A NEW TERRESTRIAL AMPHIPOD (CRUSTACEA) FROM A SUBTROPICAL FOREST IN TAIWAN, WITH DESCRIPTION OF A NEW GENUS

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ABSTRACT - A new genus and a new species of talitrids, *Bousfieldia phoenixae*, is described from a subtropical forest in central Taiwan. The species is a member of the 4-dentate cuspidactylate subgroup of landhoppers. Its closest affinities are with species of "*Parorchestia*" previously known from southern Japan and Luzon (Philippine Islands).

KEY WORDS: Amphipoda, Talitridae, *Bousfieldia phoenixae* sp. nov., Taiwan

INTRODUCTION

Terrestrial amphipod crustaceans occur mainly in the southern hemisphere. Their occurrence in the northern hemisphere is uncommon and they are nearly absent from Eurasia (Bousfield, 1984). In the Far-Eastern Asia, more than 20 talitrid species have been found native to Japan, or in regions of the Japan Sea, South China Sea and other western tropical Pacific areas (Iwasa, 1939; Bousfield, 1982, 1984; Moore, 1986; Morino, 1972, 1975, 1978, 1991; Morino and Miyamoto, 1988; Ren and Huang, 1994). These include 4 sandhoppers or beachfleas from China and a sandhopper from Taiwan. The first known Chinese landhopper, *Talitroides topitotum* reported from Hong Kong, is a cosmopolitan species probably introduced artificially (Friend and Lam, 1985). Landhoppers are usually found on the floor of mesic forests (Bousfield, 1982, 1984; Friend, 1982; Friend and Richardson, 1986; Richardson, 1992), and are also placed in the category of soil-dwelling organisms (Morino, 1991). Although landhoppers should be expected to occur in Taiwan where the climate features high and nearly year-round rainfall, the faunistic study of this taxon on the island has previously received scant attention. In this paper, we describe a 4-dentate cuspidactylate terrestrial amphipod belonging to a new genus discovered from a subtropical forest in central Taiwan.

MATERIALS AND METHODS

Monthly samples of litter fauna, including landhoppers, were taken using pitfalls at the type locality from September 1995 through January 1996. Twenty-eight pitfalls containing 5% formalin were established at plots in areas representing 4 different kinds of vegetation, i.e., natural *Machilus-Castanopsis* forest, bamboo plantation, conifer plantation and open moss garden. Landhopper specimens were obtained only from the natural forest floor. Specimens

were preserved in 75% EtOH as soon as harvested from pitfalls, and are deposited at the National Museum of Natural Science, Taichung, Taiwan, R. O. C.

DESCRIPTIONS AND REMARKS

Following the key to genera of the family Talitridae (Bousfield, 1982), the current species belongs to the 4-dentate cuspidactylate landhopper group, which consists of 7 genera and 6 species-groups previously assigned to *Orchestia* and *Parorchestia* (Bousfield, 1984; Stock and Martin, 1989). Affiliation of the Taiwanese landhopper to the genera *Agilestia, Caribitroides, Hawaiorchestia, Spelaeorchestia, Talitroides* and *Palmorchestia* can be excluded for definitional inconsistency or their endemism. The remainder genus *Parorchestia* Stebbing (1899), of which *P. tenuis* (Dana, 1852) from New Zealand is the type species, now belongs to the simplidactylate group (Bousfield, pers. com.). The genus *Orchestia* is distributionally restricted to the North Atlantic region. Taxonomically, all members of this genus are characterized by: 1) having a long dactyl of gnathopod 1 exceeding palm in female; 2) uropod 1 lacking a distolateral spine and the outer ramus marginally smooth; 3) the basis of gnathopod 2 in female strongly expanded anteriorly; and 4) the form of peraeopods 5-7 nearly homopodous (Afonso, 1977; Bousfield, 1984; Wildish, 1987, 1988; Stock, 1989; Stock and Boxshall, 1989; Stock and Abreu, 1992). The 6 species-groups have not been formulated yet. Therefore, we consider the current species to be a representative of a new genus defined as follows:

Bousfieldia n. gen.

Diagnosis: Antenna 1 short, slightly exceeding peduncular article 4 of antenna 2. Antenna 2 slender, peduncle flatter and wider in male, peduncular article 5 longest; flagellum longer than peduncle, articles slender. Mandibular left lacinia mobilis 4-dentate. Palp of maxilliped outer plate 4-articulated, article 4 short, but distinct. Gnathopods dimorphic; male gnathopod 1 subchelate, palm exceeding dactyl, with distinct posterodistal tumescent lobes in merus, carpus and propod; female gnathopod 1 subchelate, dactyl not or slightly exceeding short palm; male gnathopod 2 very large, powerfully subchelate, palm oblique with tooth; female gnathopod 2 mitten-shaped, basis not evidently expanded. Peraeopods 3 to 7 cuspidactylate, heteropodous, without distinct sexual dimorphism. Coxal gills tri-lobated. Uropod 1 with distolateral spine, outer ramus without marginal spines. Uropod 3, peduncle broadened proximally, with large peduncular spines on upper side, short ramus with apical spines. Telson, posterior part slightly upturned, with concave sides converging to narrow apex, which bears apical spines at each corner.

Type-species: *Bousfieldia phoenixae* n. sp.

