The length of the mandible from the base to the apex.

**PW**  Pronotal width: The maximum width of the pronotum in dorsal view.

**WL**  Weber's length: The maximum diagonal length from the anterior most point of the pronotal slope (excluding neck) to the posteroventral corner of the propodeal lobe in profile view.

**PNL**  Petiolar node length: The maximum longitudinal length of the petiolar node in lateral view, excluding its anterior and posterior peduncles.

**PNH**  Petiolar node height: The maximum height of the petiolar node from the lowest part of the subpetiolar process to the dorsal apex in lateral view.

**PNW**  Petiolar node width: The maximum width of the petiolar node in dorsal view.

**PPNL**  Postpetiolar node length: The maximum longitudinal length of the postpetiolar node in lateral view, excluding its anterior and posterior peduncles.

**PPNH**  Postpetiolar node height: The maximum height of the postpetiolar node from the lowest part of the node to the dorsal apex in lateral view.

**PPNW**  Postpetiolar node width: The maximum width of the postpetiolar node in dorsal view.
TABLE 1. Details of the observed *P. lini* and *P. jongi* colonies.

<table>
<thead>
<tr>
<th></th>
<th><em>P. lini</em></th>
<th><em>P. jongi</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of collection</td>
<td>Dec. 07. 2015</td>
<td>Mar. 05. 2016</td>
</tr>
<tr>
<td>Locality</td>
<td>Lienhuachih Forest Dynamics Plot, Nantou, central Taiwan</td>
<td>Fenghuang Education Area, Nantou, central Taiwan</td>
</tr>
<tr>
<td>Vegetation type</td>
<td>Machilus-Castanopsis forest zone, mainly Lauraceae and Fagaceae</td>
<td>Secondary forest, mainly <em>Acacia confuse</em></td>
</tr>
<tr>
<td>Nesting habitat</td>
<td>within a fallen branch</td>
<td>ca. 20 cm deep in soil</td>
</tr>
<tr>
<td>Numbers of workers</td>
<td>ca. 100</td>
<td>ca. 25</td>
</tr>
<tr>
<td>Numbers of gynes</td>
<td>ca. 5</td>
<td>1</td>
</tr>
<tr>
<td>Numbers of larvae</td>
<td>ca. 30</td>
<td>ca. 15</td>
</tr>
<tr>
<td>Duration of observation</td>
<td>ca. 6 months</td>
<td>ca. 2 months</td>
</tr>
</tbody>
</table>

**Taxonomy**

**Genus Protanilla Taylor**

*Furcotanilla* Xu, 2012: 481. Type species: *Protanilla furcomandibula* Xu, 2002: 140, by original designation.  
*syn. nov.*

**Diagnosis.** Workers and queens of *Protanilla* can be distinguished by the combination of the following characters (after Borowiec et al. 2011):

1) clypeus disc flattened, trapezoidal to bell-shaped;
2) in workers, scape nearly as long as head width, or slightly longer (95 < SI < 120);
3) mandibles long and triangular in full-face view, apically down-curved in lateral view; masticatory margins with peg-like teeth (modified setae) and crenulate, but the apical 1/3 denticulate and without peg-like teeth.
4) petiole in lateral view rectangular and node-like, with clearly differentiated posterior face and not fused with postpetiole.
5) postpetiole (abdominal segment III) in dorsal view as broad as long or longer, not distinctly broader than petiole; narrowly attached to gaster by tubular constriction with clearly differentiated posterior face, or broadly attached to gaster (in the latter case postpetiole trapezoidal in dorsal view).

**Protanilla jongi** sp. nov.

Figs. 1–4.

**Type material.** Holotype ♀ (worker): TAIWAN, Nantou, Fenghuang Education Area, (23°43.763’N, 120°47.313’E), alt. 840 m, by hand-collecting, 05. III. 2016, Po-Cheng Hsu leg. (NMNS). Paratypes: 1 ♀ (worker): same location as the holotype, by Winkler extraction method, 28.XI.2015, Po-Wei Hsu leg.; 8 ♀ (worker), 1 ♀ (queen): same data as the holotype (1 worker at NTU; 2 workers and queen at NCUE; 2 workers at KUM; 2 workers at BMNH; 2 workers at FMNH)

**Etymology.** The new species is named after Dr. Jaw-Jinn Jong, an entomologist from Taiwan.

**Measurements.** Holotype worker: HL 0.80, HW 0.69, CI 86, SL 0.74, SI 107, ML 0.47, PW 0.51, WL 1.24, PNL 0.37, PNH 0.45, PNW 0.35, PPNL 0.42, PPNH 0.38, PPNW 0.37; Paratype workers (n=9): HL 0.77–0.84, HW 0.66–0.75, CI 85–89, SL 0.67–0.75, SI 97–107, ML 0.43–0.50, PW 0.43–0.54, WL 1.17–1.33, PNL 0.31–0.39, PNH 0.43–0.49, PNW 0.31–0.37, PPNL 0.37–0.44, PPNH 0.35–0.41, PPNW 0.36–0.39; Paratype queen: HL 0.73, HW 0.62, CI 85, SL 0.68, SI 110, ML 0.37, PW 0.58, WL 1.44, PNL 0.37, PNH 0.52, PNW 0.39, PPNL 0.46, PPNH 0.44, PPNW 0.44.
Description. Holotype worker: Body brownish-yellow. In full-face view, head longer than wide, slightly narrow anteriorly; posterior margin straight; lateral margins convex. Eyes absent. Clypeus in full-face view with a bell-shaped outline; anterior margin concave, without depressed middle strip. Mandibles long and triangular; masticatory margin slightly crenulate, with approximately 20 peg-like teeth; apical 1/3 denticulate and without peg-like teeth. A longitudinal groove running along the dorsolateral margin of mandible, traversing the width to inner margin at 1/3 the length to apex, just before the preapical series of denticles. A series of long stout hairs on masticatory margin of mandibular apical portion, with the foremost one stoutest. In lateral view, mandible strongly down-curved apically, with a small blunt denticle at inner ventral face, 1/3 the length to base. Antennae 12-segmented; scape long, slightly exceeding posterior margin of head; segments 2–3 somewhat conical and longer than wide; segments 4–11 nearly as long as wide; terminal segment twice as long as wide. Mesosoma slender. Pronotum in dorsal view round, twice as broad as mesonotum, in lateral view with a convex dorsal outline. Promesonotal groove distinct dorsally and laterally. Mesonotum thin, in dorsal view narrow posteriorly, in lateral view with a straight dorsal outline. Metanotal groove depressed with several short longitudinal notches. Propodeum in dorsal view oval, with posterior half round, in lateral view with a convex dorsal outline and propodeal spiracle in the middle lower part above bulla of metapleural gland.

Petiolar node in dorsal view round, in lateral view straight anteriorly and slightly convex dorsally, forming a round posterodorsal corner and a clearly differentiated posterior face sloping down to the articulation with postpetiole; anterolateral part just above the anterior short peduncle forming a small projection. Subpetiolar sternite in lateral view approximately 1/4 as high as petiole height, narrow posteriorly, with a lobe-like subpetiolar process.
anteroventrally. A circular transparent fenestra in the center of that process. Presclerites of postpetiole constricted to helcium, attached to almost the center of the anterior face of postpetiole at approximately 45 degrees. Postpetiole broadly attached to abdominal segment IV, without any free posterior face above the articulation with abdominal segment IV. Postpetiole in dorsal view with bell-shaped to trapezoidal outline, broad posteriorly, in lateral view with a round anterior face and a slightly convex dorsal outline above the articulation with petiole; anteroventral corner of postpetiolar poststernite forming a right angle. Postsclerites of postpetiole and presclerites of abdominal segment IV, when the articulation is outstretched, forming a continuously outline. Presclerites of abdominal segment IV coarsely sculptured; pretergite narrow; pretergite well-developed and bulging. An inconspicuous narrow girdling constriction between pre- and postsclerites of abdominal segment IV. In dorsal view, anterior margin of posttergite of abdominal segment IV slightly concave. In lateral view, dorsal and ventral margins of postsclerites of abdominal segment IV forming a continuous outline which is slightly convex, and narrow anteriorly, but never forming a deep and narrow notch between the posttergite and poststernite at the anterior margin. Sting long, exceeding half the length of gaster.

**FIGURE 2.** Protanilla jongi sp. nov., paratype queen. A. Full-face view. B. Body in dorsal view. C. Body in profile view. Scale bars: A, 0.5 mm; B and C, 1 mm.