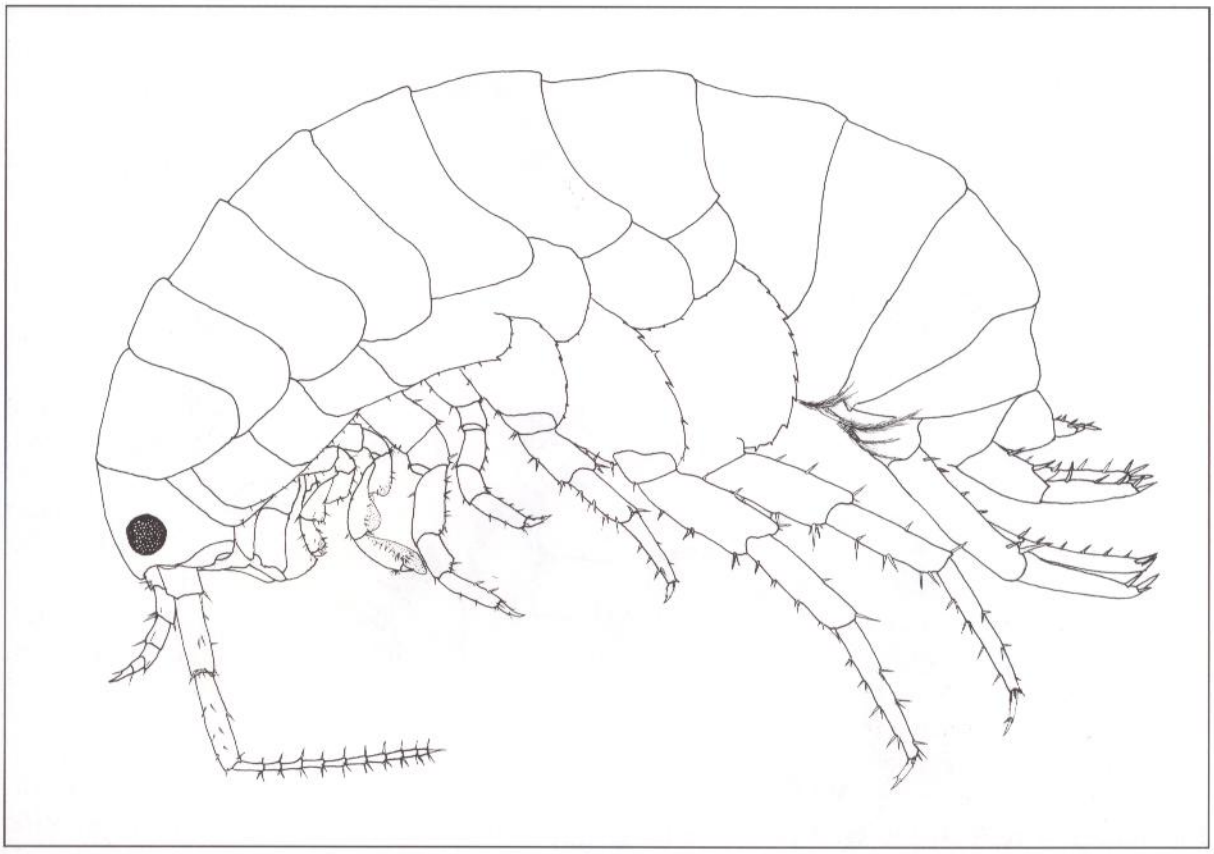
Etymology: This genus is named in honor of Dr. E. L. Bousfield for his endeavor in Indo-Pacific landhopper studies, particularly in extending his encouragement for us to establish a new genus for the type-species.

Remarks: The diagnosis of the new genus is based on the type-species described below. The genus *Bousfieldia* probably includes other Western Pacific cuspidactylate species previously assigned in the genus *Parorchestia,* e.g., *P. lagunae* from Philippines (Baker, 1915), *P. kinabaluensis* from Borneo (Shoemaker, 1935) and "*Parorchestia*" spp. from the Ryukyu Islands and Japan proper (Morino, 1991), for the possession of some characters typifying this new genus. *Parorchestia luzonensis* from the Philippines (Baker, 1915), bearing marginal spines on the outer ramus of uropod 1, however, can be excluded from the genus *Bousfieldia.*

Bousfieldia phoenixae sp. nov.

(Text-figures 1- 7)

Types: Holotype, female, NMNS 2191-1 (length



Text-figure 1
Lateral view of a female *Bousfieldia phoenixae* sp. nov. (body length 7.6 mm).

8.0 mm); allotype, male, NMNS 2191-2 (length 7.0 mm); paratypes NMNS 2191-3 (10 ♀ ♀, 2 ♂ ♂), NMNS 2191-4 (7 ♀ ♀), NMNS 2191-5 (6 ♀ ♀, 1 ♂), NMNS 2191-6 (4 ♀ ♀), NMNS 2191-7 (2 ♀ ♀, 1 ♂), National Museum of Natural Science. The type series were collected by W.-H. Chou.