*Paratye* female (queen): Body brown, darker than that of worker. In full-face view, head slightly longer than wide; sides convex; posterior margin straight. Compound eyes large, located in the center of the side of head. Ocelli present. Clypeus same shape as in workers. Mandibles similar to worker, slightly more robust and less down-curved in lateral view. Antennae similar to worker. Mesosoma well developed. Pronotum in dorsal view approximately as long as scutum, in lateral view with a convex dorsal outline. Scutum in dorsal view shield-shaped, somewhat triangular, in lateral view with a flat dorsal outline. Scutellum in dorsal view small, half the
FIGURE 3. Protanilla jongi sp. nov., paratype worker. A. Mandibles in full-face view. B. Mandibles in ventral view. Scale bars: 0.25 mm.
length of scutum, in lateral view with a convex dorsal outline. Propodeum in dorsal view somewhat trapezoidal, with posterior face convex, in lateral view with a round dorsal outline. Propodeal spiracle large, at middle lower part above bulla of metapleural gland, which is considerably more developed than that of workers. Petiole and postpetiole in both dorsal and profile view same shape as in workers, but postpetiole in lateral view with a more convex dorsal outline and a more produced anteroventral corner. Presternite of abdominal segment IV less prominent than those of workers. Abdominal segment VI broadly attached to postpetiole, in dorsal view anterior margin concave.

**Diagnosis.** *Protanilla jongi* sp. nov. can be easily distinguished from other *Protanilla* species by the combination of the following characters: mandibles with a small blunt denticle at the ventral margin, postpetiolar sternite with a right-angled anteroventral corner in lateral view, postpetiole broadly attached to abdominal segment IV and with a bell-shaped outline in dorsal view.

**Remarks.** Some variation in the shape of the petiole and postpetiole were observed among the holotype and paratype workers: anterior face of the petiole (above the short peduncle) sometimes slightly concave; the angular anteroventral corner of postpetiolar sternite sometimes slightly produced.

*Protanilla lini* Terayama, 2009  
Figs. 5–6.

**Material examined.** 2 ♀ (worker): TAIWAN, Nantou, Lienhuachih Forest Dynamics Plot, by hand-collecting, 07.XII.2015, Po-Cheng Hsu leg. (NCUE); 1 ♀ (queen): same data as workers. (NCUE).
Measurements. Worker: see Terayama, 2009: 126; female (queen): HL 0.63, HW 0.54, CI 86, SL 0.52, SI 96, ML 0.31, PW 0.42, WL 1.03, PNL 0.24, PNH 0.41, PNW 0.28, PPNL 0.22, PPNH 0.43, PPNW 0.32.

Supplementary description. Worker: see Terayama, 2009: 126. Furthermore, a longitudinal inconspicuous groove running along dorsolateral margin of mandible, traversing the width to inner margin at approximately half the length. A series of long stout hairs on masticatory ventral apex of mandible. Presclerites of abdominal segment IV constricted to articulation with postpetiole; pretergite thin; preternite bulging and coarsely sculptured.

Female (queen): Body yellowish-brown, similar to worker. In full-face view, head somewhat round, as broad as long; sides convex; posterior margin straight to slightly concave. Compound eyes large, located slightly above the middle of sides of head. Ocelli present. Clypeus same shape as in workers. Mandibles long and triangular, with a longitudinal groove running dorsolaterally, traversing the width to inner margin at 1/3 the length to apex; masticatory margin slightly crenulate with approximately 15 peg-like teeth; apical 1/3 denticulate and without peg-like teeth. A series of long stout hairs on masticatory ventral margin of mandibular apex, with the foremost one stoutest. In lateral view, mandibles down-curved apically. Antennae 12-segmented; scape long, reaching posterior margin of head; segments 2–11 as long as wide; terminal segment approximately 1.5 times as long as wide. Mesosoma well developed, in lateral view with a flat to slightly convex dorsal outline. Pronotum in dorsal view approximately as long as scutum, with convex sides, in lateral view with a convex dorsal outline. Scutum in dorsal view triangular, in lateral view with a flat dorsal outline. Scutellum in dorsal view small, half the length of scutum, in lateral view with a flat dorsal outline. Propodeum in dorsal view trapezoidal, with straight posterior face and round corners, in lateral view with round dorsal outline. Propodeal spiracle large, above bulla of metapleural gland.
Petiole and postpetiole same shape as that of workers in both dorsal and profile view, but in lateral view petiole and postpetiole thinner than those of workers.

Remarks. Records have revealed that *P. lini* is distributed across the north and central parts of Taiwan, primarily in natural or seminatural areas above an altitude of 600 m. *Protanilla lini* workers seem to be spotted more easily on rainy days, possibly because of migrations caused by floods.

**FIGURE 6.** *Protanilla lini* Terayama, 2009 queen. A. Full-face view. B. Body in dorsal view. C. Body in profile view. Scale bars: A, 0.5 mm; B and C, 1 mm.

**Biological notes on Protanilla in Taiwan.** The *P. lini* colony was collected from the Lienhuachih Forest Dynamics Plot at an altitude of 760 m. The area is a Machilus-Castanopsis forest zone that is mainly composed of Lauraceae and Fagaceae trees. The colony was found nesting in some cavities and tunnels within a fallen dead branch. The *P. jongi* colony was collected from the Fenghuang Education Area at an altitude of 840 m. The area is a tea garden with several types of vegetation, mainly *Cunninghamia lanceolata*, *Schima superb*, bamboo, and various ferns. It is near secondary forest which mainly consists of *Acacia confuse*. The colony was found nesting in a built chamber at a depth of approximately 20 cm in soil, covered by a stone.

The *P. lini* and *P. jongi* colonies were observed in our laboratory for the duration of 6 and 2 months, respectively. All of the members demonstrated the behavior noted by Wilson and Hölldobler (1990), which is consistent with those of typical trap-jaw ants (e.g. *Odontomachus* and *Anochetus*). Although mandibles of *Protanilla* workers are not linear in shape, they are able to open to 180 degrees and strike during predatory interactions. This behavior was also recorded in "*P. wallacei*" a few times in the laboratory (F. Ito, personal communication). Furthermore, we observed that *Protanilla* workers locked their mandibles in the striking position when guarding their nest entrances in the laboratory. The guarding behavior was also recorded in *L. japonica* by
Masuko (1990), who noted that most of the workers stood near the brood pile facing outward, with the anterior half of the body raised, the forelegs suspended in the air, and the mandibles open. However, whether Leptanilla could quickly snap their mandibles as those of Protanilla and other trap-jaw ants was not mentioned in the previous articles.

**FIGURE 7.** Distribution map of Protanilla jongi sp. nov. and *P. lini* Terayama, 2009 in Taiwan.
In our laboratory observations, we provided various types of prey (centipedes, cockroaches, meal worms, termites, springtails, and woodlice). Only certain types of centipedes were accepted; specifically, both species appeared to prefer geophilomorph centipedes that were approximately 3–4 cm in length. Smaller and larger geophilomorph centipedes were also acceptable, but the members were unable to finish those exceeding 4 cm. We removed them to avoid a sanitation problem in the nest. Moreover, as P. jongi is larger than P. lini, P. jongi seemed to prefer larger prey compared with P. lini. This observation is similar to the ecological notes in Ogata et al. (1995), which reported that L. taiwanensis larvae were found in the field feeding on a geophilomorph centipede.
approximately 4 cm in length; Masuko (1990) also demonstrated this phenomenon, indicating that *L. japonica* exclusively fed on geophilomorph centipedes ranging from 1–2 cm in the laboratory (but whether centipedes larger than 2 cm were provided is unclear). However, "*P. wallacei*" was observed to feed on *Occasjapyx dipluran* (Billen *et al.* 2013). Further field and laboratory observations are required to determine the degree to which *Protanilla* and other Leptanillinae specialize on centipedes.

In our captive colonies, when a live centipede was encountered by *Protanilla*, the workers grabbed the appendages of the centipede by quickly snapping their mandibles and stinging the victim. The centipede was paralyzed within a few minutes and transported back to the nest, where it was consumed by numerous larvae that were carried and attached to the prey by the workers. We did not observe the situation discussed in Masuko (1990), where *L. japonica* workers carried the larvae toward the paralyzed prey rather than bringing the prey back to the nest.