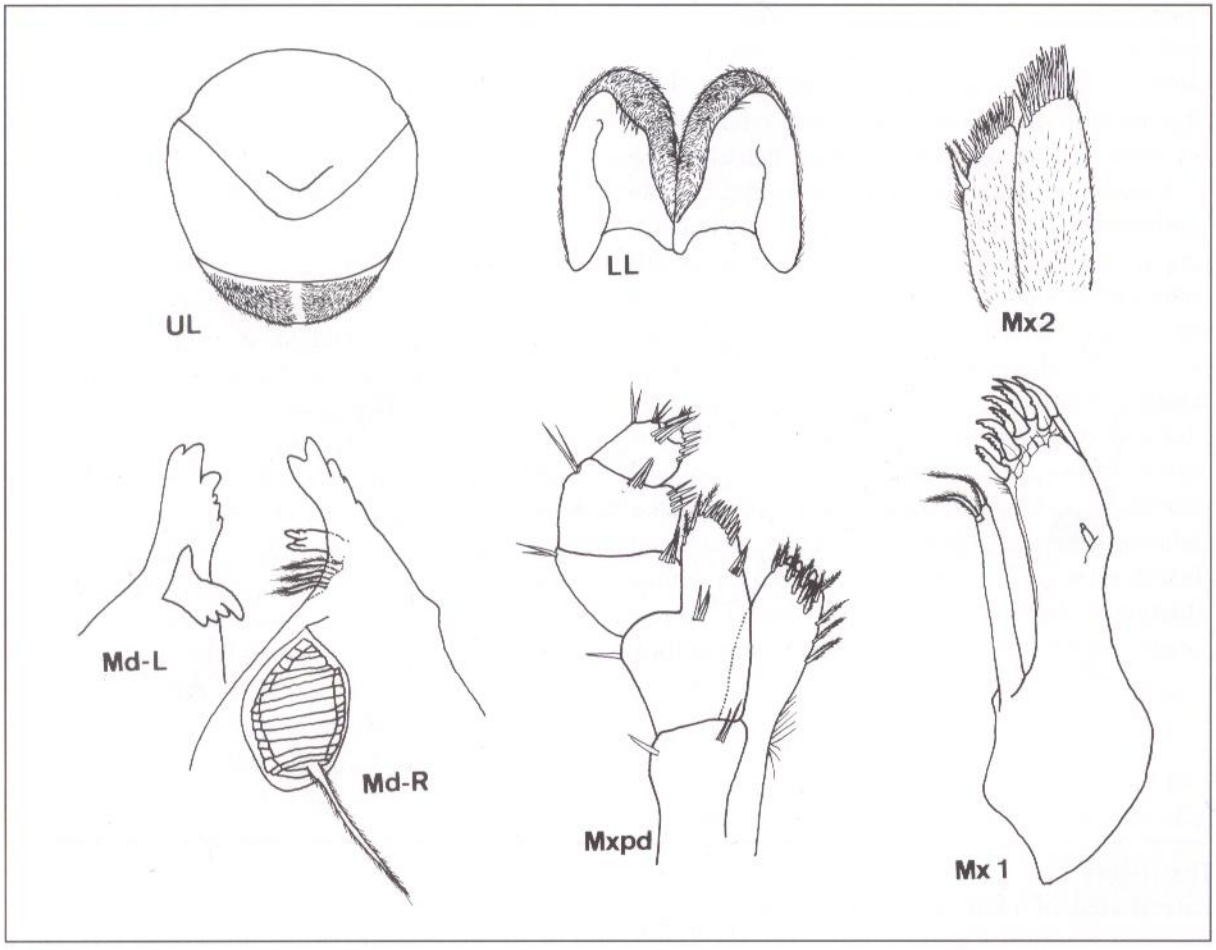
Type locality: Taiwan: Nantou Co., 4 km north of Luku, in a subtropical forest at Fong Huan Valley, 800 m in elevation.

Diagnosis: Antenna 1 having 3 short articles of flagellum, reaching 1/4 of peduncular article 5 of antenna 2; antenna 2 bearing not more than 12 articles of flagellum; anterior coxal lobe of peraeopod 6 not well developed; pleopods well-developed, subsimilar in form and length; uropod 3 with 2 peduncular spines and 2 apical ones on ramus, marginal spine on ramus absent; telson not hirsute, with a shallow median cleft, having 1 submarginal and 1 subapical spine on each side.

Description:

Body (Text-figure 1). – Slender and strongly compressed laterally, dorsal surface smooth. Length of adult females 6.2-8.2 mm and males 6.4-7.7 mm.

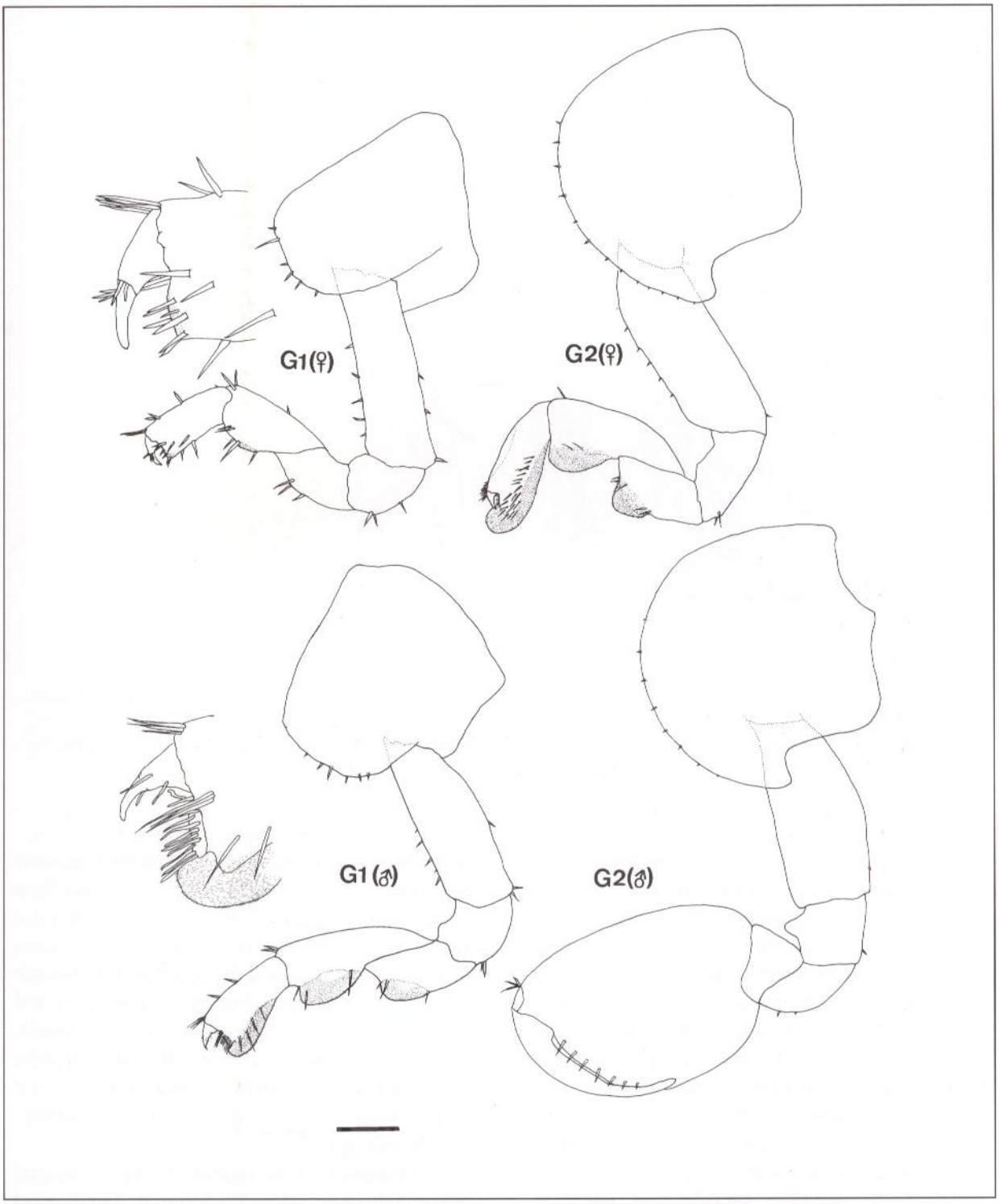
Head (Text-figure 1). – Height subequal to length. Eyes near the anterior end and at upper part of head, nearly round, black, diameter ca. 1/3 of head length; ocelli numerous. Antenna 1 short, reaching 1/4 of peduncular article 5 of antenna 2, hind margin smooth; flagellum of 3 articles, shorter than peduncle, upturned