However, whether the synchronized larval development and larval hemolymph feeding behaviors in *L. japonica* also appear in *Protanilla* species remains unclear. In our observations, we did not record the gynes of either species feeding on larvae. Nevertheless, during the 6-month observation of the *P. lini* colony, we did note the larvae of different instars present in the colony at the same time. More living material of *Protanilla* species is needed for the further examination of larval biology.

In addition, strong and distinct odors spread when the two *Protanilla* colonies were excavated and even when undisturbed in the laboratory. However, it remains unclear whether the odor was produced by adults or larvae.

**Furcotanilla** as a synonym of *Protanilla*. According to Xu (2012), the monotypic genus *Furcotanilla* is morphologically close to *Protanilla*, but is distinguishable by the combination of the following characteristics:

1) Massive mandibles armed with a long tooth and a short tooth on the lateroventral margin;
2) Postpetiole broadly attached to the anterior face of gaster;
3) Ventral outline of postpetiolar sternite in lateral view deeply concave; and
4) Anterior margin of the abdominal segment IV deeply concave in order to accept the postpetiole.

However, we found that the characters of *P. jongi* are intermediate between those of *Protanilla* and *Furcotanilla*, raising doubts about the validity of *Furcotanilla*. First, *P. jongi* has a single, inconspicuous, and small tooth at the ventral margin of its long and thin mandibles. The tooth seems to be equivalent to the two rather developed teeth seen in *Furcotanilla*; that is to say that the shape of the mandibular blade of *P. jongi* is intermediate between *Furcotanilla* and typical *Protanilla* spp., though overall more similar to those of *Protanilla*. Specialized shapes of mandibular blades are also found in *P. izanagi* and *Anomalomyrma taylori*, which have a high, convex lamella projecting vertically from the dorsal surface of each mandible. Thus, the shape of the mandibular blade seems to be inadequate for distinguishing genera of Leptanillinae because modifications of the character have probably occurred frequently in the tribe Anomalomyrmini (see also Borowiec *et al.* 2011). Furthermore, *Furcotanilla* and *Protanilla* species (including *P. jongi*) exhibit similarities in the arrangement of teeth and setae/hairs of the mandibles, including peg-like teeth on the masticatory margins, which were considered a synapomorphy of *Protanilla* (Borowiec *et al.* 2011), denticles at the down-curved mandibular apex, and a long stout hair in the anteroventral part.

In addition to the mandible features, *P. jongi* shows an intermediate or mosaic condition between *Furcotanilla* and typical *Protanilla* regarding the shape of the postpetiole and the structure of the articulation between the postpetiole and abdominal segment IV. The postpetiole of *P. jongi* is trapezoidal in dorsal view, and broadly attached to abdominal segment IV; these characteristics are identical to those of *Furcotanilla*. In *P. jongi*, however, the anterior margin of abdominal segment IV is just slightly concave in dorsal view, and the side of abdominal segment IV lacks any deep and narrow notch between the tergite and sternite at the anterior margin; these characteristics are similar to those of *Protanilla*. Furthermore, the postpetiolar sternite and presternite of the abdominal segment IV in *P. jongi*, when the articulation is outstretched, form a continuous ventral outline that is nearly straight at the postpetiolar sternite and prominent at the presternite of abdominal segment IV. By contrast, the ventral outline of the postpetiolar sternite in *Furcotanilla* is deeply concave according to Xu (2012). Overall, the characteristics observed in *P. jongi* are more typical of *Protanilla* species, in which the postpetiolar sternite is not concave, and the presternite of abdominal segment IV is coarsely sculptured and bulging, which can be seen in other species to varying degrees.
Current taxonomy strives to make all higher taxa monophyletic. Rates of evolution vary among characters, and creating a new higher taxon based on only a few traits may result in paraphyly. This may be misleading for studies of behavior and biology. Some major ant genera, which consist of hundreds of species, contain subgroups with highly divergent morphology. We should avoid creating new genera based only on morphological gaps, and instead place highly divergent species into informal “species-groups.” We should avoid the description of new genera until we have a clear understanding of their evolutionary history. In this case, we can easily speculate that Furcotanilla is actually well-embedded within the Protanilla clade, with highly-derived mandibles and some other notable characters. In fact, the only species of Furcotanilla, *F. furcomandibula*, was initially described as *Protanilla furcomandibula* in Xu, 2002. The intermediate status of *P. jongi* helps further bridge the gap between these two genera. In conclusion, we synonymize Furcotanilla with Protanilla, and transfer “*F. furcomandibula*” back to Protanilla as *Protanilla furcomandibula rev. comb.*

### Key to the world fauna of Protanilla based on the worker-caste
(Modified from Xu 2012, Bharti & Akbar 2015)

1. Mandibles with a large convex dorsal lamella and a large longitudinal groove on outer surface ............................................ *P. izanagi* Terayama, 2013 (Japan)
   - Mandibles thin, long and narrowly triangular, without a dorsal lamella; with or without a groove on outer surface .......... 2
2. Lateral or ventral margin of mandibles with 1–2 denticles. Postpetiole broadly attached to abdominal segment IV ........ 3
   - Lateral and ventral margin of mandibles smooth, without denticle. Postpetiole narrowly attached to abdominal segment IV... 4
3. Ventral faces of mandibles with only one inconspicuous denticle. Anterior margin of abdominal segment IV in dorsal view slightly concave. Side of abdominal segment IV with a deep and narrow notch between the tergite and sternite at the anterior margin. In profile view, postpetiolar sternite nearly straight, and anterior corner forming a right angle ............................................ *P. jongi* sp. nov. (Taiwan)
   - Lateroventral margins of mandibles armed with 2 distinct teeth (one long and one short). Anterior margin of abdominal segment IV in dorsal view deeply concave. Side of abdominal segment IV without a deep and narrow notch between the tergite and sternite at the anterior margin. In profile view, postpetiolar sternite deeply concave ............................................ *P. furcomandibula* Xu, 2002 rev. comb. (China: Yunnan)
4. In full face view, anterior margin of clypeus strongly concave. In dorsal view, petiole distinctly longer than broad. Body bicolored, the middle portion black, the rest brownish yellow ............................................ 5
   - In full-face view, anterior margin of clypeus straight to weakly concave. In dorsal view, petiole as broad as long or broader than long. Body concolorous, uniformly yellowish brown or reddish brown ............................................ 6
5. In full-face view, anterior 1/3 of the head distinctly narrowed. In profile view, anterior and dorsal faces of petiolar node somewhat differentiated, meeting at a broadly rounded angle. Head brownish yellow. Body small (HW 0.42–0.45 mm in types) ............................................ *P. bicolor* Xu, 2002 (China: Yunnan)
   - In full face view, anterior half of head distinctly narrowed. In profile view, petiolar node evenly rounded, with no differentiation of anterior and dorsal faces. Head light black to blackish brown. Body large (HW 0.60–0.65 mm in types) ....................... *P. gengna* Xu, 2012 (China: Yunnan)
6. In profile view, anterior face of petiole distinctly concave, anterior lateral corner protruding ............................. 7
   - In profile view, anterior face of petiole straight, sloped or slightly convex ............................................. 8
7. Petiole distinctly broader than long, slightly widened posteriorly. In profile view, top half of postpetiole slightly inclined anteriorly and roughly round ............................................ *P. rafflesii* Taylor, 1990 (Singapore and Malaysia)
   - Petiole nearly square in dorsal view, as broad as long, weakly narrowed posteriorly. In profile view, top half of postpetiole roughly rectangular, with straight anterior and posterior face ............................................ *P. wardi* Bharti & Akbar, 2015 (India)
8. Top half of postpetiole not inclined forward, posterodorsal corner angled. In dorsal view, both petiole and postpetiole round, as long as broad ............................................ *P. lini* Terayama, 2009 (Taiwan)
   - Top half of postpetiole strongly inclined forward. In dorsal view, at least petiole or postpetiole compressed anteroposteriorly, broader than long ............................................ *P. tibeta* Xu, 2012 (China: Tibet)
9. In full face view, anterolateral corners of head prominent and tooth-like. In profile view, petiole relatively thick and roughly trapezoidal, dorsal face long, approximately as long as anterior face ............................................ *P. tibeta* Xu, 2012 (China: Tibet)
   - In full face view, anterolateral corners of head smooth and without prominent tooth-like structures. In profile view, petiole relatively thin and roughly triangular, dorsal face short, approximately half the length of anterior face ............................................ *P. concolor* Xu, 2002 (China: Yunnan)

**Notes.** *Protanilla schoedli* Baroni Urbani & De Andrade, 2006 was described from one damaged gyne; therefore, it has been excluded from the key.
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