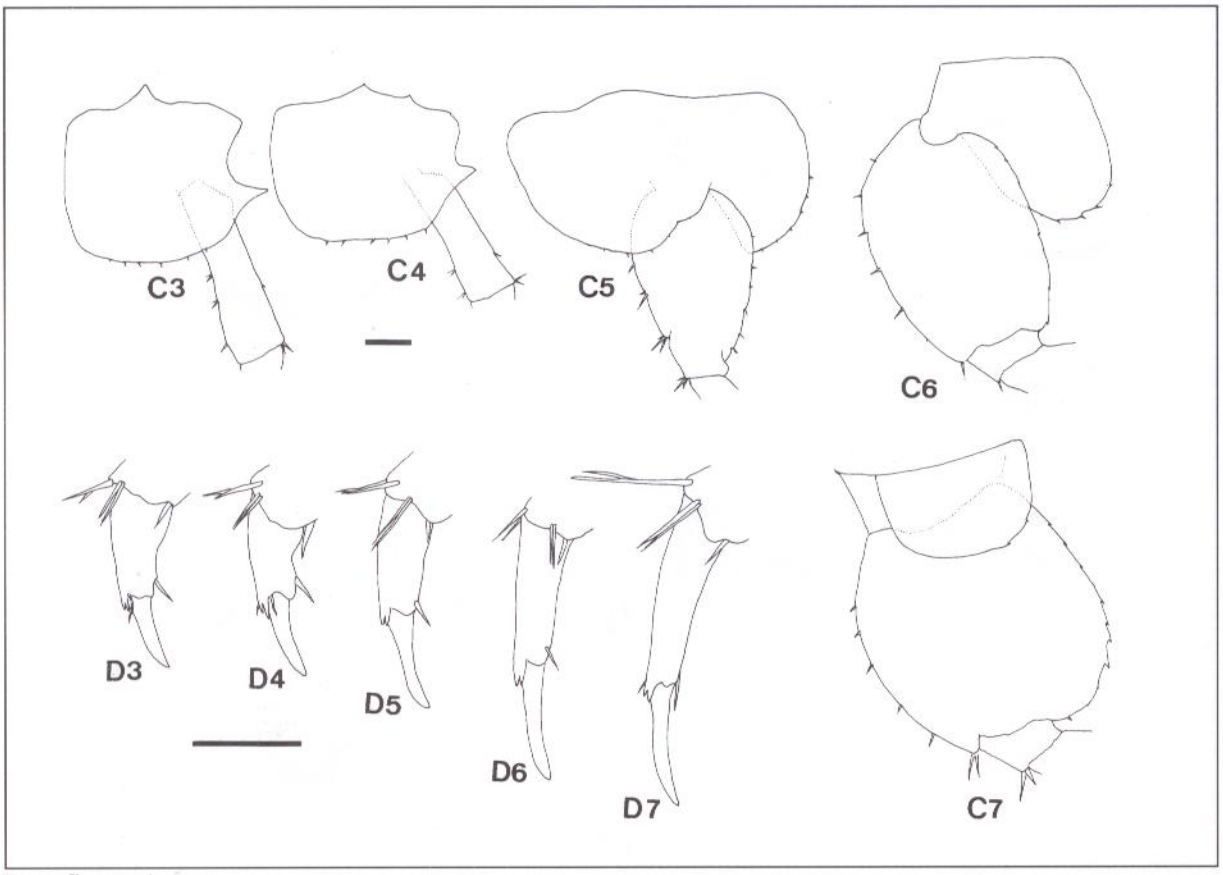
Text-figure 2
Mouth parts of *Bousfieldia phoenixae* sp. nov. **LL**, lower lip; **Md-L**, left mandible; **Md-R**, right mandible; **Mxpd**, maxilliped; **Mx1**, **Mx2**, first and second maxillae; **UL**, upper lip.

distally; peduncular articles subequal in length. Antenna 2 sexually dimorphic in peduncular form, male having flattened and wider peduncle; peduncular article 5 elongate, longer than others; flagellum of 9-12 articles, longer than peduncle, bristles present at distal end of each article.

Mouthparts (Text-figure 2). – Upper lip broad, deep, apex rounded and densely pilose. Lower lip broad, densely pilose on inner shoulder, distally in central trough and outer margin; lateral lobes long. Left mandible incisor 6-toothed; molar process strong, with 10-11 striae. Right mandible incisor 5-toothed; molar process strong, with several striae. Maxilla 1, inner plate slender with 2 terminal setae; outer plate narrowly elongate with serrated apical spines, dental formula (Friend, 1982) 4-2-5-6-6-5-5-5-5. Maxilla 2 plates narrow, subelliptical, pilose throughout; inner plate slightly shorter than outer; inner plate with ca. 16 subapical spines more or less in 2 rows, 2 plumose spines located at inner corner, medial one larger than submedial one; outer plate with ca. 18 subapical spines more or less in 2 rows. Maxilliped inner plate distally rounded, with



Text-figure 3
Gnathopods of *Bousfieldia phoenixae* sp. nov. **G1 (♀), G2(♀)**, gnathopods 1 and 2 of female. **G1 (♂), G2 (♂)**, gnathopods 1 and 2 of male; Scale= 0.2 mm.

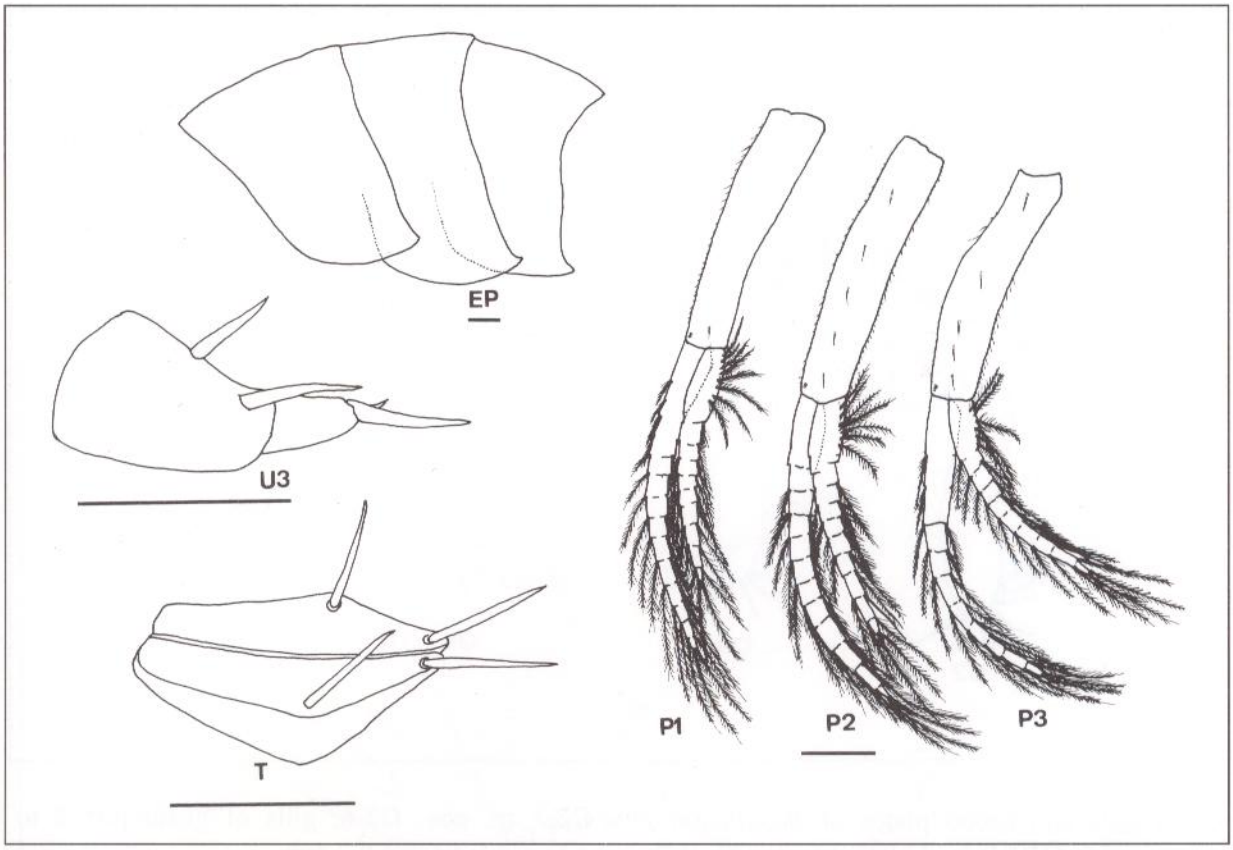


Text-figure 4
Coxae and dactyls of peraeopods of *Bousfieldia phoenixae* sp. nov. **C3-7**, coxae of peraeopods 3-7; **D3-7**, dactyls of peraeopods 3-7; Scales (short one: for C3-7; long one: for D3-7) = 0.2 mm.

apical and subapical plumose spines and 3 large conical spine-teeth, inner margin with 3 plumose setate and slightly pilose below; outer plate apically blunt, with 3 plumes and a group of subapical spines, inner margin with a group of 3 submarginal spines, outer margin with 2 groups of 1 or 3 submarginal spines. Maxilliped palp broad; segment 1 with 2 groups of 2 or 3 marginal and submarginal spines; segment 2 with well-developed medial lobe, inner margin scalloped, with 3 groups of 2-4 spines; outer margin of segment 3 with 4 groups of 2-4 long spines, partly masking 4th segment, which is dome-shaped and spinose apically.

Coxae (Text-figures 1, 3, 4). –Coxa 1 rounded anterodistally, spinose below; coxa 2 deep, broad, spinose below, posterior process prominent, subacute; coxae 3-4 of medium depth, subquadrate, spinose lower margin slightly curvy or almost flat, posterior process small and acute; coxa 5 deep, subequal to depth of coxa 4, anterior lobe large, posterior and ventral margins spinose, posterior lobe small; coxa 6 depth subequal to length, anterior lobe small, margin rounded distally; coxa 7 not deeper than coxa 6, gently curving below, weakly spinose.

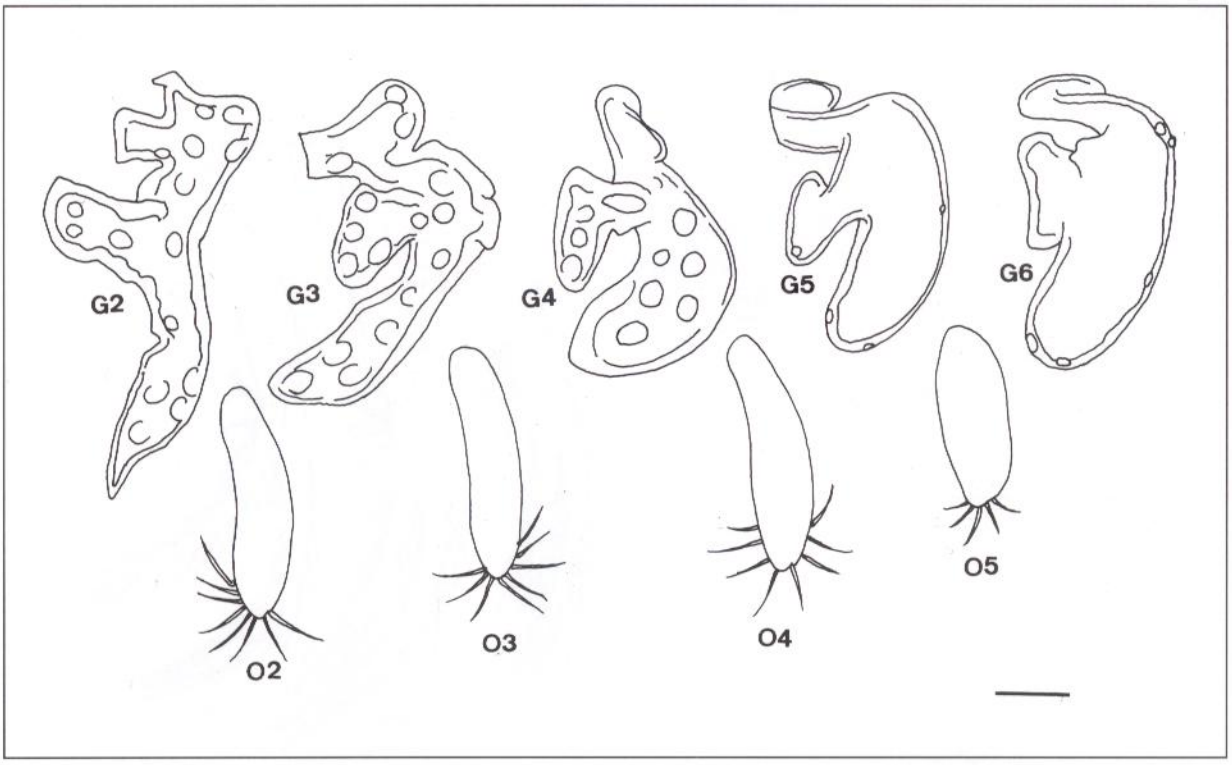
Gnathopods (Text-figures 1, 3). – Sexual dimorphism present in gnathopods. Gnathopod 1 of male short; basis strong, spinose on both margins; merus with posterior tumescent lobe; carpus deep, tumescence almost along entire



Text-figure 5
Epimeral plates (**EP**), pleopods (**P1-3**), telson (**T**) and the third uropod (**U3**) of a female *Bousfieldia phoenixae* sp. nov. Scales= 0.2 mm (note: P1-3 share the scale under P2).

posterior margin, length of posterior margin about half of anterior margin; propod slightly curvy, shorter than carpus, length about twice maximum width, posterodistal tumescent lobe large; subchelation strong, dactyl not exceeding palm. Gnathopod 1 of female differing from that of male in having almost parallel-sided basis, smaller tumescent lobes in carpus and propod, lacking tumescent lobe in merus, and having a powerful dactyl just exceeding the palm.

Gnathopod 2 of male strongly subchelate, much larger than 1; basis, anterior margin poorly spinulose, widened distally; ischium lobed anteriorly; merus lacking posterior tumescence; propod long-ovate, bearing a group of fine marginal spines anteriorly near dactylar hinge; palm oblique, anterior two-third almost straight, remaining posterior part slightly convex, lined with rows of short spines; dactyl regular, smoothly arcuate. Gnathopod 2 of female slightly longer than gnathopod 1; basis almost parallel-sided, curving anteroproximally and spinose anteriorly; merus not distinctly shorter than ischium, with prominent posterodistal tumescence; carpus elongate, with prominent posterodistal tumescence; propod stout, shorter than carpus, bearing lateral and medial rows of small spines, anterior margin weakly convex with a group of spines near hinge of dactyl, distal lobe short and rounded; dactyl small, subterminal.

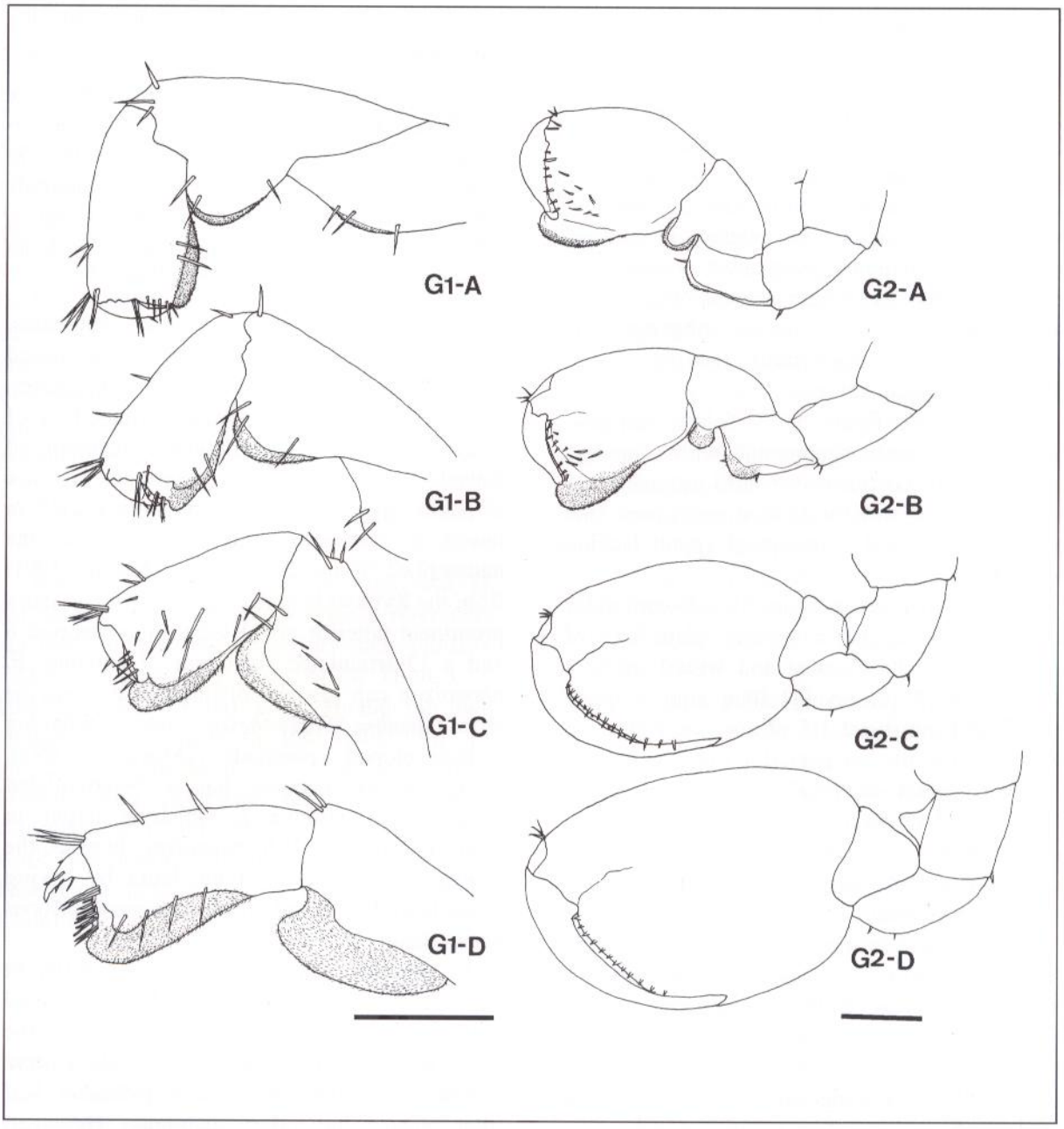


Text-figure 6
Coxal gills and brood plates of *Bousfieldia phoenixae* sp. nov. **G2-6**, gills of gnathopod 2 to peraeopod 6; **O2-5**, blood plates of gnathopod 2 to peraeopod 5. Scale= 0.2 mm.

Peraeopods (Text-figures 1, 4). – Peraeopods 3-7 cuspidactylate. Peraeopods 3 and 4 distinctly longer than gnathopods 1 and 2, dactyls subequal in form, dactyl length about 3 times maximum width, dactyl 4 evidently pinched; peraeopod 4 shorter than 3, length of carpus three times maximum width, carpus distinctly shorter than that of peraeopod 3. Peraeopods 5-7 heteropodous, not sexually dimorphic; basis different in size and form, broadened proximally, gradually narrowing distally, margins curving, spinose and serrate; peraeopod 5 smallest; dactyls slender, length more than 3 times width, nails curved.

Epimeral plates (Text-figure 5). – Plate 1 smoothly rounded anterodistally and distally, posterodistal corner slightly protruded, hind margin slightly sigmoid; plate 2 just longer than plate 3, both convex anterodistally and distally, posterodistal corner produced, hind margin smooth.

Pleopods (Text-figure 5). – Pleopods well-developed, subsimilar in form and length. Peduncles sublinear, each bearing 2 coupling spines; peduncle 1, inner margin hirsute, outer smooth, with a facial spine distally; peduncle 2, both margins hirsute, outer hairs longer than inner, with 5 facial spines in a row; peduncle 3, inner margin smooth, with some hairs scattered at upper part, outer margin hirsute, with 5 facial spines in a row. All pleopods biramous, inner rami the longer, but outer held across inner proximally. Rami not shorter than peduncles, with distinct segmentation except segments 1-3, and armed with 2 apical and 8-14 pairs of marginal, long finely plumose setae; inner and outer ramal segments of pleopods 1-3 are 15-9, 14-9 and 11-9, respectively.



Text-figure 7
Successive change of gnathopods 1 (left) and 2 (right) of male *Bousfieldia phoenixae* sp. nov. A, juvenile, body length (BL): 5.5 mm; B, juvenile, BL: 6.3 mm; C, subadult, BL: 6.9 mm; D, adult, BL: 7.2 mm. Scales (left: for gnathopods 1; right: for gnathopods 2) = 0.2 mm.

Uropods (Text-figures 1, 5). Uropod 1 with short prepeduncle; peduncle longer than rami, slightly narrowing distally, bearing 2 widely separated spines on the outer margin and 4 on the inner margin, with 1 elongate, curved distolateral spine; rami slender, subequal in

length, outer ramus lacking marginal spines, inner ramus with 4-5 ones, both with large apical and subapical spines. Uropod 2, peduncle subequal to rami in length; peduncle bearing 1 terminal, 1 outer marginal and 2 inner marginal spines; rami slender, subequal in length, outer ramus with 3 and inner ramus with 2-3 marginal spines, apical spines with tapering acute tips. Uropod 3, peduncle expanded proximally, narrowing distally, longer than depth, 1 large and 1 small slender spine set submarginally; ramus short, tapering distally, bearing 1 large and 1 small apical spine.

Telson (Text-figure 5). – Telson elongate, dorsal view nearly pentagonal, with a median shallow cleft, posterior one-third upturned and narrowing to distinctly divided apex; each side with 1 lateral and 1 subapical spine; lacking facial hairs.

Brood plates (Text-figure 6). – Brood plates elongate and curving anteriorly, plate 5 (= of peraeopod 5) the shortest and widest; plate 2 armed with 8 (up to 11) long simple-tipped setae, set from distal 1/5 of anterior margin to apex, subapically on posterior margin; plate 3 with 8 setae set subapically on anterior margin to apex and to distal 1/6 of posterior margin; plate 4 with 8 apical and subapical setae set on distal 1/5 of both margins; plate 5 with 5 apical and subapical setae.

Coxal gills (Text-figure 6). Gills flat, margin thickened, more or less trilobate, anterior extension varying from slender and curving (gills 2, 3) to narrowly rounded (gills 4, 5, 6), gills 2-4 with rounded tubercles, only few small ones present marginally on gills 5 and 6; gill 2 the longest.

Variations. Number of flagellum articles of antenna 2 varied with body length: 6 (3.8-4.4 mm), 7 (4.2-5.5 mm), 8 (5.1-5.9 mm), 9 (5.4-6.6 mm), 10 (6.2-7.6 mm), 11 (7.6-8.0 mm) in females and 8 (5.5-6.3 mm), 10 (6.4-7.2 mm), 11 (7.6 mm) and 12 (7.7 mm) in males. Females larger than 6.2 mm bearing brood plates. Successive changes of the gnathopods 1 and 2 in males are shown in text-figure 7.

Distribution: Currently only known from the type locality.

Etymology: This new species was found at the Fong-huan-ku Bird Park (note: fong-huan = phoenix, a legendary bird; ku = valley, in Chinese) under Mt. Phoenix which is commonly believed to be governed by the Goddess "Phoenix". The specific name *phoenixae* is an expression of our deep respect to her.

Remarks: Among the possible congeners, *Bousfieldia phoenixae* can be distinguished from *"Parorchestia" kinabaluensis* (Shoemaker, 1935) in having a 3-articulated flagellum of antenna 1, a 9- to 12-articulated flagellum of antenna 2, well-developed pleopods, and presence of lateral spines and a median shallow cleft in telson. *B. phoenixae* seemingly resembles the undescribed *"Parorchestia"* sp. 2 (Morino, 1991) from the Ryukyu Islands, which, however, has a prominent anterior coxal lobe on peraeopod 6 and a 13-articulated flagellum of antenna. *B. phoenixae* can also be distinguished from the other Japanese *"Parorchestia"* species in having well-developed pleopods (Morino, 1991). *"Parorchestia" lagunae* has a 14-articulated flagellum of antenna 2, which is larger in number than those of *B. phoenixae*; besides, the former is different from the latter by having larger body length and telson with inconspicuous hairs (Baker, 1915).

In monthly samples taken from different habitats, *Bousfieldia phoenixae* was collected only from the natural forest floor where the dense undergrowth appears to provide a more humid environment and more palatable leaf litter than the other habitats. However, interpretation of the distribution pattern using data obtained from pitfall traps should be cautious because the catch in individual traps is heavily microhabitat-dependent (Richardson, 1992). Further sampling employing other techniques is required to define more fully the habitat use of this species.

Terrestrial talitrid amphipods usually show a lesser degree of adaptation to desiccation than

do their semiterrestrial counterparts (Morrit, 1987). Activity of landhoppers can be affected by weather (Richardson et al., 1991). In the type locality of *Bousfieldia phoenixae*, larger numbers being sampled in late summer (i.e., 93 in September) than in autumn and winter (i.e., 11 in October, 26 in November, 16 in December and 15 in January) suggests that cooler and drier weather decreases the activity of this species. In addition, the sex ratio of adults (i.e., 30 ♀ ♀ :5 ♂ ♂) highly biased to female *B. phoenixae* may also indicate a difference in activities, behaviors or survival rates between sexes. The biology of *B. phoenixae* remains largely unknown presently.

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臺灣亞熱帶林之新種陸生端腳類（甲殼綱）與一新屬之描述

周文豪、李政諦

摘 要

本文報告採自臺灣中部亞熱帶林之跳蝦科（Talitridae）一新屬和新種：鳳凰母布氏蝦 *Bousfieldia phoenixae*。本種乃四齒尖趾亞群（4-dentate cuspidactylate subgroup）陸跳蝦之一員，親緣上接近日本和菲律賓呂宋的 "*Parorchestia*" 跳蝦。

關鍵詞：端腳目，跳蝦科，鳳凰母布氏蝦，新種，臺灣